



## ПРОСПЕКТ СВОБОДНЫЙ-2016

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ СТУДЕНТОВ,  
АСПИРАНТОВ И МОЛОДЫХ УЧЁНЫХ

ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ  
МЕЖДУНАРОДНОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ,  
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## **«English for Masters»**



# RESEARCH OF THE MODIFIED SORPTION MATERIAL FOR EFFECTIVE SEWAGE TREATMENT CONTAINING IONS OF THE HEAVY METALS

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Sorption extraction of metals from sewage was widely adopted enough owing to high efficiency and lack of secondary pollution. Efficiency of sorption cleaning reaches 85-90% and depends on the chemical nature of a sorbent, its structure and size of a sorption surface [1]. Meanwhile, high sorption properties, low cost, prevalence in the nature make them cost-effective raw materials in technologies of purification of production sewage.

Akdolit-Gran is the alkaline material prepared from perfect dolomitic breeds applied as the filtering and sorption loading to cleaning natural and sewage. Natural dolomite – sedimentary carbonate rock from white till dark gray color, figure 1. This sorbent is made in Germany and widely used in the West and the European part of the Russian Federation.



a) – the size of grains of a sorbent, b) – ore, for production of a sorbent

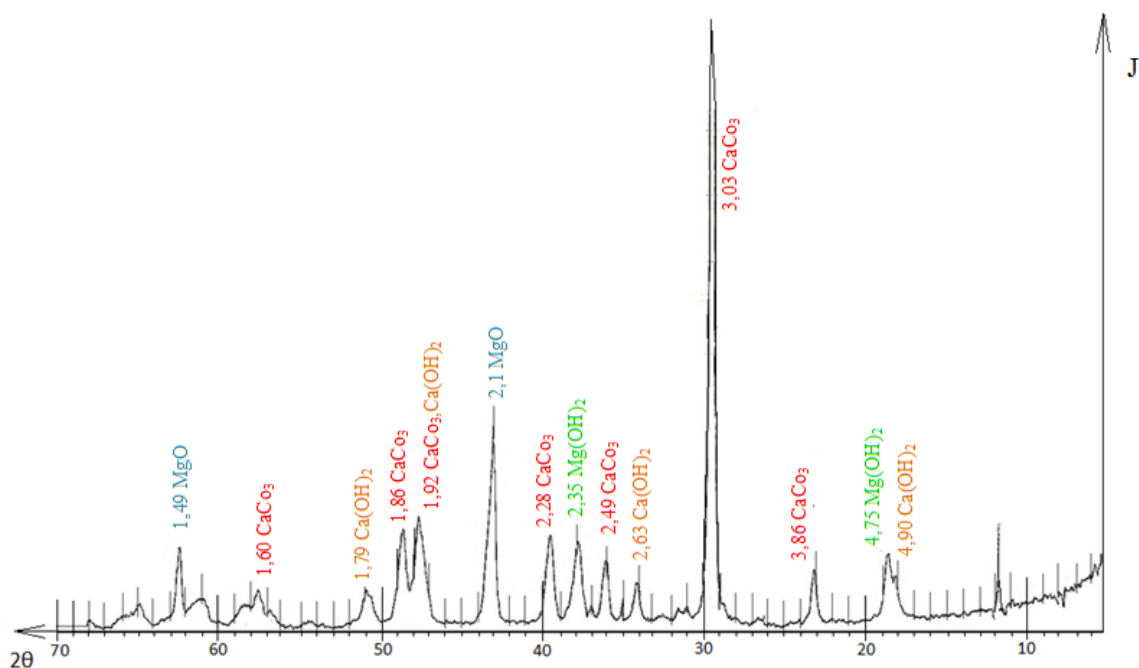
Fig. 1 – Sorbent Akdolit-Gran

Form of grains is spherical with the following sizes:

Grain size 0	0,5 – 1,2 mm
Grain size 1	0,5 – 2,5 mm
Grain size 2	2,0 – 4,5 mm
Grain size 3	4,0 – 7,0 mm

From references [2] it is known that sorption properties of dolomite depend on preliminary processing of a mineral. Calcinating promotes a breed loosening with formation of structures with bigger porosity and a specific surface. Approximate chemical composition of Akdolit-Gran: a  $\text{CaCO}_3$  calcium carbonate – 68,9%;  $\text{CaO}$  calcium oxide – 1,4%;  $\text{MgO}$  magnesium oxide – 25,4%; a  $\text{MgCO}_3$  magnesium carbonate – 0,6%;  $\text{Fe}_2\text{O}_3$  iron oxide – 0,6%;  $\text{Al}_2\text{O}_3$  aluminum oxide – 2,7%;  $\text{SiO}_2$  silicon oxide – 0,3%;  $\text{H}_2\text{O}$  water – 2,7%. Values represent averages for several years of regular testing.

The aim of the research was the study of physic-chemical and sorption properties of a sorbent of Akdolit-Gran. The finding of optimum parameters for sewage treatment was a research problem. The mineralogical structure of a sorbent is defined on the basis of data of the X-ray diffraction analysis made on the DRON-3 diffractometer, figure 2.



**Fig. 2 – Difraktogramma of sorbent Akdolit-Gran**

The analysis of a difraktogramma testifies that the main phase in a sorbent of Akdolit-Gran is  $\text{CaCO}_3$  calcite ( $d = 0,38, 0,30, 0,23, 0,19$ , and  $0,018\text{\AA}$ , the extreme, in nanometer), besides, it is observed quite significant amount of oxide of  $\text{MgO}$  magnesium ( $d = 0,21, 0,15\text{\AA}$ ), diffraction maxima with small intensity which correspond to  $\text{Mg(OH)}_2$  magnesium hydroxide ( $d=0,21; 0,15\text{\AA}$ ) and to hydroxide of  $\text{Ca(OH)}_2$  calcium ( $d=0,49; 0,26\text{\AA}$ ) which were formed as a result of hydrolysis of oxides of magnesium and calcium. Other substances specified in technical documentation on a sorbent (to  $\text{MgCO}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{SiO}_3$ ) aren't revealed owing to their small concentration.

Researches of process of sorption of heavy metals were conducted in static conditions by method of separate hinge plates with use of model solutions with the following concentration:  $\text{Cu(II)} = 60\text{ mg/dm}^3$ ;  $\text{Ni(II)} = 15\text{ mg/dm}^3$ ;  $\text{Zn(II)} = 20\text{ mg/dm}^3$ , figure 14. These concentrations are most widespread in sewage. Initial size pH was 7-8, when using a sorbent of Akdolit – Gran size pH in model waste liquids changed to 9,0 – 9,5 that is explained by the alkaline nature of a sorbent. The prepared solutions of sewage with the set concentration of ions of copper, nickel and zinc neutralized previously lime, and then entered different amount of sorption material. Flasks maintained at periodic stirring in vitro (at  $t = 40 \pm 3^\circ\text{C}$ ) within 30 minutes then solution was filtered ("a blue tape") and analyzed. Residual concentration was defined on a nuclear and issue spectrometer with inductively connected ICAP-6500 plasma. The received results of experiment are presented in table 1

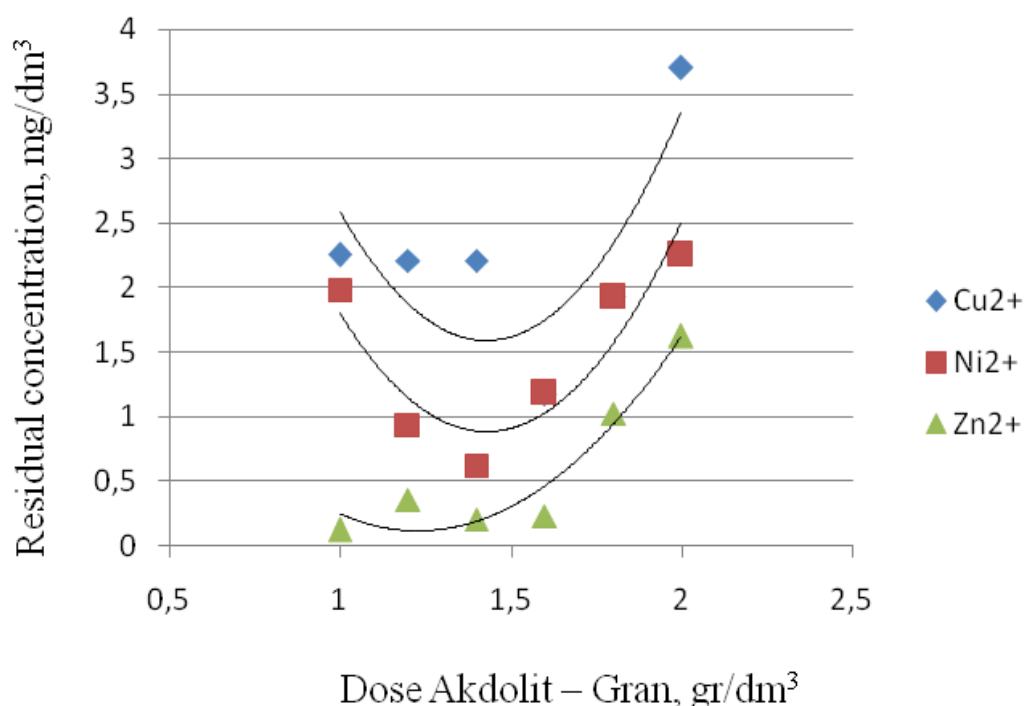
**Table 1 – Results of experiment**

№	Dose Akdolit – Gran, $\text{gr/dm}^3$	Residual concentration, $\text{mg/dm}^3$		
		Cu(II)	Ni(II)	Zn(II)
1	1	2,256	1,986	0,128
2	1,2	2,208	0,938	0,356
3	1,4	2,210	0,623	0,208
4	1,6	1,178	1,183	0,235
5	1,8	1,932	1,926	1,025
6	2,0	3,701	2,258	1,628

The analysis of the table shows that the use of the studied material as a sorbent allows to reduce concentration of ions of heavy metals considerably in initial water.

According to the table which shows the graphic dependences of residual concentration of ions of heavy metals on a dose of sorption material. Nonlinear character of curves allows to find optimum value of a dose of a sorbent Akdolit-Gran for extraction of ions of heavy metals.

The doses of the recommended sorption material found by practical consideration show that at increase or reduction of a mass fraction extent of sorption, an optimum dose of Akdolit – Gran 1,4 – 1,6 gr/dm<sup>3</sup> decreases (figure 3).



**Fig. 3 – Graphic dependences of residual concentration of ions of heavy metals on a dose sorbent Akdolit – Gran**

Data of pilot studies have been also used for development of the scheme on neutralization of the sewage containing ions of heavy metals with application of a modern sorbent Akdolit – Gran.

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## DOMESTIC AND FOREIGN EXPERIENCE ADAPTATION OF THE URBAN ENVIRONMENT FOR PERSONS WITH DISABILITIES

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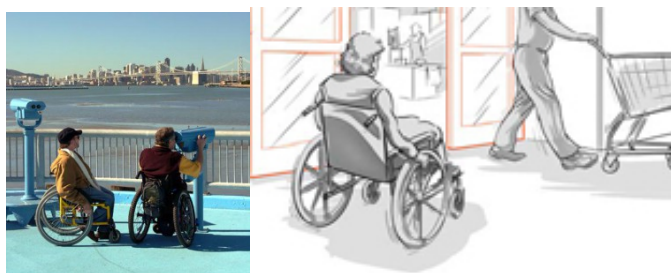
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How to achieve harmonious and interactive environment?

**Universal design**<sup>[3]</sup> - is the design of environments, communications, products and services that contribute to their applicability to all people, regardless of their age, body size or abilities. The term "universal design" was introduced by the American architect Ronald Mace in the 80-s of the XX century. The idea was quickly picked up in Japan and in several European countries, especially in the field of design of products and architecture.

### Principles of UD:

1. Equality in use (Fig.1);
2. Flexibility in use (Fig.2);
3. Simple and intuitive design (Fig.3);
4. Easy-to-understand information (Fig.4);
5. The validity of the error (Fig.5);
6. Low physical effort (Fig.6);
7. Size and space for access and use (Fig.7).

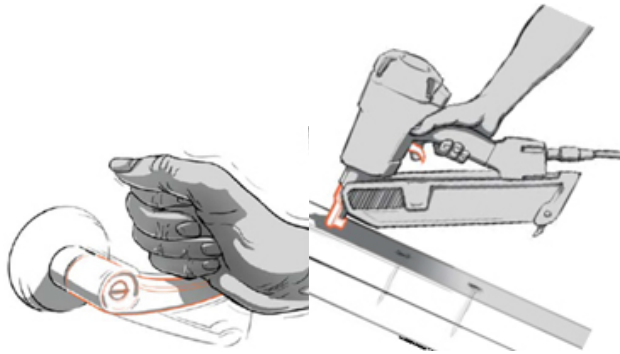


*Fig.1 and Fig.2 - Equality and flexibility in using*



*Fig.3 and Fig.4 - Simple and intuitive design, and easy-to-understand information*





***Fig.5 and Fig.6 - Validity of the error and low physical effort***



***Fig.7 - Size and space for access and use***

Among all these principles are easily recognized those rules that lie at the foundations of design, accessibility, ergonomics and many others. Universal design is the key to a comfortable life for all citizens.

Striking examples of adaptation of the urban environment to the needs of disabled people from international experience include projects to introduce tourist routes in the layout of attractions for the visually impaired that allow people with poor eyesight to "see" with their hands, and, therefore, recognize the world (Fig.8).



***Fig. 8 - Hungary (Budapest)  
The layout of the attractions for the blind***



In Sweden citizens have very responsible attitude towards people with disabilities, so in every corner of this country pedestrian crossings are adapted for all categories of citizens, namely: reduced borders, button, audible and tactile equipment (Fig. 9).



***Fig. 9 - Sweden (Equipping pedestrian crossings)***

In Russia the most significant example of such adaptation of objects of the urban environment for people with limited mobility can be considered to be the objects of industrial cultural heritage - the railway station in Sochi.

During its construction the station was fully complied with the requirements on provision of barrier-free environment for people with limited mobility. A new underground passenger tunnel was built providing access to the railway platforms. The new underpass has wide stair assemblies madewith the help of materials with anti-slip properties, spacious corridors, awell-planned system of visual communication for the convenience of the disabled. The subway has a tactile tile, specialhandrails and ramps aremade for strollers and cyclists (Fig.10). For wheelchair users there are lifts (Fig.11). The old part of the station is also fully adapted for physically challenged citizens. The project took into account the smallest nuances. For example, a window of one of the ticket offices is located lower than the others, which makes it useable wheelchair users (Fig.12).



***Fig.10 and Fig.11- underpass***



***Fig.12- Ticket counter for wheelchair users***

After studying international and domestic experience in adapting old and building new environment for the needs of people with disabilities, it can be concluded that with a clear understanding of the needs and requirements you can create affordable, safe, and most importantly humanistic urban environment, which will usher in the social "rehabilitation" of towns and people in general.

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# RESEARCH OF PROPERTIES AND QUALITIES OF THE 8 MM DIAMETER EXTRUDED BARS FROM AN ALLOY 6082 RECEIVED BY DIFFERENT METHODS OF PRODUCTION

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1. Billet for extrusion of the 162mm diameter is cast homogenized.
  2. Billets are heated in installation where the induction method of heating is used by vortex currents before extrusion.  
Extrusion of bars is made by the method of direct extrusion on the press No. 30 forced 20MN, diameter of the container - 170 of mm, the number of channels – 15.
  3. Quenching is made in vertically quenching furnaces (VQF) with observance of necessary temperature conditions.
  4. The extruded quenched semi-finished products are subjected to editing by stretching on the stretcher machine forced 1,0MH if it is necessary the correction is made with the roll of grinding machine.
  5. The stretched semi-finished products are cut at measured lengths with sampling for control of mechanical properties and its structure. Cutting is carried out on the TsKB-40 circular saws by bunches.
  6. Aging – in air electric furnaces of resistance.
  7. Mechanical properties, a micro and macrostructure are controlled in the laboratory.
- The actual sizes of bars and mechanical properties of the extruded bars are specified in the table 1:

Table 1.

Production of a bar	Diameter of a bar, mm	Heattreatment parameters	Tensile strength, MPa	Yield strenght, MPa	Specific elongation, %
Requirements for alloy EN 755-2 the 6082 condition of T6 the extruded bar <20 mm			≥ 295	≥ 250	≥ 8
KraMZ, LLC	7,89	T <sub>3</sub> =530-540°C,	387	343	15,0
	7,89	T <sub>CT</sub> =160-170°C,	387	345	16,0
	7,88	τ <sub>B</sub> =7h	382	338	12,5

In Siberian Federal University (SFU) the bar has been made on the installation SPP-200 by method of combined casting and rolling-pressing. The size of whetstone is 20x20x250 mm which was used as workpiece for rolling-pressing of a bar in SFU received by milling from a templet of cast bar - 500 mm diameter of an alloy 6082 in the cross section of production of LLC KRAMZ.

Then they have been melted into furnaces and moved to SPP-200. The actual sizes of bars and mechanical properties of the extruded bars are specified in the table:

Production of a bar	Diameter of a bar, mm	Heat treatment parameters	Tensile strength, MPa	Yield strength, MPa	Specific elongation, %
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SFU	7,7	initial state	169	112	27,5
	7-8,54		172	112	23,8
	7,6		177	115	24,8
	3-8,60				
	7,7				
	4-8,56				
	7,7	T <sub>3</sub> =530-540°C, T <sub>CT</sub> =160-170°C, τ <sub>B</sub> =7h	286	241	16,8
	3-8,56		249	198	16,0
	7,6				
	8-8,55				
	7,8	T <sub>3</sub> =530-540°C, T <sub>CT</sub> =160-170°C, τ <sub>B</sub> =10h	278	245	14,0
	0-8,49		272	225	15,8
	7,7				
	7-8,56				
Requirements by EN 755-2 of the alloy 6082 condition of T6, the extruded bar <20 mm			≥ 295	≥ 250	≥ 8

- The content in the studied bars of the basic alloying elements and iron as main impurity has been determined by method of the chemical analysis;

- Control of the geometrical sizes of bars. Results have shown that the bar of production in SFU has significant differences at a rate of cross section in length from 7,63 to 8,56 mm unlike a bar of production in LLC KRAMZ with rather stable size within 7,88-7,89 mm;

- Tests of mechanical properties. Heat treatment of the received bars in SFU was carried out in the laboratory conditions.

The level of strength characteristics of bars of LLC KRAMZ has higher values conforming to the established requirements. Strength properties of a bar production in SFU after heat treatment are lower than the requirements of EN 755-2.

Research of a macrostructure of bars has shown that the bar of production of LLC KRAMZ has uniform structure with the accurate section of a circular form. A macrostructure of a bar production in SFU is a non-uniform in section with segments of a rough multi-structure. In cross section the bar has essential out-of-roundness.

Research of a microstructure of bars has shown that there are also significant differences in their internal structure. So, the structure of a bar of production of LLC KRAMZ received by method of extrusion has rather uniform structure with equally distributed disperse allocations of excess and secondary phases. On the section of a bar production in SFU both in cross and longitudinal sections you can find out the rough multi-structure caused by existence of not deformed congestions of intermetallic allocations of a crystallizational origin. That is existence of sites of cast structure along with the deformed structure in peripheral area is observed. Preservation of cast heterogeneous structure with sites of rough eutectic allocations could promote the obtaining of low values of strength characteristics of bars.

Signs of the over burning in structure of a bar of production in SFU which could be shown at metal recrystallization aren't revealed.

On the basis of the above-stated comparative researches of a bar 8mm diameter from an alloy 6082 productions of LLC KRAMZ and SFU are established the following:

- Geometrical parameters of a bar production of SFU have no stable size on diameter and a form of cross section;

- Parameters of a bar production of LLC KRAMZ have constant size of diameter and a form of cross section;

- Mechanical properties of a bar of production of SFU after heat treatment are lower than requirements of EN 755-2 unlike a bar of production of LLC KRAMZ which properties conform to the requirements;

- Structure of a bar of production of SFU is non-uniform with a rough non-uniform structure both in cross and longitudinal sections.

- For obtaining the required characteristics and stabilization of the sizes to continue works of the production of bars 8mm diameter from an alloy 6082 by casting-rolling method;

- To make a new die block which monolithic with a die holder;

- To change deformation degree in the process of manufacturing by a molding rolling method;

- To carry out development works on research of influence of cooling from pressing temperatures and a molding rolling method on mechanical properties of bars.

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**CLUSTER APPROACH****Bezushenko K.O.**

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For the effective development and competitiveness of territories new approaches and management methods are needed, which are based on new achievements of science and world experience. The most effective means of development and competitiveness of territories is in the cluster approach, which leads to the creation of a special form of innovation (cluster).

Since the end of 2000s, developing countries focus their attention on the manifestation of the clustering of the economy. This is based on the economic policies of different countries. Therefore, cluster development is becoming one of the most promising directions of competitiveness development of the economy with developing industries. The goal of this approach is the purposeful development, individual direction and segment of the national economy due to promotion of group enterprises consolidated within cooperative relationships that produce complementary products, and, of course, specialized and research institutes. This approach is one of the most effective ways of innovative industries development while innovation is the main factor of transition to innovative model of economy.

The core of the cluster approach is the notion of "cluster". What is the essence of this definition? Generally, the word "cluster" in english is translated as: swarm, bunch, collection, concentration, etc. In other words, this word has a lot of insights, but its distinctive feature is the association of any particular elements of an approach for the realization of a certain goal.

First, the term "cluster" is widely used in most sciences, but especially in the natural sciences, e.g. in physics, medicine, chemistry, astronomy. In physics a cluster is a group of elementary particles. But thanks to Professor of Harvard business school Michael Porter it entered the language of economics. From the point of view of M. Porter, cluster is a group of geographically neighboring interconnected companies and related organizations operating in a certain area and characterized by common activities and complementary to each other [1]. It should be noted that there are many authors who bring different definitions to the concept of the cluster, and this indicates the existence of an established common definition to the concept. In this connection it is relevant research in this area.

The main features of clusters can be distinguished as:

- geographical grouping (nearby firms, organization entails the likelihood to save on production cooperation);
- specialization (recorded around the specific scope);
- a variety of economic representatives (activity cluster also includes specialized institutions, organizations, research institutes, etc);
- competition and collaboration (these are the main ways of interacting within a cluster, a new relationship within a cluster stimulates innovative activity);
- the execution of a sufficient "critical mass" in the scale of the cluster (in order to acquire the results of internal development);
- long-term perspective;
- involvement in the innovation process (innovation).

We can say that the clusters also provide an opportunity to implement innovation process from new product idea and to its implementation, as they allow you to instantly achieve longer



and maintain a high level of competitiveness [2]. Table 1 shows the characteristics of the cluster.

Table 1 – Cluster features

Features	Cluster
Goal	Grouping of various institutions, firms for production of highly competitive products
Accommodation	Placement in the areas of competitive advantages presence
Division of labor	Exception of the development of the regions with the least possibility of clustering and bias of the productive forces to competitive regions
Criterion development	Natural development of economic and social relations in the circle of the cluster
Link	Network mechanism including horizontal and vertical linkages among cluster members
Infrastructure development	Sufficient development

The main reasons for creating a cluster are: presence of competitive advantages, favorable geographical location, the existence of raw material resources, as well as the presence of special educational institutions [3].

Analyzing carried out research one can draw some brief conclusions:

- thanks to Professor of Harvard business school M. Porter the definition of "cluster" entered the language of economics;
- cluster theory has more theoretical origin, which were formed in the late 19th century and early 20th century;
- initially, the cluster approach became widely used in Europe. In the Russian Federation this approach is considered as new, because only in recent years that it starts vigorously being applied in the strategies of the Russian Federation;
- at the moment cluster approach is considered as one of the most popular approaches to the launching of the economy;
- this approach is one of the first of effective methods of innovative development industries stimulation;
- review of scientific articles and literature suggests that scientists have not established a common definition of the term "cluster";
- now increase the competitiveness of regions, districts and the country as a whole is an urgent task for the country;
- characteristic quality of a cluster is its innovative orientation;
- personality cluster has synergetic effect that should appear in lifting of competitiveness of the whole cluster.

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## **DEVELOPING SOFTWARE FOR THE SALES REPRESENTATIVE ROUTE**

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This paper focuses on creating the best route for a sales representative.

The most current data (online route, time and traffic information), obtained by Yandex.API service are used to calculate the optimal route for a sales representative. Then we applied an algorithm to place outlets for a preferred time of visiting on the basis of the sales rep purpose. As a result, the program obtained statistical data on working hours in each point of sale, as well as the time that was spent to get there. On the basis of these data we calculated personal coefficients for duration and work in each outlet. A separate coefficient was used for each employee.

The object of study is to consider options to optimize the trade representative routes.

The purpose is to develop, study and implement software and algorithmic complex that ensures the formation of a daily route sheet for a sales representative.

The famous traveling salesman problem, set in 1934, is one of the major problems in graph theory. In our region (discrete optimization problems) traveling salesman problem is a kind of testing ground where all new methods are tested.

**Problem Formulation.** Salesman (hawker) should leave the first town to visit once in an unknown order towns 2,3,4 ... and then return to the first town. The distances between these towns are known. What order should a sales rep visit the towns for his route to be the shortest? In the terms of graph theory: to find a Hamiltonian cycle in the graph of minimum length.

The sales rep problem is the so-called NP-challenge, i.e objective, which accurate solution can be obtained in general only in exponential time. Therefore, with a large number of vertices it is inefficient to solve it with a search algorithm.

We studied software products that allow solving the problem of routes development. The analysis revealed that the developed software products are different in their purpose and functionality require fine-tuning, or have an incorrect algorithm of work. These factors cause many problems with the route development.

Designing the optimal route for a sales representative, the following algorithm was developed:

**Input:** employee, the points that he needs to visit and time for any two points required to move from one to another; information about the points contained in the points array, such as the time from which you can go to the point (visitFrom), the time till which this point can be visited (visitTo). Const value, which is the result of intensive research, estimating the approximate time spent on average by the carrier for the delivery of goods from one point to another.

**Output:** specific points in time at which it is necessary to visit all the points, staying within the given constraints, or a message that is not possible to build a schedule for a given set of points.

**Algorithm:**

1. We should sort points in ascending order in terms of time, from which you can visit each point, and if it is the same at any two points, then in ascending order of time, till which they can be visited.

2. Calculate the time to move from point to point, taking into account the coefficient of the employee. If the resulting time falls within the time interval of this point work, put it in the array. If the received time is left of the time period for visiting this point, we add the amount which you want to move the point to fall within this range to the time and put into the array. Otherwise, we look for such points in an array, after which you can insert a point to fall within a period of time and the amount which this point was shifted by was minimal (minDiff). If we find such a point, we insert point  $i + 1$  after this point, and move all the elements in the array timeline by an amount minDiff, simultaneously checking whether the points fall within their intervals. If a point does not fall, then the algorithm concludes with negative results. We perform this procedure for all the points.

3. Next, the optimization procedure is started. For all the points we search groups, which work intersect and solve traveling salesman problem for these groups. We form a new decision on the basis of solutions for overlapping groups. We finish the algorithm.

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## A PERSPECTIVE OF THE SEVERE PLASTIC DEFORMATION FOR IMPROVEMENT OF QUALITY PRODUCTS PRODUCED BY DRAWING AND EXTRUSION

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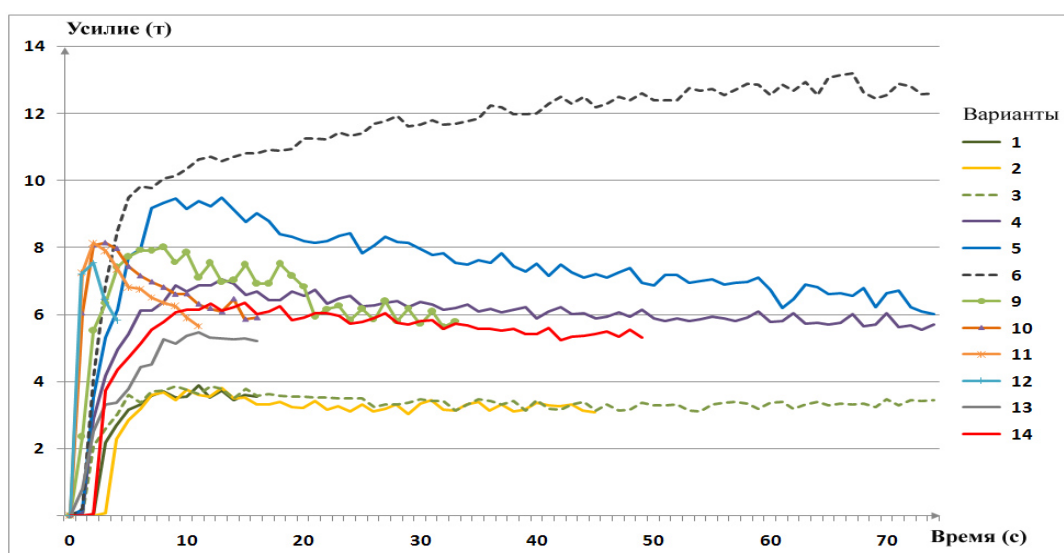
Increased requirements for special-purpose materials, including composites with high specific strength dictates the need to develop new methods and equipment for their manufacture. One of the major problems in the manufacture of long hard-materials and products of modern extrusion techniques, drawing is the emergence of local gradients in density, high internal residual stresses, obtaining high values of elastic aftereffect, uneven shrinkage values after the heat and as a result of warping, cracking.

The methods of severe plastic deformation (SPD) which can be effectively used in the process of extruding or drawing of long rods in several passages, pieces of plasticized mixtures of carbide are of particular importance in the solution of quality improvement problems, elimination of the structural heterogeneity of the problems.

It is seen that the strain at ECAP is uneven over the length of the preform. (Graph 1) The initial and final parts of the blank are deformed to a lesser degree, due to the load circuit and form the tool. The grid at the ends of the workpiece remains practically unchanged.

The reason for the lack of deformation in the billet at the ends is that they do not pass through the rolling gap, i.e. through the channel crossing area where an intensive shear strain.

In accordance with the scheme of the process they can't pass through this zone, and therefore will always have a lower deformation close to zero, which is characteristic of many metal forming (MF) processes having a deformation zone and the non-contact workpiece using finite dimensions.



**Graph 1 - Effect of ECAP process parameters on the necessary efforts of the press.**

Analysis of the graphs shows that the maximum effort is observed in the initial moment of pressing. The pressure on the metal punch increases rapidly and reaches its maximum at the initial time of plastic deformation. Further pressure monotonically decreases

in proportion to a decrease in the height of the deformed sample, i.e., contact surface areas in the vertical channel.

If the friction coefficient equals to zero (embodiments 1, 2, 3), it is seen that the ECAP force is constant for each sample, i.e. consumed only shear plastic deformation in the channel region of intersection. The increase of the maximum compression force occurs under following values: the coefficient of friction (embodiments 4, 5, 6), the height of the workpiece (embodiments 4, 13, 14) and strain rate (embodiments 9, 10, 11, 12).

Objective: Provision of structural uniformity in terms of compressible material (minimize residual stresses and density fluctuations).

In the process, the following tasks:

- Analysis of the structural design, types of profiles shaping material supply channels.
- Optimization of sealing process by changing the configuration and change the local generator of the surface and cross-sectional area of forming channels press tools.

One of the most promising methods for quality improvement in extrusion and drawing is a method comprising intensive plastic deformation in the seal with large degrees of deformation at relatively low temperatures under high pressures applied.

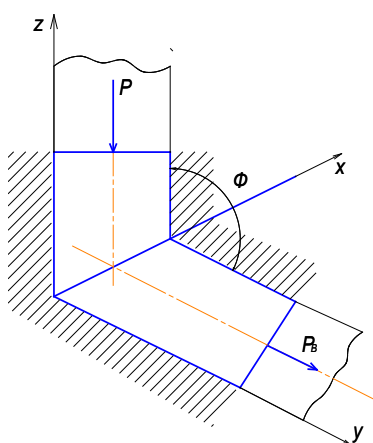
The analysis of the literature data in this field shows that the material produced by SPD acquire properties, unattainable by conventional compression methods: strength at a sufficiently high level of ductility, superhardness, wear resistance, low temperature and high speed superplasticity.

Due to the ability of forming a uniform ultrafine structure and relative ease of implementation, it has become a promising method of equal-channel angular pressing (ECAP). When ECAP (Fig. 1) is deformed preform at an angle  $\varphi = 90-150^\circ$  by forcing it through equal channel cross-section of the simple shift pattern.

The main characteristics of ECAP, according to [3] are as follows: temperature; route pressing the material, the angle of intersection of channels, the number of deformation passes. Three main routes are applied.

The first route involves a re-compact workpiece without rotation elements. In the second reception workpiece is rotated  $90^\circ$  around its axis between the passes and in the third one at  $180^\circ$ . [3].

Determining the material movement nature during compaction articles having drop sizes along the pressing axis are challenging the theory of formative processes.



**Fig. 1 - Scheme of ECAP**

Due to the limited length of the perform, the flow of material in the ECAP process is not permanent, in spite of the channel axis and symmetrical workpiece. The terms of friction are constantly changing, allowing not to reduce the problem to a two-dimensional deformation and requiring a three-dimensional mathematical model.

Also in the simulated workpiece thermal processes and to calculate the temperature field with its deformation need to know how the heat will be distributed in the blank in front of it forming, i.e. initial thermal boundary conditions.

Boundary conditions for thermal heat equation can be given in the form of convective heat transfer and heat transfer [7].

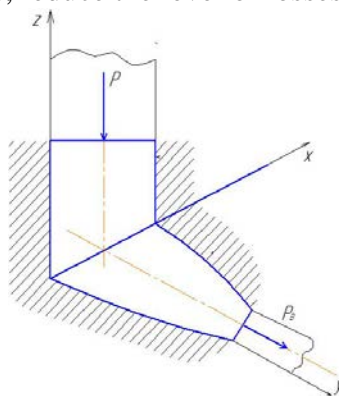
Another effective method of increasing the structural homogeneity of the material and the quality of products is the method of SPD proposed in G.V. Perelman [8]. During the flow of the material through the channels of the material outlet opening (zone II in Fig. 2) Material structure is transformed from the longitudinal parallel to the drawing axis in orthogonal to it, and the subsequent passage of the material through the forming preform cone leads to restoration of the texture in the longitudinal (zone III in Fig. 2) the entire cross section blank, particularly in its central areas. It seems appropriate to use the proposed compression scheme to increase the degree of deformation of the material at the entrance to the hole, longitudinal texture material recovery through the implementation of intensive plastic deformation.

Using the given mathematical models, the schema tensely - deformed state in the seal areacan be selectively modified.



**Fig. 2 - The structure of the material: A - standard equipment; b - parts and accessories with a diaphragm**

Changing within the technical capabilities of the press equipment the ratio between the diameter of the workpiece, the hole length and outline (profile) cone shape can be produced in the material blanks longitudinal texture of good quality (Fig. 3b), provide high strength properties and the quality of products, reduce the level of losses from manufacturing defect.



**Figure 3 - Scheme of the combined method of SPD**

Using both approaches to the implementation of the SPD in the molding or extrusion, drawing of long workpieces or rods can be offered as a further improvement of the structure of the material and the quality characteristics of the resulting moldings, combined method SPD (Fig. 4). The method involves changing the material supply channels by narrowing their output. Characteristics of deformation is controlled by using the power and kinematic parameters of the workpiece combinations to produce its optimum geometry that will ensure the required quality parameters of the workpiece.

In the process of modern methods of intensive plastic deformation, design, supply channels and methods for the preparation of long or hard-materials with high homogeneity of the structure and an increased level of physical and mechanical characteristics were examined and studied. Proposed new prospective scheme promising effects on compressible material at drawing and extrusion, which helps prevent the formation of dead zones, to ensure the uniformity of the material, to minimize residual stresses and density fluctuations in density.

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## **AUTOMATION OF CALCULATIONS AND SIMULATION DIE**

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Designing products based on advanced materials including polymer-based and composites is one of the most important conditions for improving the operational and economic performance of modern industrial equipment. The reason for the failure of 70% of machines and mechanisms is the wear of movable associations and work members under the influence of friction force. Processes occurring in the tribocoupling limit the working service of the product.

The set of materials is commonly used in a friction condition is often insufficient for complex provision of numerous and often conflicting requirements. The market is forcing the manufacturers to meet the challenges of improving the strength and performance of the friction units with minimal financial investment i.e. to maintain an active search for new wear-resistant and low-cost materials and efficient methods for their manufacture

At the moment, most of the manufacturers are trying to find cheaper and more durable materials so their attention is focused on products from polymeric composite materials (PCM), due to their physical, mechanical and performance properties and relatively low cost of manufacturing. However, currently, there are no clear guidelines for the development of structures and technological products of the manufacturing process (PCM) for the given specific operating conditions while providing optimum combination of mechanical and performance properties.

In all branches of modern industry there are a number of problems:

- 1) Compaction homogeneous, dense compacts with a uniform distribution of phase components by volume.
- 2) The emergence of interparticle adhesive bonds, the interparticle friction and border friction on the surfaces of mold inserts.
- 3) Local gradients in density and high internal residual stresses, larger values of afterwork, the unevenness magnitude of shrinkage during cooling and as a result of warping, cracking or even destruction of the compacts, the violation of the accuracy of the size and shape of the deviation and non-compliance with the requirements and tolerances.

The aim of the research work: Production work of an endmill by the method of extrusion (to minimize residual stresses, density fluctuations, porosity, microcracking, etc.).

High-pressure die casting is used mainly for the manufacture of thermoplastics. It is carried out under the pressure of 80-140 MPa on injection molding machines piston or screw type having a high degree of mechanization and automation. Injection molding machines carry out granulation dosing material and transfer it into a plastic condition, the injection (injection) dose melt into a mold, in the form of an extract pressurized before its hardening or curing and ejection opening shape of the finished product.

To equalize the pressure and improving mold filling injection molding is used to melt pre-compression, injection molding, injection molding with the imposition of mechanical vibrations and others methods.

The pressure in the injection mold during filling of the polymer melt increases gradually and distributed along the length of the mold cavity after unevenly in the consequence of high melt viscosity and its rapid growth during cooling or curing.



High-pressure die casting allows producing parts weighing from a fraction of a gram to several kilograms. When choosing a machine for molding products it is necessary to take into account the volume of melt required for its production and the clamping force

required holding the mold in the closed position during filling of the mold cavity melt

- T-Flex library parts molds

The library includes all the elements of parts of molds for thermoplastics casting under pressure in accordance with GOST and OST. To facilitate the search for a particular part, the library is divided according to the type of parts: plugs, columns, plates, etc. Build a parametric model and as well as all other elements of the library contains settings dialog.

- Autodesk Inventor Tooling

AutoCAD Inventor Tooling – software complex intended for designing molds, tooling, molds, dies, punches, injection points and gating systems. The software package allows for calculations of molds and poured out the calculations, and create documentation.

- ANSYS Inc

The software package ANSYS - a universal finite element software package that is designed to solve problems in various fields of engineering.

The work program was designed to calculate the execution of molds sizes. SolidWorks has been chosen as a program for the forming of the mold. The program will be able to simulate a 3D model of the die.

The program calculates the height of the compact, the height of the loading chamber, the size of the mold cavity (window) of the matrix, the rod size, punch size. The program will add a geometric calculation die under the profile of the mold, die build 3D models in SolidWorks.

Experience in the development of this program as well as market analysis of the existing programs has allowed the following conclusions: all software developers seeking to facilitate the forming of mechanisms for their own CAD-programs creating the application program of creation for them.

1. Development of a composite material for an endmill (the selection ratio of the components of the composite). Designed composite must meet the strength characteristics of the end mill.

2. Finite element calculation of the flow of material through a die (extrusion process simulation). At this stage, the material flow calculation performed through a die and its solidification in the mold.

3. Control of the cutter on the power load.

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**OPTIMIZATION OF THE MODES OF PROCESS OF ELECTROPROCESSING  
OF THE SEWAGE CONTAINING THE EMULSIFIED  
OIL PRODUCTS**

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Now the policy in the field of protection of water resources is directed to decrease in intake of the polluting substances in water objects stage-by-stage. The achievement of the maintenance of components of sewage at the level of the maximum permissible concentration (MPC) that promotes introduction of effective technologies of sewage treatment and creation of systems of the closed water supply.

Oil and also numerous products of its processing which are widely used in a national economy as fuel, greasings, initial raw materials get in significant amounts to atmospheric, industrial and economic and household sewage and come to open reservoirs together with its, the soil, the underground water-bearing horizons, disturbing natural biochemical processes. It's also causing death of flora and faunae of lakes, rivers and seas, reducing fertility of soils. Thus oil-containing sewage became one of global pollutants of the environment.

Prevention of dumping of oil products with sewage water quite is complex engineering challenge. On the one hand, it is caused by great variety of the chemical compounds united by the general concept of "oil products" and also by the existence in drains of other accompanying pollution. From the other hand, the numerous enterprises of storage and transportation of oil products, the enterprises of agricultural, motor transportation, household, metalworking and other industries using oils and oil products. They have as a rule primitive treatment facilities and sometimes have not it at all.

It leads to inevitable dumping of oil-containing drains into environment worsening a sanitary and hygienic condition of the soil, water and air basins and respectively influencing on plants and animal life.

In spite of the fact that the problem of sewage treatment containing oil products exists not one decade and a significant amount of publications is devoted to it. But it hasn't solved completely yet. Therefore cleaning of oil-containing drains especially small and medium-sized enterprises giving a huge amount of the sewage which is difficult to process in the usual ways - an actual task. [1,2]

Relevance of this work is deep purification of oil-containing sewage, which allows resolving issues of environmental protection and rational use of water resources.

The purpose of work was optimization of process of electrocoagulative sewage treatment of containing the emulsified oil products.

The being of work consisted in studying of research of technological processes of electrochemical processing of oil-containing drains; definition of the optimum modes of process of electro processing of the sewage containing the emulsified oil products using asymmetric current

The practical importance consists in creation of effective technology of processing of the sewage containing the emulsified oil products, allowing stabilizing the production at low expenses of the electric power.

Scientific novelty: The optimum modes of process of electroprocessing of the sewage containing the emulsified oil products when using asymmetric current are defined.

Researches were conducted on the model and natural sewage containing the emulsified oil products of JSC "Krasnoyarsk Metallurgical Plant".

From the analysis of references and patent documentation numerous works show [2-4] a solution of the problem of purification of oil-containing sewage, but nevertheless issues of

definition of the optimum modes of electrocoagulative processing are insufficiently covered in the references.

It is known that the electric power expense is influenced when receiving the ions of metal generated in electrolyte by a form of current [4]. The way of processing of oil-containing drains has been developed by asymmetric current for carrying out process of effective purification of oil-containing sewage in the stable mode [5]. Asymmetric alternating current is a pulse current of a special form with various sizes of amplitudes and duration of positive and negative polarity. It can be received by means of the device developed at Engineering Systems of Buildings and Constructions department of School of Engineering and Construction of the Siberian Federal University [6].

Studying of the technological process of purification of oil-containing sewage was carried out in dynamic conditions on the electrolyzer with a working volume of 300 ml. with flat aluminum electrodes which working surface made 3.66 sq.dm and the distance between plates was 10 mm, at pH = 6.8-7. Determination of concentration of oil products was carried out with use of a KH-2 kontsentratomer. Studying of structure of rainfall which is formed when electroprocessing of the sewage containing the emulsified oil products was carried out by means of the differential and thermal analysis on the NETZSCH STA 449 F device. The X-ray phase method of the analysis on the D8-ADVANCE diffract meter, the German company "Bruker-AXS" has been applied to research of a structure of deposit

The planned experiment method has been put in practice for the purpose of identification of the factors influencing process of purification of oil-containing sewage and receiving mathematical models by the Boxing Hunter. The varied parameters on which process of electroprocessing of oil-containing sewage have accepted by asymmetric current most depends on the following:  $x_1$ -amplitude of direct current, A;  $x_2$ -amplitude of the return current, A;  $x_3$ -stage, s;  $x_4$ -duration of the return current, s;  $x_5$ -initial concentration of oil products, mg/dm<sup>3</sup>;  $x_6$ -time of contact, min. Estimated criterias were:  $y_1$  - the content of oil products in the purified water, mg/dm<sup>3</sup>;  $y_2$ -specific expense of the electric power, kW • h/m<sup>3</sup>. The main level, intervals of a variation and border of area of research are specified in table 1.

Table 1. Main levels and intervals of a variation

Фактор	Interval	+2,378	+1	0	-1	-2,378
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
$X_1$	0,5	2,69	2	1,5	1	0,21
$X_2$	1,0	4,9	3,5	2,5	1,5	0,12
$X_3$	20	127,6	100	80	60	32,44
$X_4$	29	101,3	60	30	1	0
$X_5$	300	1426	1113	813	513	100
$X_6$	3	17,13	13	10	7	2,66

After processing of experimental data the equations of regression of rather residual concentration of oil products have been received:

$$Y_1 = -13.86 - 0.64 \cdot X_1 + 0.15 \cdot X_2 + 0.05 \cdot X_3 + 1.01 \cdot X_4 + 0.05 \cdot X_5 + 0.04 \cdot X_6 + 1.35 \cdot X_1 X_2 - 2.51 \cdot X_1 X_3 - 0.37 \cdot X_1 X_4 + 1.02 \cdot X_1 X_6 - 0.32 \cdot X_2 X_3 - 1.48 \cdot X_2 X_4 - 1.07 \cdot X_2 X_5 - 1.4 \cdot X_2 X_6 - 2.16 \cdot X_3 \cdot X_4 - 0.14 \cdot X_3 \cdot X_5 - 1.26 \cdot X_3 \cdot X_6 - 1.36 \cdot X_4 X_5 + 2.75 \cdot X_4 X_6 + 0.25 \cdot X_5 X_6 + 4.49 \cdot X_1^2 + 3.57 \cdot X_2^2 + 3.46 \cdot X_3^2 + 3.27 \cdot X_4^2 + 4.1 \cdot X_5^2 + 2.58 \cdot X_6^2$$

Equation of regression of rather specific expense of the electric power:

$$Y_2 = -29.35 - 2.68 \cdot X_1 + 0.48 \cdot X_2 + 1.12 \cdot X_3 + 1.7 \cdot X_4 - 1.91 \cdot X_5 - 1.97 \cdot X_6 + 1.76 \cdot X_1 X_2 - 4.77 \cdot X_1 X_3 - 0.98 \cdot X_1 X_4 + 0.66 \cdot X_1 X_6 + X_2 X_3 - 2.22 \cdot X_2 X_4 - 1.47 \cdot X_2 X_5 + 0.9 \cdot X_2 X_6 - 4.16 \cdot X_3 \cdot X_4 + 0.81 \cdot X_3 \cdot X_5 + 3.38 \cdot X_3 X_6 - 2.33 \cdot X_4 X_5 + 2.69 \cdot X_4 X_6 + 3.54 \cdot X_5 X_6 + 10.54 \cdot X_1^2 + 7.38 \cdot X_2^2 + 7.39 \cdot X_3^2 + 6.5 \cdot X_4^2 + 8.57 \cdot X_5^2 + 5.13 \cdot X_6^2$$

It is established as a result of researches that use asymmetric current promotes effective dissolution of the anode due to the destruction of a polarizing oil film by means of an impulse of negative polarity that will allow to provide the stability of electrochemical processing of oil-containing drains at high effect of cleaning.

The calculations in the Scilab program have been made for definition of the optimum modes of electroprocessing of the sewage containing the emulsified oil products. "Scilab" is a system of computer mathematics which is intended for performance of engineering and scientific calculations. In figures 1, 2 the graphic interpretations in the form of surfaces for the choice of optimum conditions allowing to determine areas of a joint optimality by residual concentration of oil products and an expense of the electric power for regulation of process of electrocoagulative processing are presented. From graphic constructions that at high concentration of the emulsified oil products in waste water ( $S_{npiskh} = 1113 \text{ mg/dm}^3$ ) the area of a joint optimality is in ratio size limits on continuance of direct and return current  $\sim 2$  for a ratio of amplitudes of negative and positive impulses (1/1.5; 1/3.5; 2/3.5).

At reduction in the conditioned water of concentration of the emulsified oil products ( $S_{npiskh} = 513 \text{ mg/dm}^3$ ) the area of a joint optimality is displaced towards the bigger size of duration of a positive impulse. At electrocoagulative processing of the sewage containing the emulsified oil products there is an anode dissolution of aluminum. In the subacidic and neutral environment almost insoluble hydroxide of aluminum  $[\text{Al}(\text{OH})_3(\text{H}_2\text{O})_3]$  with strongly developed surface causing high adsorptive ability in relation to particles of oil products and the weighed substances is formed.

Optimization of process of electrocoagulative sewage treatment containing the emulsified oil products when using an asymmetric current has allowed regulating process taking into account technical and economic indicators. The solution of an actual problem of processing of oil-containing sewage allows carrying out a complex of actions for reduction of waste of the enterprises of mechanical engineering for prevention of environmental pollution.

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## RESIDENTIAL COMPLEX FOR PEOPLE WITH AUTISM

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According to a definition autism is a phenomenon which is unfortunately not rare.

Autism is a disorder arising from a violation of brain development, and is characterized by severe and comprehensive deficit of social interaction and communication and restricted interests and repetitive actions. All of these symptoms are manifested before the age of three years old. Similar conditions, in which marked milder signs and symptoms, are referred to autism spectrum disorders. Classified as a disease of the nervous system, autism manifests itself primarily in the developmental delay and unwillingness to make contacts with others. This condition is most often formed in children aged up to three. The symptoms of this disease do not always manifest themselves physiologically, but the behavior of the child observed and reactions allow doctors to recognize this disorder in approximately 1-6 cases per thousand. Causes of autism are still not fully revealed.

In 2000 it was considered that the prevalence of autism is from 5 to 26 per 10,000 among the children. In 2005 there was one case of autism among the 250-300 infants which is more than isolated deafness and blindness, Down's syndrome, diabetes, cancer or other diseases. According to the World Autism Organization, in 2008 one case of autism accounted for 150 children. In the same year, the United Nations (UN), understanding the depth of the problem and the severity of the consequences for the society, declared the 2 April as "World Day of Autism Awareness." In 2012, the Center for Disease Control in the USA reported there is 1 case of autism for every 88 children. For 10 years the number of children with autism has increased 10 times which proves the idea that the trend may continue in the future.<sup>[1]</sup>

Creating a comfortable living environment, creating the possibility of proper care, providing opportunities for development, self-realization, the creation and strengthening of contacts with the public, are the important tasks that must be completed.

This work focuses on the competitive experimental project which is a multifunctional residential complex for people with this disease, and is an attempt to create a comfortable and positive environment for living and development. It is located in the city's fabric, and in the daytime opened to the townspeople. This enables interaction and strengthens social ties. It gives an understanding that living here is part of a whole, they are cared for and not forgotten.

The territory of the complex is divided into several major functional areas.

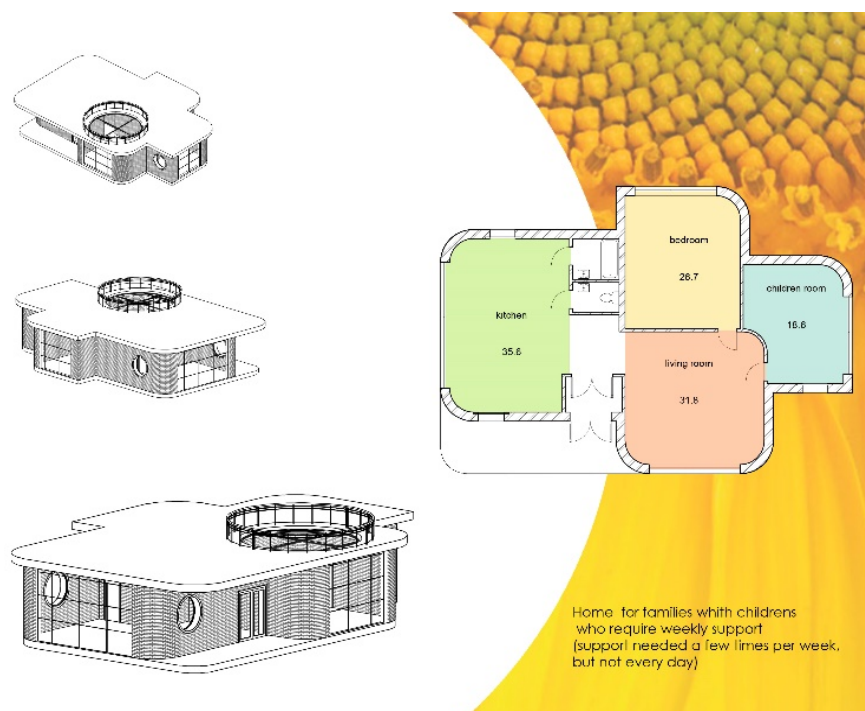
### **Residential:**

These are compact houses for families or communes to live: each has a spacious common living room which is like the core of the flower, and bedrooms, rooms for nurses, kitchen and bathrooms like petals. The corners of rooms are smoothed as the planning contributes to mitigating the environment. In this way every person has the ability to communicate and develop together. Altogether they have the ability to retire at the same time, and it is essential for every human being. These are one-storied houses with outdoor terraces that located on a green meadow, surrounded by trees. The proximity of nature helps to feel harmony and peace of mind. At the entrance there are no stairs because the floor level is the same everywhere, which contributes to a freedom of movement.



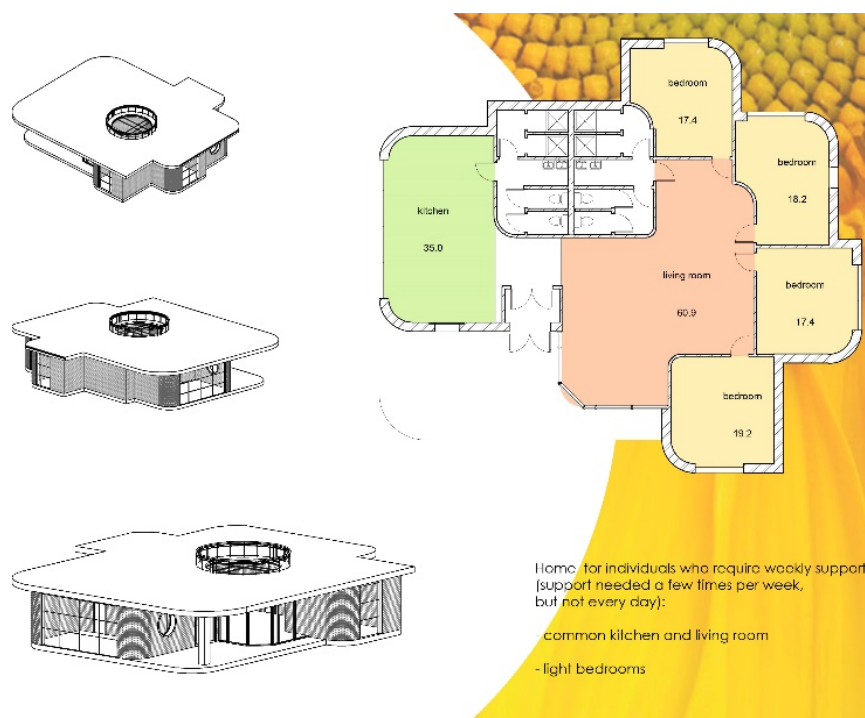
The houses have a typology:

- a family house that can comfortably accommodate parents with a child, a young couple or a family;



**Fig. 1 - A family-type house\***

- a house for people who need episodic care: there may be people with various degrees of autism that would enable them to help each other and learn from each other. Volunteers and nurses come to the residents several times a week to help at home and provide proper medical care.

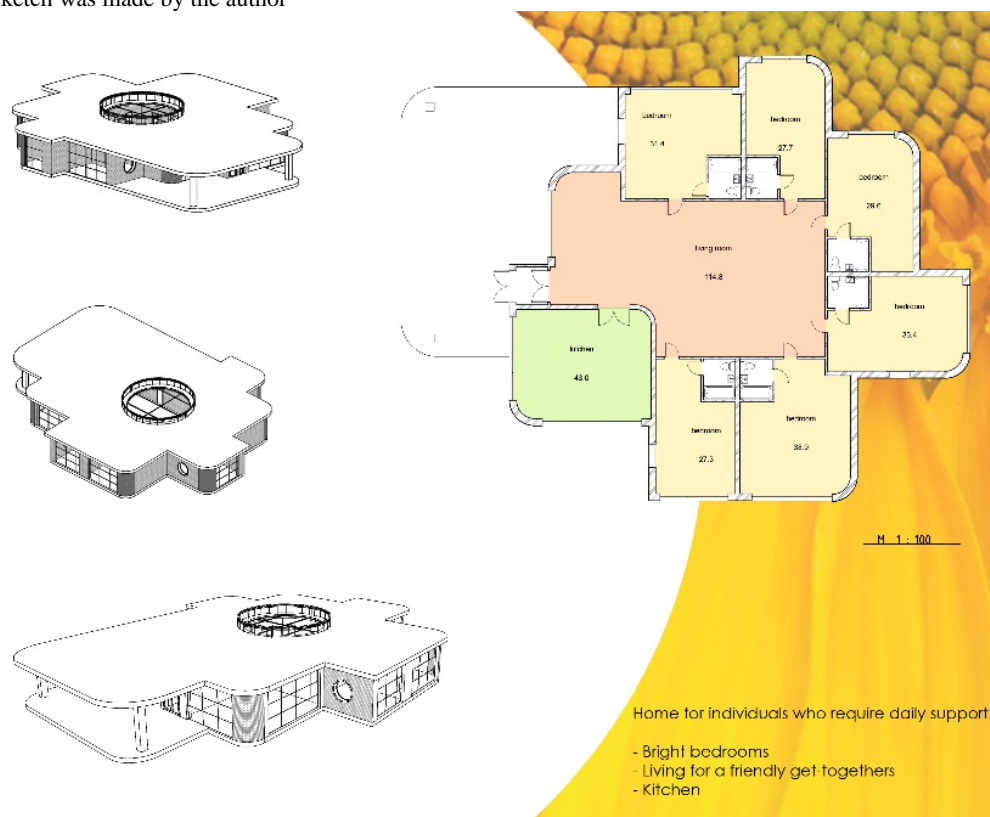


**Fig. 2 - a community-type house\*\***

- a house for people who need daily care. It may also be home to people with various degrees of the disease, nurses, and volunteers coming here every day.

\* The sketch was made by the author

\*\* The sketch was made by the author



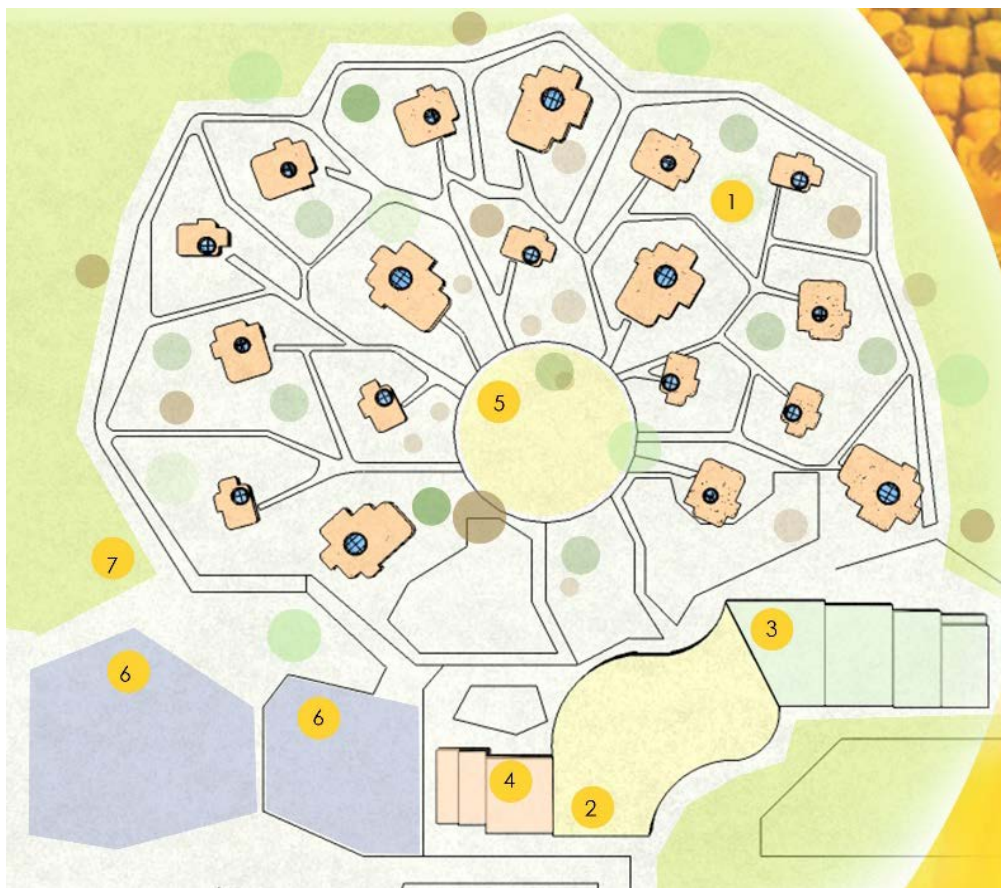
**Fig. 3 - Adaily care-type house\***

**The main building** that contains the medical unit and living rooms for those who need constant care, treatment rooms, gyms, rooms for joint activities, a dining room and a cafe, and a home service area. It adjoins the career center which works for both residents and patients of the residential complex. Center specialists help to understand and develop their working skills and help employers meet the specifics of cooperation with people with autism.

An active development area with open-air cages with animals, beds and gardens, sports grounds and playgrounds. This area is open to the public, and patients can communicate with other people, get acquainted and make friends with the guests, develop their skills and just have fun.

**The general plan** of the complex has a distinct center which has a radial development and saturation of functional areas, which is also a kind of symbol – a sunflower blossom. The core of the flower is the area of communication and development, petals are residential houses. In common it creates a sense of belonging and privacy at the same time.





**Fig.4- Master plan\*\***

\* The sketch was made by the author

\*\* The sketch was made by the author

To attract some attention to such problems, to acquaint the society with people suffering from autism is an important task, which cannot be ignored. Everyone, to the best of their knowledge and effort can help one's neighbor. Thanks to the joint efforts, the world can become a better and kinder.

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## **PROBLEMS AND SOLUTIONS OF COMMUNICATIONS IN INNOVATION INFRASTRUCTURE OF RUSSIA**

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Since 1940 the world has picked up the idea of innovation and began to cultivate them. For more than 50 years, the world has come the way from the Research Institute for innovative infrastructures, which is a complex of organizational and legal system. Not least in this system, and sometimes paramount occupy interaction between participants of innovation that are informational, financial, human resources, legal, etc. character.

Only a good and harmonious interaction of innovation participants contributes to the effective yield of innovations on the market, or on the production and implementation.

The study revealed clearly defined problems in the communication component of the innovation infrastructure in Russia as a whole and in individual regions:

- lack of awareness of stakeholders;
- weak horizontal linkages;
- lack of relevant graduates;
- lack of coordination between state agencies. support;
- the need to exchange information and experiences;
- lack of production chains.

On the interaction of innovative infrastructure elements.

In Russia, as in any other country, which focuses on innovation, there are state support organizations leading innovation. This support, as noted by the innovative organization, is very significant. However, oddly enough, at first glance, it was revealed by a survey of low demand for the services of innovation infrastructure facilities, with sufficient knowledge about them.

Almost all innovations are based on scientific research, we owe the scientific structures. And education is the bedrock of which it is to keep pace with the times. But the educational and scientific institutions claimed about the absence of the network of interactions between universities and business, resulting in a small "popularity" of their services, leading to the stagnation of both business and science.

The third innovative organizations are not aware of the existence of development institutions and their activities, one-fifth do not know about the activities of the RVC(Russian Venture Company), the Fund for Assistance to Small Innovative Enterprises in the scientific and technical sphere, 40.6% do not know about the technology platforms, and only 36, 2% have heard something about it [1].

However, the innovators themselves clearly understand what they do not have to improve both their personal effectiveness and innovation climate in the country. A high demand in the markets for business events and meetings was revealed, acceleration and educational programs, counseling and mentoring [1].

The survey identified barriers to conducting innovative activity on the part of commercial enterprises:

- the lack of qualified staff (57.1% say big business and 49.0% of small and medium-sized enterprises);
- dissatisfaction to the universities (must prepare personnel according to market needs);

- lack of awareness of stakeholders and the public about the market for innovative goods and services;
- poor coordination in the activities of innovative infrastructure elements (excessive bureaucracy);
- weak horizontal links between stakeholders innovation (as with other businesses, as well as with educational and scientific institutions).

Formation of an effective innovation infrastructure in Russia and in the world.

Importantly, the innovative process efficiency depends more on the interoperability system elements at each stage of operation than the performance of each of its stages. Of particular importance are the ease and speed of the transition from the previous stage to the next. In this case, the regulatory task of the state is the full involvement of the participants in the economic process in the innovation environment, from society to the educational, scientific, and public institutions, and the formation of stable relations between them.

That integration is the main mechanism for ensuring the effectiveness of the process. The innovative infrastructure as a mechanism of integration creates a relationship between the objects of innovation, ensuring its effective functioning.

By the basic objects of innovation infrastructure necessary to carry small innovative enterprises. Based on their work, carried out basic innovation, giving impetus to the further development of innovative activity.

The main role of small innovative enterprises is the primary check on her commercialization ideas, its capacity for the bringing of any benefit, the development of a product prototype, preparation of documentation, necessary for the start of production.

The key element in improving innovation infrastructure can be the creation of the All-Russian information center in the field of science and innovations aimed at solving the problem of information support of small innovative businesses.

The main objective of the center is collecting information on the existing scientific and technical developments and innovative products produced in Russia, as well as providing information to all interested entities. Transfer of information on the results of research and development should be mandatory for organizations conducting research at the expense of budget, and voluntary for others.

Creating such a center should improve the information security of small innovative businesses that will allow them to correctly determine the development strategy and increase their chances of success in the competition. It is important that businesses operating germinating topics will combine efforts on higher quality and the fastest solution developed by the task.

Improving innovation subsystem of the region on the basis of project-networking.

The solution to this problem is seen in the application design and network-based approach to the formation of an innovative subsystem region, allowing to minimize the importance of the subject of the territorial factor in the economic space. This will provide a continuously renewable processes of innovation, increase the return on resources spent on the formation and development of regional innovation subsystems.

The path to innovation development in the regions is on the move to the new format of the socio-economic organization of society, which is based on the triad of Information Society - Economy Network - Network Organization.

Under the Network Economy should be understood this the nature of the relationship between business entities in which the production, distribution, exchange and consumption of a product made by partial or complete use of information networks [6].

Project-networking will allow to realize the advantages of modern information technologies, the main of which is the opportunity incarnation of innovative projects without

direct contact of the participants, through the exchange of information on distance, which will attract the necessary resources at the lowest cost [6].

World experience shows that successful innovation, design and networking can achieve synergies in innovation that occurs in an atmosphere of creativity, collaboration and co-creation. Moreover, at the present stage networking becomes a prerequisite for ensuring the competitiveness of innovative enterprises as well as the timing of technology obsolescence is rapidly reduced.

Thus, further development of the economy in the regions is associated with the practical implementation of the project-network approach. Intensively developing, the network model can become the main driver of innovative processes development in the region [6]. In general terms, the network form of organization of the innovation process is a structure conducive to the creation of a common space in which the effective interaction of the subjects of this activity is made.

In conclusion, it is necessary to create an environment of interaction between participants of innovation activity in which information for a productive and successful innovation, such as the list of development institutions, business incubators, technology parks, etc., their demands and opportunities of innovative product information and services for enterprise and consumer sectors of other innovative enterprises information to be able to establish the horizontal and vertical linkages in order to achieve synergies, etc. disseminated immediately and would be readily available, through which the business would be able to interact, the state, science and all the elements of the innovation infrastructure.

There are particular proposals to resolve the identified problems. It is necessary to create a specialized information-trading platforms with an indication of the existing requests for innovative products, both on the part of ministries, departments, public corporations, and the real economy, to create a network of national clearing houses to ensure that innovators access to the necessary information resources and services, to create all-Russian information center in the field of science and innovations aimed at solving the problem of information support small business innovation, design and apply the network approach to innovation sub region.

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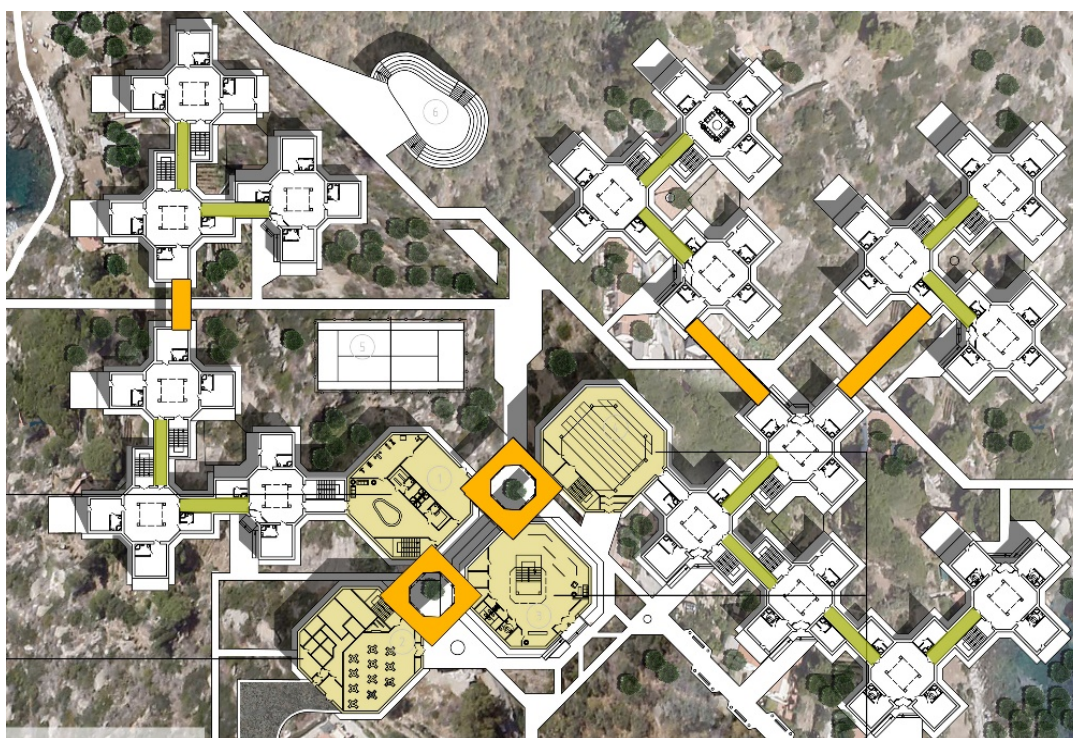
**SOCIETY FOR ALL AGES: CITY OF CRAFTS****Grigoreva A.,**

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We are living in the amazing world with the unique nature, culture, and people. Every day isn't similar to any other one with its new discoveries, knowledge and achievements. Every person begins the way of tests and mistakes from the childhood and gets wisdom and vital pacification only by an old age. In the West there is a concept of a "third age" - the period of active life which begins with retirement <sup>[4]</sup>. Such people with the extensive life experience and a set of achieved objectives and the passable tops can always teach us something. They seem to have everything: the family, success, etc., but most of them lack for one component which is the coziness and heat. So, because of that the idea to create an environment which would meet all the requirements as elderly people as the youth was born.

The project is developed on the basis of the architectural competition "Society for all ages" declared by the organization ICCA, New York<sup>[2]</sup>. The project is found on a basis of modules, honeycombs.

The example of modules is represented in figure 1



**Fig. 1 – The general plan of the settlement developed on the basis of modules.**

<sup>1</sup> The general plan of settlement was created by author.

Thanks to these modules the comfortable place to stay for people of different ages and generations can be formed. Thanks to flexibility of this structure there is a possibility of changing of the developed environment (setting out additional structures or a possibility to create new workplaces) <sup>[5]</sup>.

The project is located in a very picturesque place of the city of Krasnoyarsk along the bank of the river Bazaikha. From the Northern and Western sides the complex is surrounded by mountains, in the East there are many private low-rise houses. The church, a children's

camp, some grocery stores, and bus-stops are located nearby. Also, on the trunk-line there are polyclinics, hospitals, pharmacies and a railway station which is within walking distance of the project.

In a such a picturesque town-planning situation it was important to dissolve visually architectural materiality, adjoining to the river, and create a cozy, comfortable environment at the same time. The object represents the settlement of low-rise houses integrated into the existing housing estate. There is a public zone consisting of four blocks settled down in the central part. In the main block there is the entrance group, an exhibition, administration offices, workshops are located. The second block has a restaurant, a library, a projection booth and lecture halls. Third block is for sports. And the fourth represents the covered greenhouse for leisure activities.

Inhabited cells are located around the public zone. Thanks to that decision the complex has received private psychologically comfortable space for a courtyard. All modules are connected by a warm transition on the second floor.

The modular system has been taken as a basis for inhabited cells. One module consists of three-four rooms with a toilet and conveniences in them. All rooms are united by the big atrium part, where elderly people can gather for a conversation or playing chess. It is necessary because at such age the question of absence of people nearby is particularly sharp. Three modules are packed together, and staircases appear. In some cells there are rooms for nurses.

Also, some houses have exits to the small green lawn on which it is possible to grow up flowers and greens in the summer.

- The average area of a living room is 35-40 square meters. .
- Complex capacity is 200 people.

The perfected plasticity of the building together with a conjoint bricklaying gives the impression of a comfortable and warm structure. And the windows chaotically scattered on a facade add vivacity and dynamics.

This settlement may be interesting to both young and elderly people as the functional filling of this complex is extensive and meets the requirements of people of all age categories.

Elderly people need to be looked for. They put their hearts and souls into us when we were little, tolerated our whims when we were growing up, and they deserved warmth and coziness, when it is possible to go outside in the morning, while sunrise, to hear the murmur of water, singing of the birds and children laughing nearby. It is important for them to share their knowledge or learn to play big tennis. We all come from childhood, and all of us need movement, care and love.

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## **THE ROLE OF THE ANALYSIS OF FINANCIAL STATEMENTS IN MODERN CONDITIONS**

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The analysis of financial statements is the important tool thanks to which all interested users can increase quality of administrative decisions adoption. The use of analytical information allows management to be aware of an overall picture of economic and property status of an enterprise. Nowadays we may estimate solvency and reliability of the company on the basis of data of financial statements. It is possible to predict changes of its solvency in the future. By means of analysis it is also possible to check the companies to cooperate with in future or in which the head intends to make some investments.

Accounting reports data are the initial source for the analysis. The parts of accounting reports are the balance sheet and the report of financial results. Additional reports may be also applied for clear money transfer visualization and help to get the right opinion of the enterprise activity. The accounting reports are usually composed once a year. They are delivered to tax authorities and other controlling services. But drawing up intermediate accounting reports (monthly and quarterly) allows to control better the situation and to avoid mistakes. Besides, frequent reports allow tracking dynamics of the company development, to compare experience of certain periods in order to try to analyze when indicators reached the highest marks and what actions were undertaken during this period for this purpose.

The analysis of the balance sheet shows: how effectively the company uses assets, whether it is enough of them for full and successful business; whether the management is capable to conduct fully and develop successfully the activity of the company; possibility of preservation and growth of the initial capital. The analysis of financial reports of the enterprise shows how income flow has changed for several years. Data of the reports help to draw a conclusion on right administrative decisions adoption; estimate factors affected the income level.

The tasks of carrying out the analysis of financial statements include research of indicators: assets, liquidity, financial stability, profitability, business activity. These indicators are studied with the following methods:

1) The horizontal analysis (a temporary method) consists of reporting indicators for different periods of time in comparison. By means of this method it is possible to compare both reports themselves, and changes between indicators.

2) The vertical analysis is necessary to see changes of each indicator of the reporting which influence the generalized indicators.

3) The factorial analysis helps to define the reasons of net profit level change, to study the factors influencing this indicator.

4) The spatial analysis consists not only in comparison of separate articles of the enterprise reports, but also in comparison of the same indicators of competitor companies.

5) The express analysis consists of the balance sheet data studying. This method allows defining liquidity and solvency of the enterprise. It is usually used by the companies-partners.

6) The method of financial coefficients helps to make calculation of indicators of accounting reports interrelations. On the basis of this method it is possible to draw conclusions on the main indicators characterizing a financial condition of the enterprise: coefficient of independence, financing stability, liquidity.



In order to carry out any analysis correctly, accounting reports have to be executed in due form. Constant management control for this purpose is necessary. The analysis of financial statements is not only calculation of the main indicators and coefficients; it is also comparison of all received values and changes of their dynamics.

The main objective of carrying out the analysis is valid conclusion about the financial position of this organization which will be proved with the calculations executed earlier. The use of analytical information gives possibility in due time to reveal, eliminate defects of financial activity and to find reserves of the enterprise cost growth.

Accounting of the most Russian companies often doesn't match the requirements to it from the side of the users. Reforming of financial statements resulted in decoding reduction and absence of accounting articles. It had great influence on informational content of accounting. It is keenly felt in the conditions of the crisis.

Imperfection of the Russian system of record-keeping impacted on the lack of accounting transparency. The delay of registration of facts of economic activity or absence of their registration results in data distortion in financial statements. Optimization of taxation of some enterprises was reflected in making impossible the definition of real figures for financial analysis. For the improvement of the situation it is necessary to bring the system of accounting closer to international standards. It will help organizations to finish off the financial reporting on their specific activities.

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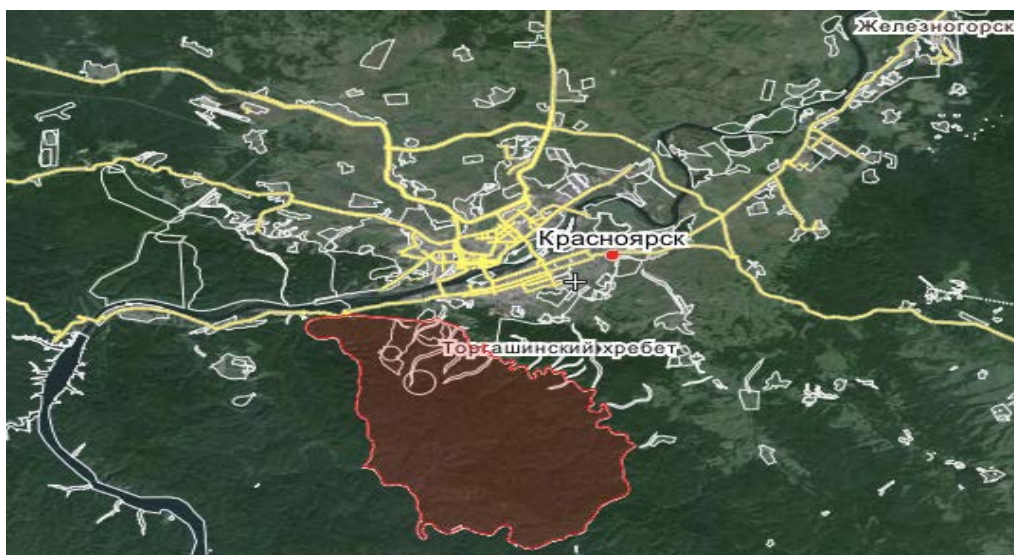
## THE QUESTION OF CHANGING THE STATUS OF SPECIALLY PROTECTED NATURAL TERRITORIES "STOLBY"

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Protection of wildlife is based on creating a system of specially protected natural territories. It contributes to the conservation and restoration of the surrounding nature at a high ecological level. According to Russian legislation, protected areas include: reserves, national parks, natural parks, natural monuments, arboretums and botanical gardens. Common for them is the functional purpose of the protection of nature but with a different mode of using of territories, the extent permitted by economic activity and the development of recreational and tourist district.

The state specially protected natural territory "Stolby" is located in the north-western spurs of the Eastern Sayan Mountains, which border with the Central Siberian Plateau. The natural borders are right tributaries of the Yenisei River, in the north-east - the river Bazaiha, in the south and south-west - the river Mana and Big Slizneva. From the northeast the territory borders on the suburbs of the city of Krasnoyarsk. The legal address of the reserve is Sverdlovskii, 26a, Cariernaya street. Currently, its area is 47154 hectares. Protective zone created on 20 May 1994, on the area of 13,464 square hectares. Foundation date is June 30, 1925. The territory was founded for saving of natural complexes around the syenitic residual outcrops - "Stolby".



***Fig. 1 - The situational scheme of disposition the reserve "Stolby"***

During the process of studying the changes in the state of the natural complex in the conditions of perennial anthropogenic loads and optimization the recreational use of the area the question arose about changing the status of the protected territory "Stolby" from the reserve to the national park that became the main purpose of the study. It is necessary to identify all changes in the state of the natural complex "Stolby" which is subjected to many years of anthropogenic loads, and also to find the right way of interaction between human

beings and protected areas in order to organize the optimal and rational use of the territory, for both recreational and protection functions.

National parks can take a special place among all categories of protected areas, since they are able to provide population with an access to the natural wildlife and ensure the conservation this nature as a national heritage at the same time.

In national parks the recreational function is considered to be an inevitable evil. The visitors can see a potential threat rather than an opportunity to attract them to support protective activities. The recreational function and protection of the territory should not be mutually exclusive. These two functions can be mutually reinforcing. Protection of natural and cultural resources ensures the availability of recreational opportunities in the future. And the fact that society can properly evaluate these resources by means of appropriate recreational impressions gives powerful support to their protection. It becomes obvious that, paying attention to work with the population, especially protected territories can play an important role in changing the attitude of society to problems of protection of the natural heritage.

To achieve these goals, it is necessary to solve the following issues:

- to allocate natural resources and the condition the ecological system of the territory of the natural complex "Stolby";
- to assess the impact of economic and recreational activities on the natural resources of the specially protected territory "Stolby";
- to detect the anthropogenic factors that affect the wildlife of the specially protected territory "Stolby";
- to study the recreational resources and architectural solution of the territory;
- to study the questions of legal maintenance of national parks.

In the process of research some general scientific research methods will be used: method of analysis; method of comparison; method of observation; statistical method, and systematic method. To achieve the objectives completely, it is necessary to carry out sociological studies with the help of methods such as a questionnaire and analysis of documents.

As a result of the research and full-scale survey of the tourist and recreational district, some violations were identified. For example, the territory "Stolby" already has such functional areas that cannot be envisaged in reserves, namely:

- a recreational zone;
- service to the visitors including overnight accommodation places, campgrounds and other facilities for tourists, as well as cultural, consumer and information services to visitors;
- an economic purpose, within which economic activities necessary for the functioning of the national park are carried out.

As a specially protected natural territory, reserves should be completely withdrawn from all types of use. The reserve "Stolby" is an exception to the general rule. Because of the historical traditions of visiting the rocky district of the reserve there was created an individual scheme of zoning of its entire territory: protection, buffer, strict nature protection and tourist excursion districts that resembles the structure of a national park following the federal law. Therefore, it is necessary to conduct a detailed functional zoning and require completion of local regulations, and also change in the status from "Reserve" to "National Park", which will benefit the development of specially protected natural territories "Stolby".

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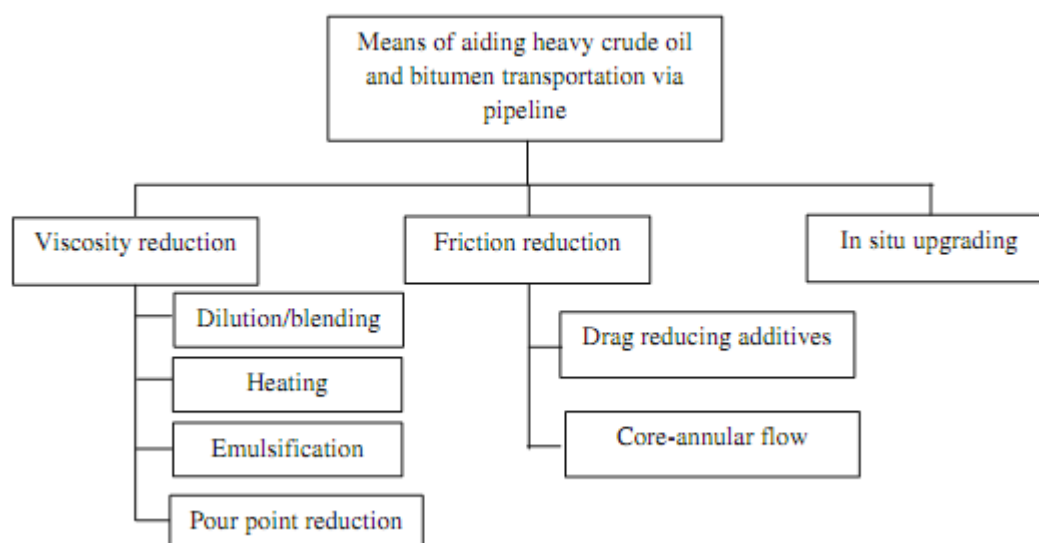


## DEVELOPMENT OF A METHOD OF SMOOTHING DISTURBANCES ARISE IN THE FLOW OF FLUID IN THE PIPELINE

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To transport heavy oils economically, the pressure drop in the pipeline must be lowered to minimize the pump power required to push the oil over a long distance. However, because of their high viscosity at reservoir conditions compared to conventional light crude oils, conventional pipelining is not adequate for transporting heavy crude oil and bitumen to refineries without reducing their viscosity. The methods used for transporting heavy oil and bitumen through pipelines are generally grouped into three as shown in Fig. 1: (a) viscosity reduction [e.g. preheating of the heavy crude oil and bitumen and subsequent heating of the pipeline, blending and dilution with light hydrocarbons or solvent, emulsification through the formation of an oil-in-water emulsion and lowering the oil's pour point by using pour point depressant (PPD)]; (b) drag/friction reduction (e.g. pipeline lubrication through the use of core-annular flow, drag reducing additive); and (c) in situ partial upgrading of the heavy crude to produce a syncrude with improved viscosity. Areas of research are anti turbulent additives and their use in the oil industry for the transportation of oil through pipelines [1].



**Fig.1 - Diagrammatic display of methods of improving heavy crude oil and bitumen flow via pipelines**

The aim of this study is to develop a test bench for testing anti turbulent additives which are used in the fields of real or suggest a different way of smoothing disturbances in the pipeline.

As the dominant transport fluid property, high crude oil viscosity poses great challenges to oil production, refining and transportation through wells and pipeline. The viscous drag, wall friction and pressure drop in the pipeline are much higher in heavy oil compared to conventional light oils. The drag is the result of stresses at the wall due to fluid shearing causing a drop in fluid pressure. This makes it challenging to pump the oil through a long distance. Therefore, drag reduction is a lubrication technique based on core-annular flow



to reduce pressure in the transport of heavy oil via pipelines. The commonly used techniques to lower the friction to enhance pipeline transportation of heavy crude oil include dragreducing additives and core-annular flow. Both technologies reduce flow drag by varying the velocity field such as dampening the turbulent fluctuation in the near wall region of the pipeline, while the flow in the heavy oil pipeline is laminar or slightly turbulent with minimum flow resistance based on viscosity influence on flow drag. However, most studies on flow drag reduction pay attention mainly to reducing the viscosity by physical or chemical methods, but according to Newton's viscosity law flow drag depends upon fluid viscosity and velocity profile [2].

The pressure drop encountered in heavy crude oil transportation via pipelines is more acute when it is to be transported over a long distances; therefore drag reduction by incorporating an additive becomes an option. The transportation of crude oil via pipelines is mostly in the turbulent flow regime. Additionally, high frictional loss as a result of high viscosity causes much of the energy applied to transport the crude oil to be wasted. High drag in turbulent flow is caused by radial transport of flow momentum by fluid eddies. Polymer drag reduction was discovered decades ago by Toms (1948), who observed about 30-40 % drag reduction upon the addition of polymer (methyl methacrylate) to turbulent monochlorobenzene flowing via pipeline. In this respect, drag-reducing additives help to reduce friction near the pipeline walls and within the turbulent fluid core of moving fluid. Therefore, for energy conservation and high efficiency of bitumen and heavy crude oil transfer, drag reduction is vital.

Drag-reducing additives are classified into three categories: polymers, fibers and surfactants. The key role of these additives is to suppress the growth of turbulent eddies through the absorption of the energy released by the breakdown of the lamellar layer. Furthermore, drag additive helps reduce friction near the pipeline walls and within the turbulent fluid core during transportation, which results in high flow rate at a constant pumping pressure. Consequently, solubility of the drag-reducing additives in the heavy crude oil is a key requirement. In addition, there should be degradation resistance and stability against heat and chemical agent. The common difficulties encountered in the use of dragreducing additives includes the tendency of the additive to separate when stored, difficulty in dissolving the additives in the heavy crude oil and the problem of shear degradation when dissolved in heavy crude oil. In addition, determining the dosage required to maintain constant pressure drop is challenging.

This theme was developed in Russia, on the basis of problems at the Vankor field. The advantage of the use of additives are definitely increasing through put capacity of the pipeline, as well as the reduction of energy losses. The only disadvantage of anti turbulent additives use is its high price [3].

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## EXTRUSION PARAMETERS INFLUENCE ON THE MECHANICAL PROPERTIES OF HIGH-STRENGTH MAGNESIUM ALLOY

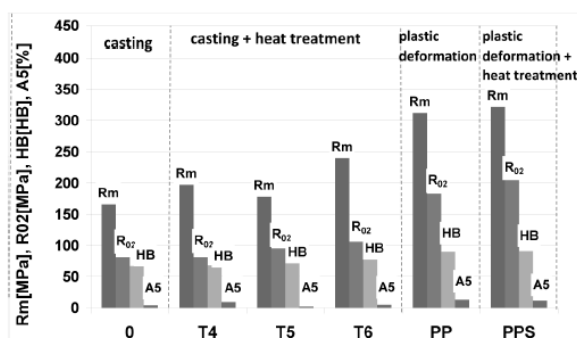
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Today, most of parts manufactured from magnesium alloys, especially in Poland, are produced by casting methods, i.e. by gravity casting into metal and sand moulds, and by pressure diecasting. Magnesium alloys are processed by plastic forming mainly at elevated temperatures. This is due to the crystalline structure of magnesium, which on crystallisation forms a hexagonal arrangement. During high temperature deformation of metals, processes such as consolidation, dynamic recovery and dynamic recrystallisation occur. These processes are occurring simultaneously in the deformed metal. Magnesium alloys have low energy of the stacking fault, and therefore dynamic recrystallisation is the leading process in high temperature plastic forming. It removes the effects of deformation hardening, increases ductility and reduces the flow resistance. In general, magnesium alloys processed by plastic working are characterised by significantly higher properties compared to those obtained by casting processes. This results from the fact that wrought materials have more refined grains.

Nevertheless, the mechanical properties of magnesium alloys are lower than the properties of numerous aluminium alloys. Therefore it is recommended to subject to plastic forming those alloys which are expected to offer very high strength. The process most appropriate seems to be extrusion which, owing to the state of compressive stress, provides the best conditions for plastic forming.

Currently the most popular magnesium alloys are alloys of aluminium, zinc and manganese. Aluminium is beneficial as regards an improvement of the tensile strength and hardness. Zinc in magnesium alloys is used to improve the alloy strength at room temperature, while manganese increases the resistance to corrosion. From the phase equilibrium diagram of Mg-Al alloys follows a variable and increasing solubility of aluminium in magnesium up to a maximum content of 12.7% in the solid state to the eutectic temperature of 437 °C. Therefore, these alloys are subjected to heat treatment to improve the mechanical properties by precipitation hardening (T5 and T6 condition). Magnesium alloys with manganese (MgMn) are not precipitation hardened. Manganese improves the corrosion resistance of alloys. The precipitation-hardened MgZn alloys are classified as alloys of the highest strength (350-400 MPa). Figure 1 shows the example of a diagram illustrating the possibility of obtaining the required mechanical properties depending on the manufacturing method and condition after heat treatment.



**Fig. 1 Graphical representation of the mechanical properties of AZ91 alloy, depending on the process of manufacture.**

To get the best economic results combined with the highest mechanical properties, a heat treatment (solution heat treatment) should be applied to products just upon their leaving the press ("online solution"). If alloys are subjected to aging, a precipitation-hardened product will be obtained (conditions T1, T5). It should be noted that it is the extrusion temperature that has a significant impact on the speed of recovery and recrystallisation, and on the degree of supersaturation. Therefore it is important to determine what effect the extrusion process parameters and heat treatment will have on the mechanical properties of magnesium alloys.

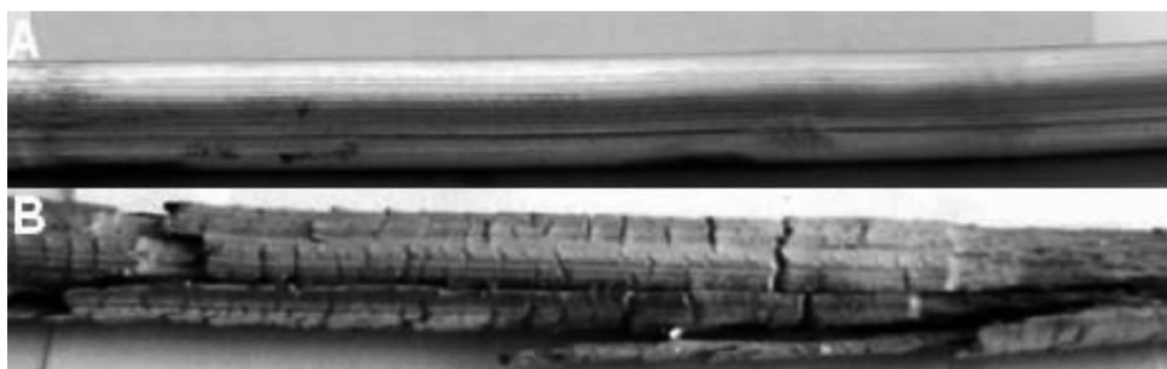
Studies of the direct extrusion process were conducted on MgAlZn (AZ80A) and MgZnZr (ZK60A) magnesium alloys belonging to the group of alloys characterized by the highest strength. The chemical compositions of these alloys were presented in Table 1. Tests of direct extrusion were carried out on a laboratory stand equipped with a press of max. 0,6MN capacity using specially designed and constructed equipment. The equipment includes a container of 30mm diameter and a ' 8mm die. For research purposes, from ingots of 100mm and 130mm diameters, rollers of 29mm diameter were cut out, which were later preheated to a predetermined temperature and extruded in the form of ' 8 mm rods. Due to the application of relatively high, as for magnesium alloys, preheating temperatures, rods were protected with chromate coating to minimise oxidation.

The extruded rods were subjected to multi-variant heat treatment, first, and examined for mechanical properties and structure, next.

TABLE 1 - The chemical composition of ZK60A and AZ80A magnesium alloys

Alloy	Zn	Al	Si	Cu	Zr	Mn	Fe	Ni	Others	Mg
MgAlZn	0,28	8.1	0.02	0.003	-	0.18	0.002	0.004	<0.3	Rest
MgZnZr	5.1	-	-	-	0.56				<0.3	Rest

Magnesium alloys (AZ80A and ZK60A) were extruded in direct process with extrusion ratio  $\lambda = 14$ , using two ram speeds, i.e. 0.8 mm/s and 2.8 mm/s. The materials were preheated from 350C to 450C. As a criterion in an assessment of the extruded rod quality, the surface condition was adopted, i.e. the occurrence of hot cracks, and the macro- and microstructure. The extrusion process parameters, i.e. the stock temperature, the ram speed, and the recorded maximum extrusion force with comments on the selected variant, are shown in Table 2. Figure 2 shows the example of a rod extruded from ZK60A alloy under properly selected process parameters, compared with a rod extruded from AZ80A alloy. The extrusion at mis-selected temperature and ram speed (both were too high) resulted in overheating of the material and hot-cracking.



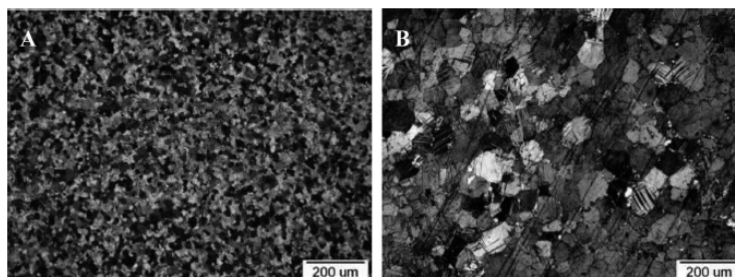
**Fig. 2 Examples of extruded rods: A – ZK60A alloy (extrusion temperature 450C, VT = 0.8 mm/s), B – AZ80A alloy (extrusion temperature 450C, VT =2.8 mm/s)**

Table 2 - The extrusion process parameters selected for magnesium alloys

Alloy	Billet temperature [°C]	Max. extrusion force [MN]	Results
Ram speed: $V_T = 0,8$ mm/s, Extrusion speed: $V_W = 0,7$ m/min			
AZ80A	350	0,20	+
	380	0,23	+
	420	0,16	+
	450	0,12	+
ZK60A	350	0,18	+
	380	0,17	+
	420	0,10	+
	450	0,10	+
Ram speed: $V_T = 2,8$ mm/s, Extrusion speed: $V_W = 2,4$ m/min			
AZ80A	350	0,35	+
	380	0,31	+
	420	0,28	cracking
	450	0,30	cracking
ZK60A	350	0,33	+
	380	0,32	+
	420	0,28	+
	450	0,27	cracking

Figures 3 and 4 show the examples of macrostructure and microstructure of rods extruded under the properly selected direct extrusion process parameters (from Table 2): billet temperature 450°C with the ram speed of 0.8 mm/s.

In some cases, the surface quality inspection indicated that the extrusion process parameters were correct. Only later, detailed structure examinations revealed the presence of internal hot cracks.



**Fig. 3** Example of microstructure in rods extruded at 450°C with the ram speed of 0.8 mm/s.  
**A – ZK60A alloy, B – AZ80A alloy.**

The extrusion tests have showed that for both alloys it is possible to use the temperature of the extruded material ranging from 350C to 450C when the process is run with an extrusion ratio of  $\lambda = 14$  at the ram speed of 0.8 mm/s corresponding to the extrusion speed (rod speed leaving the die) of 0.7 m/min.

The mechanical properties of the investigated alloys were determined in a static tensile test (sizes of samples: diameter 8mm, base length 50mm). Rods extruded from magnesium alloys AZ80A and ZK60A were heat treated applying parameters described. Tables 3 and 4 contain the results of mechanical testing of alloys extruded at the maximum possible temperature, i.e. at 450C (VT = 0.8mm/s), and brought to different conditions after heat treatment.

Table 3 - Mechanical properties from the tensile test for ZK60A alloy

№	Temper	R <sub>p0.2</sub> [MPa]	R <sub>m</sub> [MPa]	A [%]
1	extruded	250	320	16,5
2	T6	262	310	11,5
3	T1	258	328	16,0
4	T5	293	341	18,8

Table 4 - Mechanical properties from the tensile test for AZ80A alloy

№	Temper	R <sub>p0.2</sub> [MPa]	R <sub>m</sub> [MPa]	A [%]
1	extruded	237	311	10.5
2	T6	216	300	9.0
3	T1	210	331	13.8
4	T5	290	344	9.0

1) With the extrusion ratio  $\lambda = 14$  and the ram speed equal to 0.8 mm/s, the AZ80A and ZK60A alloys can be extruded at temperatures in the range of 350 C-450 C, while with the ram speed of 2.8 mm/s, the temperature should be kept at 380C and at 400 C for AZ80A alloy and ZK60A alloy, respectively.

2) Due to a lower extrusion force, resulting in fine-grained structure and higher mechanical properties, the process of direct extrusion should be carried out at a maximum allowable temperature.

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## **THE FOREIGN EXPERIENCE OF ECOLOGICALLY-ORIENTED URBAN ENVIRONMENT RENEWAL**

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Following the model of old unsustainable development and human impact on the landscape brings to a critical point of uncontrolled process of biosphere deterioration.

Cities began to feel a dire need to maintain and increase the natural environment components, in connection with that there is an urgent need to create a new approach to the development and implementation of renovation measures. There is a priority shift in modern foreign projects of urban transformation towards the ecologically-oriented approach.

The ecologically-oriented approach is a way to improve the quality of environment, solving engineering problems, restoration of the communication between the city and the nature and maintaining its stability, and overall improvement of the ecological situation, which takes into account social functioning aspects and visual perception of architectural and landscape complexes. Such an approach to urban renewal allows creating and managing processes rather than a form that is one of its main advantages, enabling its high quality; gradually transform the city environment in a timely manner in response to changing needs and demands of its users.

In foreign practice a considerable number of modern urban renovation projects, a large part of which has already been implemented, has been accumulated.

Former industrial areas are characterized by a large number of problems associated with elevated levels of contamination of soils and water, and lack of vegetation. Therefore, in many countries, much attention is paid to the restoration of disturbed landscapes, as one of the most promising areas for the development of the city after the special measures for their regeneration.

The project of Seattle's waterfront line transformation, (USA, 2007) is a good example of such renovation (Fig.1).



**Fig.1 - Olympic park in Seattle (USA)**



Seattle Art Museum offered to convert an abandoned industrial area into a green park area and a three-level Olympic Sculpture Park. But the project became impossible without the restoration of the natural complex. Tons of oil-contaminated lands were removed and new right composition of soil was chosen carefully, also the plants typical for the northwest Pacific coasts were planted. A Tidal terrace for habitat of salmon and sea vegetation will be organized as well. The Green Corridor lying along the entire coastline of the most visited sites combined embankment and provided the access to water space, connecting the city with the natural environment.

Zhongshan Park (Beijing, China) was laid out in 2001 instead of the bankrupted shipyard, which was turned into a hideous rotting in the water scrap-heap. According to the idea of the Chinese landscape bureau «Turenscape» a special park project was established to become the most attractive part of the city and carefully preserve the history of the place: the industrial history and natural relics (Fig.2).



**Fig.2 - Zhongshan park (Beijing, China)**

The project was created on the old vegetation that managed to survive in the shipyard. Special plants for waterlogged and flooded places were selected to make up the decorative appearance of the park. As a result, they managed to achieve the incredible ecological and landscape harmony at the lowest cost.

The landscape bureau «Turenscape» is one of the leading design organizations whose projects are environmentally oriented and contain measures to restore and maintain the natural city's environment.

«Turenscape» participated in the architectural competition for the landscape-architectural concept development of Moscow park "Zaryadye". According to the author's project, the park appears to be an ecosystem for supporting the natural biodiversity. Its a modern landscape, based on understanding of environmental ethics: the achievement of good results at low costs of care and maintenance. The project includes four landscaped areas such as the monastery gardens, meadow, expanse of water, marsh and birch forest. They will allow park visitors to get acquainted with the concept of "designed nature". The best panoramic views of the historical sights of Moscow will be opened with the terrace being projected. This



is an important component for connecting the city with the embankment of the Moscow River.

An important part of modern drainage technology is the effective permeability of the urban territories. New approaches and solutions of vertical planning are being introduced to the urban environment and associated with the storm water management, collection and usage of aquatic vegetation. In this way, landscape architecture in urban environment is resource-saving and discharges the storm sewers. This method shows an example of an eco-friendly approach to the space organization (Fig.3).



***Fig.3 - Purification and reduction of storm water using plants and soil  
(Seattle, USA)***

The possibility of life in the future and the development in favorable conditions depends on human actions and decisions here and now. The return of flora and fauna to disturbed areas is a positive natural "response" reforms being carried out in the framework of ecologically-oriented renovation. It indicates that we found the right way to interact with the natural landscape.

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# MODELING THE EFFECTS OF TOOL GEOMETRIES ON THE TEMPERATURE DISTRIBUTIONS AND MATERIAL FLOW OF FRICTION STIR ALUMINUM WELDS

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During friction stir welding, the tool geometries affect the weld together with the process parameters like welding speed, vertical pressure and tool rotational speed. The present investigation deals with the three dimensional computational fluid dynamics modeling of friction stir welding process considering material flow around the tool, welding speed with respect to tool geometries. Friction stir welding tools with different tool geometries were used for the experiments to achieve acceptable aluminum welds. The temperatures near the welds for each tool were experimentally observed. A 3-D computational fluid dynamics (CFD) model was developed. Temperature-dependent material properties of the aluminum alloy were used in the CFD model. Thermal analysis was carried out considering rotational speed, vertical pressure and traverse speed for the tool geometries. The numerically predicted stirring patterns and temperature profiles closely matched with the experimental ones.

The friction stir welding (FSW) is a solid state welding process where generally the metallic materials are joined by the combined action of frictional heating and weld zone stirring by a rotating tool [1]. The heat generated in the process is much below the requirement of melting the plates; hence the FSW process is devoid of harmful effects those are observed during arc welding. The FSW process utilizes a tool which has a shoulder and a protruding pin known as the probe. The shoulder is responsible for frictional heating while the pin probe facilitates stirring of the joint material.

The mechanism of FSW are fully coupled i.e. the heat generation is related to the material flow and frictional /contact conditions & vice-versa. Therefore a thermal model alone may not be adequate to predict the temperature distribution. Smith et.al had experimentally determined viscosity for the AA6061-T6 alloy as a function of shear stress and temperature and incorporated it in a 3-D coupled thermal model for predicting temperature profiles of FSW[2]. Reynolds et.al introduced a two dimensional solid mechanics FE model using ABAQUS software and two dimensional CFD model using FLUENT software for the modeling of FSW process[3]. The main objective was to reveal the material flow around the probe [3]. Shercliff and Colegrove considered that the heat generation with constant friction stress at the shoulder and work piece interface of FSW is equal to the yield stress of the work material[4]. Colegrove and Shercliff used CFD for FSW modeling and observed that the temperature profiles and weld quality were affected by the tool material[5]. Chen and Kovacevic investigated the thermal input and evolution of stresses in FSW of 6061-T6 aluminum alloy plates with varying welding speed[6]. In a FSW investigation the power consumption of the machine (torque at the tool) was used in the calculation of the dissipated heat by the Khandakar et.al [7]. Shong and Kovacevic observed that the temperature in the vicinity of FSW tool surface could be very close to the workpiece melting temperature[8]. Schmidt and Hattel used the coulomb friction with a constant coefficient to model the FSW heat source[9]. Colegrove and Shercliff presented a CFD model to numerically analyze the material flow and heat transfer of FSW process[10]. It was reported that the model generated excessive amount of heat for a threaded tool which led to large over prediction in the weld temperature [10]. Khandakar et.al used the experimentally determined FSW machine power as distributed heat source for the numerical modeling using quasi-frictional model[11]. They

reported that the heat generation in FSW was proportional to the velocity of the tool work piece interface. Nandan et.al mathematically modeled the 3-D viscous flow and temperature field of friction stir welded austenitic stainless steel[12]. They solved the equations of conservation of mass, momentum and energy in 3-D using spatially variable thermophysical properties [12]. The gap between purely thermal and coupled thermomechanical model was explained by Schmidt and Hattel by the thermo pseudo mechanical (TPM) model[13]. Liechty and Webb investigated material flow and frictional heating in FSW with respect to two mechanical boundary conditions (sticking constant velocity and slipping variable shear stress model)[14]. In constant velocity model the tool was set at a velocity equal to some fraction of tool rotational speed. The variable shear stress model permitted areas of significant slip. Atharifar et.al presented a CFD model for simulating the material flow and heat transfer in the FSW of 6061-T6 Aluminum Alloy[15]. They considered stick/slip condition with temperature dependent material properties and assumed that the viscous and frictional heating were the only sources of heat input [15]. In this present study a numerical analysis of material flow and heat transfer is performed for the FSW of the commercial grade series AA 1100 aluminum alloy. In the course of model verification good agreements are found between the experimental and numerical results with the effect of tool on the temperature profile. Further the model visualized the effect of tool geometry in the stirred zone and material flow around the complex tool geometry.

In the present study the butt joints welded were of 6 mm thick AA 1100 aluminum alloy. The tool material is of chromium steel as per [17]. Straight and taper cylindrical tool with 30 mm shoulder diameter and 5.5 mm pin height were used. The welds were performed in a 7.5 HP vertical milling machine equipped with tool steel backing plate. The length and width of the welded plate was 300 mm and 150 mm respectively. To record the peak temperature distribution during FSW, chromel-alumel (K-Type) thermocouples were fixed at 17 and 27 mm respectively from the centre of the joints on the top surface in the retreating and advancing sides.

Temperature profiles were recorded experimentally for each of the location of thermocouple. Numerically calculated maximum temperature from the temperature counter is also determined on the same location for both the tools (tapper and straight cylindrical). It is observed that the advancing side of the material flow experiences higher temperature as compared to that of retreading side. This is observed in Figure 3 (a) & (b). This behavior may be attributed because of the higher relative velocity between tool and material at the advancing side. It is interesting that the highest temperature does not occur at the outer shoulder diameter indicating more slip at the outer shoulder dia than the root of the pin shoulder. The computed temperature profile at different monitoring locations are compared with the experimental data (Figure 4 ) and indicate that the model can be very well used to examine the temperature profile. Further it is noticed that the tapered cylindrical tool generates more heat as compared to cylindrical tool as observed from the Figure 3 (a) & (b). The velocity vectors of material flow along the thickness (Z axis) of the joint for tapered cylindrical tool are shown in Figure 5(i). Figure 5(ii) indicates the material flow path lines at the work piece surface in which the material is fed from right to left and the tool rotates in anti clockwise direction. The model predicts that the material enters the advancing side of the shoulder region at a velocity equaling to traverse speed, slows and reverses the direction near the advancing edge of the pin. At the back of the shoulder material near the pin diameter is pushed downward and subsequently expelled from the weld region. Also material at the retreading side of the shoulder does not rotate with the tool but simply extruded past the tool. Material near the pin appears to rotate with the tool as indicated in Figure 5. The model further predicts that as the particles deform around the retreading side of the pin they also extrude upward to fill the concave shoulder. Further the material along the path lines

approach the pin at the advancing edge, contact the tool, rotate towards the retreating side of the tool pin and are expelled from the weld region in anticlockwise direction.

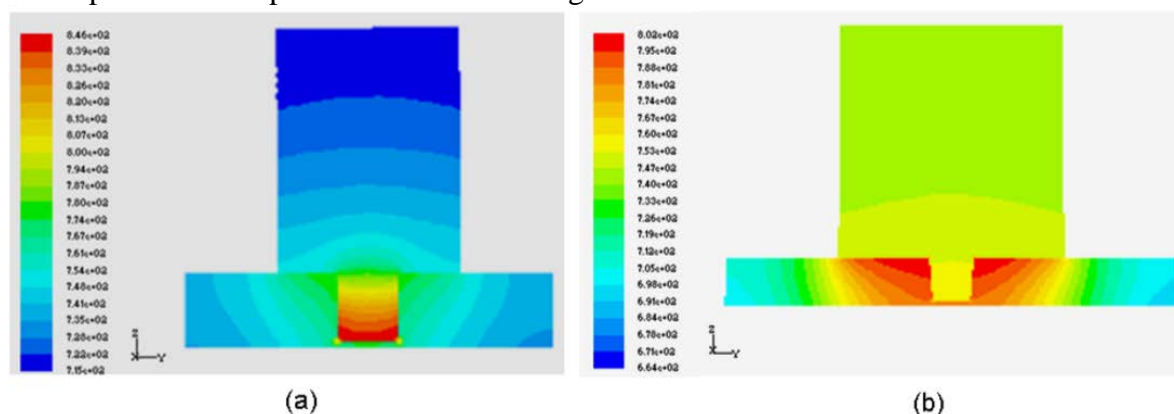


Figure 3. Temperature at FSW joints, (a) with a straight cylindrical tool; (b) tapered cylindrical tool

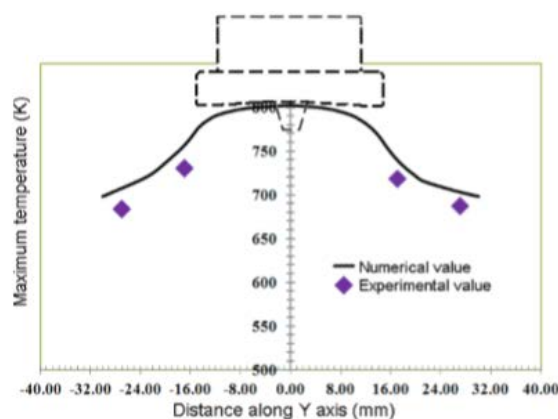


Figure 4. Comparison of experimental and numerical temperature values for tapered cylindrical tool

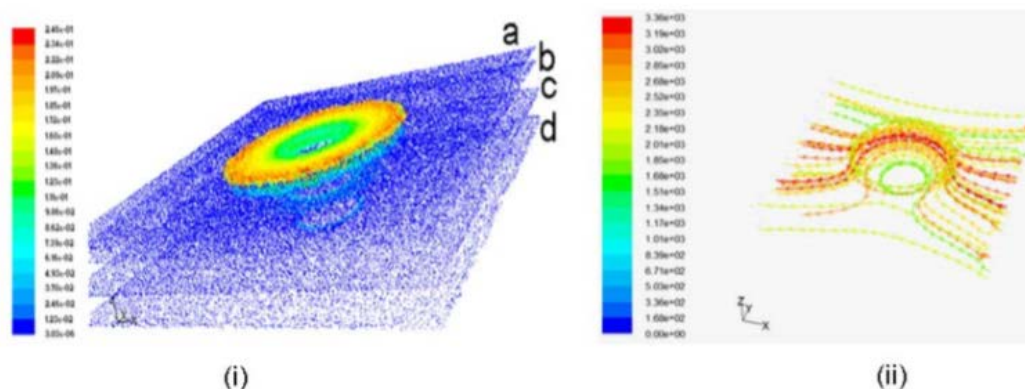


Figure 5. (i) Velocity vectors along the thickness (Z axis) of the joint for tapered cylindrical tool at (a)  $z= 3$  mm, (b)  $z= 2$  mm, (c)  $z=0$  mm, (d)  $z=-2.0$  mm; (ii) Predicted material flow line for straight cylindrical tool

A 3-D numerical model of material flow and thermal history in FSW has been investigated to determine the effect of tool geometry. The predicted material temperature from the straight cylindrical and tapered cylindrical tool well matched with the experimentally measured values. The maximum temperature in the computational zone for both types of tool is found to be less than the melting temperature of the material. The path lines indicated that most of the material flow occurred in the retreating side. The amount of material swept around the pin increased at locations closer to the shoulder. It was also observed that the



simple CFD model can be used to reliably predict the thermal conditions and material flow during FSW of a given tool geometry.

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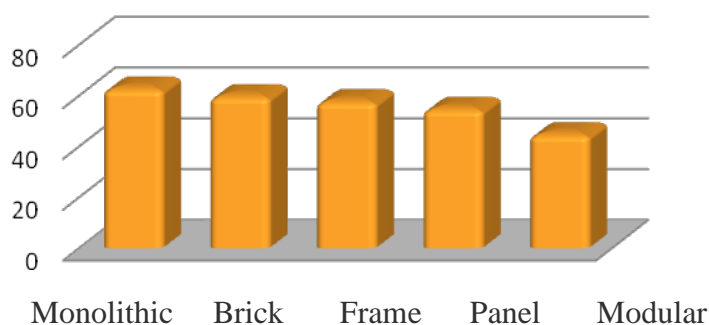
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## THE FAST-BUILT MODULAR CONSTRUCTION AND ITS ADVANTAGES IN THE MARKET OF REAL ESTATE

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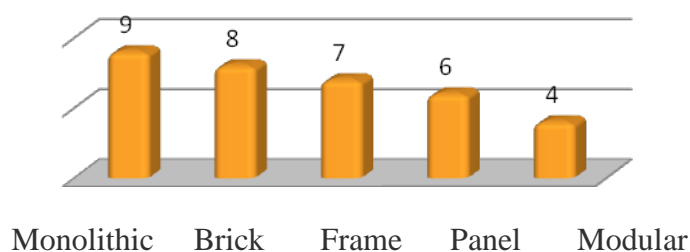
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Nowadays, there is an acute shortage of affordable housing. This shortcoming develops into a global problem in connection with big growth rate of the cities, with existence of a social inequality, with tough price policy in the market of real estate and with a condition of the available housing stock. There are inconvenient so-called "bedsit" which are a product of re-planning of more expensive multiroom apartments. These re-plannings are not always successful and often illegal. Popularity of rent housing increases, and lack of living space in property provokes a condition of depression among the population. It is known that in general 18,8% of the population have the average income below a living wage<sup>[1]</sup>. Housing prices in the city of Krasnoyarsk, depending on the area and the used materials make from 45 to 70 thousand for square meter (Chart 1) <sup>[2]</sup> and construction duration, depending on the used materials, from several months to several years (Chart 2).



**Chart 1 – The cost per square meter of living space in the primary market of Krasnoyarsk, rub**

The chart was made by authors.



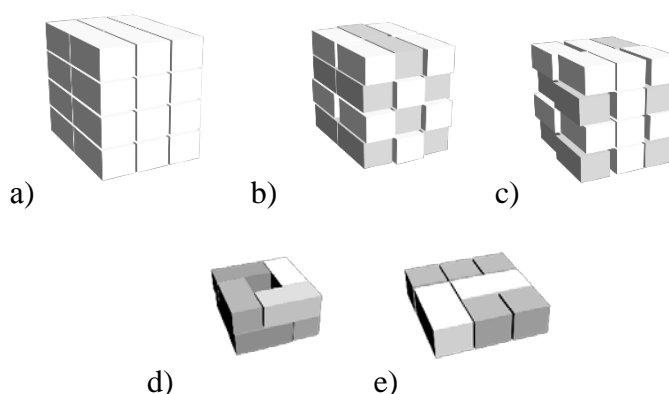
**Chart 2 – The dependence of the timing of construction from basic structural material, the month**

The chart was made by authors.



These facts force to remember the experience of the last century with modular construction, unfairly forgotten in Russia, and also to rethink a present situation in the market of real estate and think of a possible solution.

Volume and modular housing construction has been successfully applied for a long time in many countries of the world, for example, the USA, India, China and others. In Russia such construction only begins to revive. The advantage of volume and modular construction consists in construction speed: such house is built quicker than a panel, frame, brick and monolithic<sup>[3]</sup>. One also there are economic advantages: the cost of the modular house is less than its competitors. It is also possible to receive individual appearance, planning, thanks to the fact that modules can be grouped in the different ways (Fig. 1).



**Fig. 1 – Options of configuration of modules;**  
**a) without the shift of modules; b) shift of modules on a longitudinal axis; c) shift of modules on a cross axis; d) configuration of modules in two directions; e) configuration of modules of the different sizes**

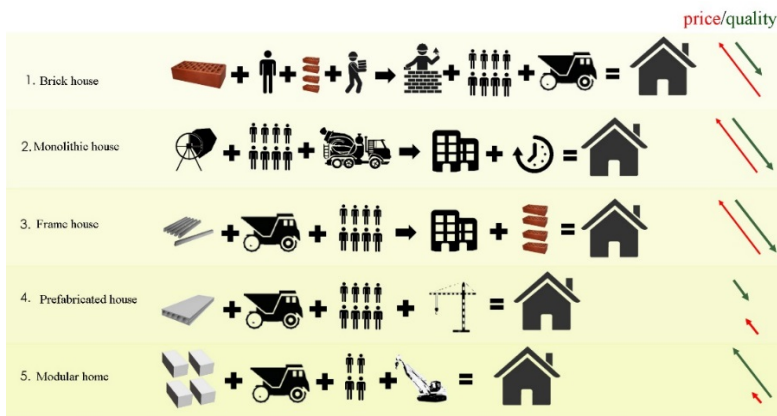
The options of configuration of modules were created by authors.

The cost of construction depends on the number of technological processes. The more of them we have the more expensive the construction becomes. In the modular house all technological processes are minimized, and the low cost and high quality is reached due to the production of inhabited modules in factory scales. In this case the construction won't be influenced in this case by neither weather conditions, nor a human factor<sup>[5]</sup>. For example, at the construction of the brick house there are about eight technological processes in view of the fact that a brick is a material piece and it is quite small. So labor costs on construction of such a house will be more than modular, where the number of technological processes is reduced to four (Fig. 2)<sup>[4]</sup>:

1. Development of soil, preparation of the platform, preparation of a ditch, base device;
2. Delivery of ready modules;
3. Assembly of modules on a building site;
4. Final finishing and preparation for operation.

Thanks to production of modules at a plant the volume of construction debris on building decreases; transportation costs, a rent of construction equipment and paid workers.

The construction of modular houses is possible on the periphery of Krasnoyarsk and in the cities with the population up to 50 thousand people, with the presence of free sites and in the neighbourhood with adverse territories: such as warehouses, railway tracks, noisy highways. Families, young couples, elderly people (living separately from the children) and physically disabled people was become potential buyers of apartments.



**Fig. 2 – Technological process**

The map of technological process was made by authors.

Having studied all features of modular housing construction, the conceptual project “Modular House of Average Number of Storeys” was developed where several buildings have taken place: eight one-room apartments of 40 – 42 sq.m; four two-room apartments of 56 – 58 sq.m; four three-room apartments of 74 – 76 sq.m. The project is calculated on a target category of citizens whose income will allow to acquire housing with an approximate cost of 40 thousand for square meter.

The house is built from volume blocks with shifts in one direction that gives the chance to receive loggias, balconies, recreational spaces, and also a dynamic facade of the building and attractive appearance (Fig. 3). Due to the simplicity and universality such an inhabited group can fit in any town-planning situation.



**Fig. 3 – Project of a modular house of average number of storeys**

The visualization of the project was made by authors.

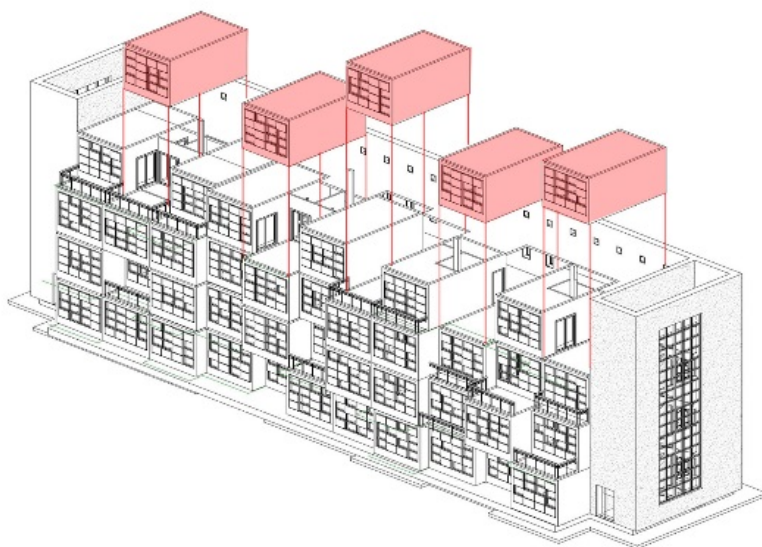
This project of a house of an average number of storeys is developed with use of the module of 3520\*6160\*2620 mm in size. Elements of a framework are located with the step of 880 mm. The module of the "lying glass" type has been used in the project. In this case loading will be transferred on vertically standing I-beams.

In modular construction 4 types of constructive system are usually used<sup>[6]</sup>:

- block;

- panel and block;
- frame and block;
- block and barreled.

In this project the frame and block constructive system has been applied. At the same time one of elements of a framework are vertically standing I-beams, being guides for modular cells. Installation of modules of such a four-storeyed house can be carried out by means of small-sized construction equipment, for example, the mobile crane. Installation of modules in this case is made floor by floor: at each other (Fig. 4).



**Fig. 4 – Installation of modules**

The scheme was made by authors.

At installation of each subsequent cell of the module is attached to the I-beams on bolted connection or on welding (The possibility of his replacement in the subsequent depends on a way of fixing of the module). At the expense of a frame basis of the module (a wooden or metal framework), collaboration of vertically standing directing I-beams and modules is ensured that provides rigidity and stability of the building.

Thus, such technology and the principle of construction can solve a problem with economic and qualitative housing, social and psychological problems in modern society and has all the chances to be realized in practice both in Krasnoyarsk Krai, and in any other regions of the Russian Federation.

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## RESTORATION AND ECOLOGICAL DESIGN: THE PROBLEM OF CHOICE ON THE EXAMPLE OF COMPLEX FORMER CITY HOSPITAL

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Nowadays many historical monuments and architecture demand the fastest restoration in Krasnoyarsk. Among them there is a specific place held by a complex of buildings of the former city hospital which is in the historical part of the city (on crossing of streets of Veynbaum and Mira Avenue) and stays inactive, gradually decaying, for a long time (fig. 1).

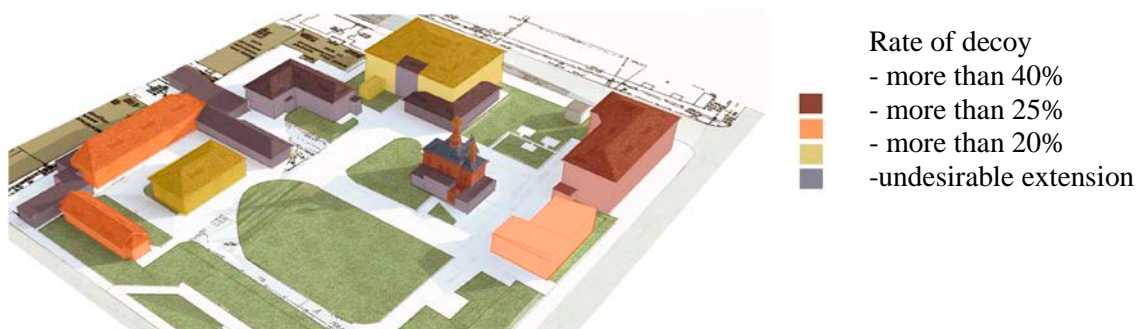


**Fig. 1 - Allocation of complex former city hospital on Mira Avenue.  
Photo of the author.**

The complex of hospital buildings was formed in the XIX – the beginning of the XX centuries. The stone buildings of the main and administrative buildings, the hospital church and several business structures built by architects and builders of last eras.

Nowadays technical conditions of these objects is estimated by experts as bad, including the design of walls, coverings, ceilings, floors, a decor of facades and interiors. For example, the completion is lost in the church temple, and some extraneous extensions have appeared. A transformer substation is constructed on site from Mira street, discording the standard forms with historically developed ensemble of buildings.

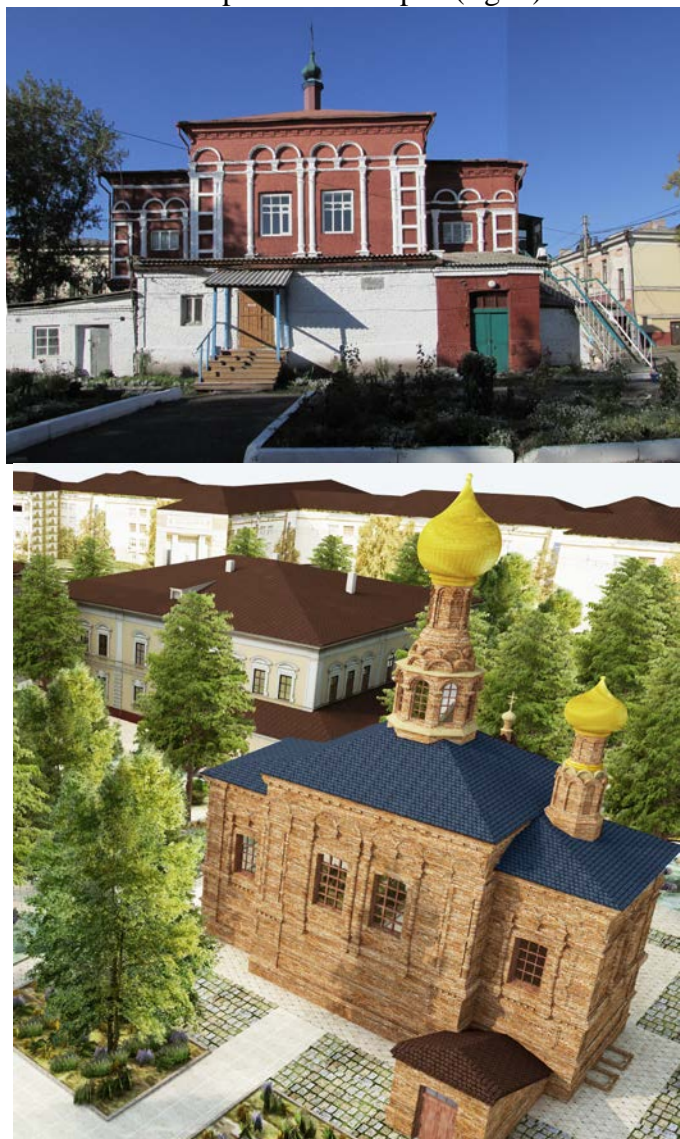
Re-planning of rooms was made in the main and administrative buildings, due to which elements of interior decors and ancient furnaces are lost. A part of windows on facades of are buildings are bricked up, and the extensions distorting historical appearance were executed. In buildings of the former laundry and business building several windows are also bricked up, separate architectural details are lost and re-planning is executed. Nowadays the question about of the need of carrying out the fastest restoration works on the majority of objects of complex has sharply ripened (fig. 2).



**Fig. 2 - Scheme of destruction degrees of objects of complex. Scheme of the author.**

The solution of the tasks is linked with the search of forms and methods of adaptation of architectural objects and historical heritage to modern requirements of society, with definition of the most demanded functions, and with the development of design offers on renovation of the former hospital complex on the basis of preservation and historical authenticity of objects is required from both researchers and designers. In the scientific and

design research, conducted by the author, historical documents which have unveiled features of process formation of Krasnoyarsk city hospital have been studied, domestic and foreign experience of renovation of similar objects is analyzed, and the design options of architectural and planning transformations of this complex is developed (fig. 3).

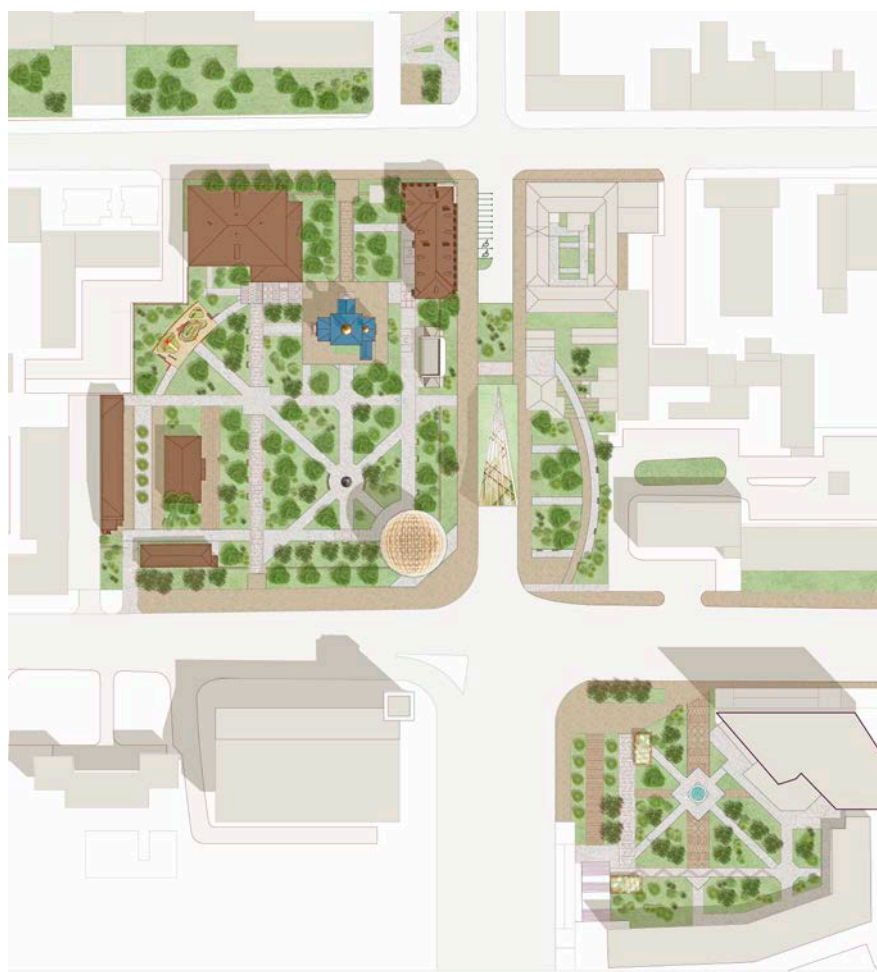


***Fig. 3 - Church today and after proposed restoration. Photo of the author.***

The public poll has shown that a significant amount of respondents inclines to a reconstruction of cultural historical value of the territory successively holding the history of the place. The Church of Prelate and Thaumaturgy Nicolay will become the central structure in ensemble of a new architectural complex which building demands the fastest restoration, and the space of careful improvement and gardening that will allow us to create one greener corner in the historical part of the city. Pharmaceutical and winter gardens, which concept of creation in this territory is submitted in the form of a vertical greenhouse for cultivation of medicine herbs, could become a prototype of formation recreational and improving functions. It is expedient to place the spherical shape, offered for it, on a southeast corner of a site free from buildings, where it will harmoniously add geometrical volumes ensemble of buildings of the Predmostnaya Square. At the same time the transparent glazing of a greenhouse won't disturb perception of historical buildings of complex to which it is offered to introduce such new functions as: trade (pharmaceutical, flower, antiquarian, book shops), cultural and



improving (public and sports clubs), and also it is probably necessary to organize the enterprises of food (for example, a restaurant with the Siberian cuisine) (fig. 4).



***Fig. 4 - Krasnoyarsk. Variant of planning transformations the territory of the former city hospital. Executed by N.A. Mordovan. 2015.***

Throughout the long period of time the studied territory carried out medical functions, and Krasnoyarsk citizens put forces and means in its arrangement in hope that the structures built by their hands will bring physical and spiritual health to its residents. In the concept of renovation of complex of former hospital it is necessary not to forget about these historical sources, having embodied them in the main principles of architectural and town-planning transformations. It is important to think in due time about the role of historical objects in the modern city in order that they were demanded and useful to society, and their using wouldn't fade out.

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**COMPUTER-AIDED TRANSLATION TOOLS****Dennis Morosoff****Language supervisor: Anna B. Alekseeva - Senior Lecturer of the Department of  
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The lack of translation specialists poses a problem for the growing translation markets around the world. One of the solutions proposed for the lack of human resources is automated translation tools. In the last few decades, organizations have had the opportunity to increase their use of technological resources. The approach taken by this article is to set aside both 100% human translation and 100% machine translation (without human intervention), to examine a third, more realistic solution: interactive translation where humans and machines co-operate.

The early beginnings of what is today called Computer-Aided Translation date back to 1980s [1] when systems of this class were developed in Japan. Japanese computer companies (Fujitsu, Hitachi, NEC, Sharp, Toshiba) worked on software facilitating the process of translation primarily in the directions: Japanese-English and English-Japanese (though other languages were also taken into consideration).

The systems relied on automatic translations which were corrected by human translators in the process of post-editing. These systems tended to focus on a specific domain of texts. The benefits of this focus included lower costs of lexical resources preparation (due to smaller volume of dictionaries), faster translation (for the same reason) and higher precision of translations [2].

By the end of 1980s, the translators had realized how much they could benefit from using a computer as a translation tool. Not only did the CAT systems provide tools for the translation process, but also facilitated word processing and management of the work. The class of such systems is now called "Translation workstations". The list below includes only some of the existent and available software:

- SDL Trados(50% of market share)
- Wordfast(17%)
- AtrilDéjà Vu(16%)
- OmegaT (3%)
- MateCat
- Poedit
- Virtaal
- Lingotek
- CafeTran
- Anymem
- memoQ

Nowadays CAT tools are widely popular among freelance translators and translation agencies.

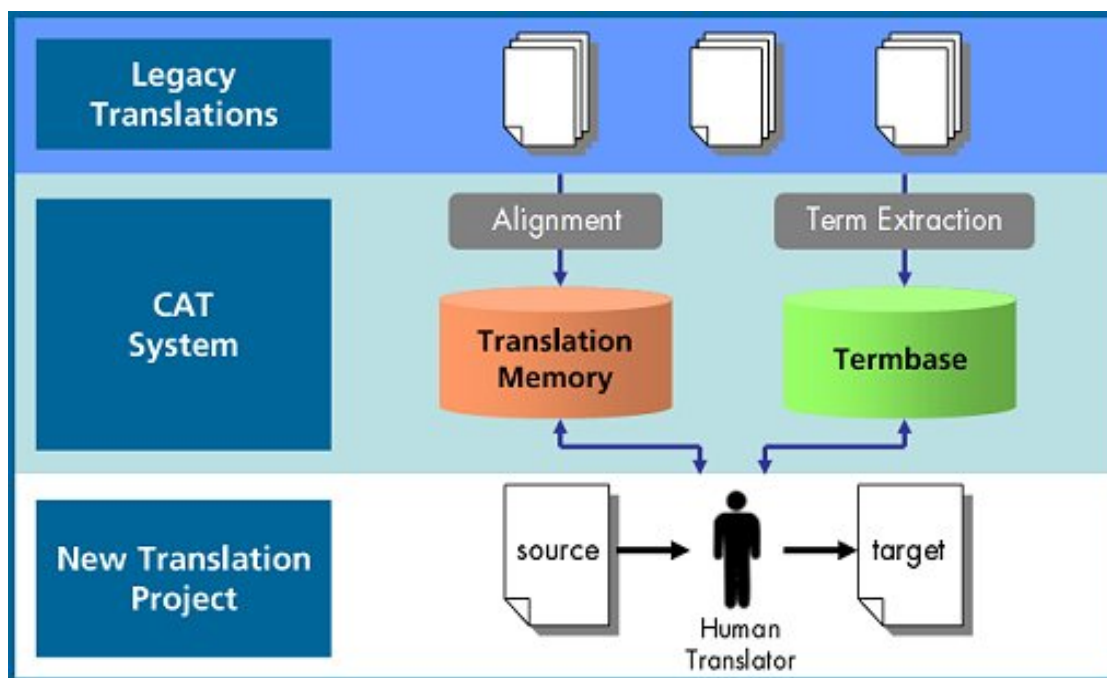
The field of Computer-Aided Translation incorporates a variety of concepts and techniques. It is difficult to find standards of the design and functionalities of CAT systems.

This section lists key concepts and definitions that clarify what should and what should not be called CAT. The definitions are inspired by those found in [3].

**Computer-Aided Translation** (also called Computer-Assisted Translation) is a term used to describe computer techniques used to make easy the process of translation.

**Machine Assisted Human Translation (MAHT)** in CAT is the work of a human translator on the translation process. The human translator is the performer of translations

while the computer plays a supportive role. This relation is a crucial characteristic of MAHT. There exists an approach where these roles are reversed - Human Assisted Machine Translation (HAMT) in which the human helps the computer in carrying out the translations. This, however, is closely related to machine translation, and is not a part of CAT.



*Fig.1 - Machine Assisted Human Translation Scheme*

**Machine Translation (MT)** is an action of fully automatic text translation. The translation is carried out entirely by the computer with no help of human translators whatsoever. Even though MT is not a proper part of CAT, MT systems are sometimes used in CAT systems to provide rough suggestions of translation. Human translator is then responsible for carrying out the postediting. Such a hybrid technique can be regarded as a CAT technique.

**Translation Workbench** also known as MAHTWorkbench or Integrated Translation System is a piece of computer software offering a variety of CAT techniques along with utilities facilitating the work with text in general.

**Translation Memory (TM)** is a database of previously carried out translations. It is assumed that TM contains only high-quality translations which can be reused in future. The reuse of translations by means of Translation Memory is the most widely recognized and appreciated feature of CAT. It reflects the natural work process of a translator before the era of computerization, when instead of using databases, translators took notes of phrases and sentences to use them later in their work.

**Terminology consultation** is a mechanism of automated dictionary lookups during text translation. It is a widely popular CAT mechanism applied in a majority of CAT systems. During translation of a sentence, a translator is provided with dictionary matches of words or phrases that appeared in the sentence. Typically, multiple dictionaries are searched for terminology matches. These dictionaries are divided into two categories: built-in dictionaries and user-created glossaries. The dictionaries and glossaries are most useful when the translation memory fails to provide a good suggestion.

**Text aligning** is a process of creating translation memories out of previously translated documents. Professional translators who do not use a CAT system often store their

translations in the form of pairs of documents (either in electronic form or on paper). In order to use these translations as a translation memory, the documents need to be aligned. The first stage of the text alignment procedure is importing two monolingual documents into the computer and splitting them into sentences. This process can be automated as automatic sentence splitting procedures usually prove effective. The next step is sentence alignment, i.e. determining, which sentences are each other's translation.

**Hashing** (in computer science) is a procedure carried out on a larger set of data in order to produce its shorter version. This short, simple dataset is called a hash. Hash is typically used to identify the original data.

**Lemmatization** (in natural language processing) is a process of substituting a word with its base dictionary form, called lemma. Lemmatization must be done with the use of a dictionary.

**Stemming** (in natural language processing) is a process of substituting a word with its shorter version, called stem. Stem does not necessarily have to be a dictionary word. Stemming is often done without the use of a dictionary, by simply removing word's flexion suffixes.

In recent years, CAT tools have revolutionized the market of translations (see for instance [4]). As they allow for reducing the cost of translation, translation agencies using CAT can offer their services at lower prices. Moreover, consistency of translations granted by CAT became not only a desired but demanded quality.

As a result, CAT allows the agencies to offer better translations for lower prices and be far more competitive than companies preferring the traditional work model.

The popularity of CAT tools and the fact that agencies using them are more competitive on the market suggests that CAT indeed facilitates the process of translation.

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## THE PRODUCTION OF LIGATURES FOR ALLUMINIUM ALLOYS

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In modern conditions the rise of the development of the technical level of production, product quality and reduction of the harmful effects on the environment is a vital task for all industries including metallurgy [3]. This problem is directly related to the problem of obtaining of high quality ingots and castings as they define the operational characteristics of semi manufactured products. The obtaining of high-quality ingots and castings depends on the quality of initial charge materials and especially their ligatures. Different tasks are carried to solve this problem out towards the development of rational technology of making and using ligatures. Ligature in the metallurgy is an alloy of two or more components comprising a sufficiently large number of alloying metal added to the melt to obtain the desired chemical composition, structural and technological properties of castings and ingots. Application of ligatures is necessary because of the low dissolution rate of the refractory components in pure form in liquid aluminum as well as because of higher degree of assimilation of easily ligature oxidized elements [4]. Ligatures are obtained by two main ways [1]:

- fusion of the pure components;
- reduction of the alloying metal from its compounds.

Ligatures are produced in accordance with GOST R 53777-2010 "Master alloys of aluminum. Technical conditions. "The standard should specify the following requirements:

- the brand, the chemical composition and color coding;
- kind of ligatures and its weight (wafers, rods, flakes, pieces);
- control of the chemical composition from foundry casting work;
- the quality of the surface and lack of strict monochromaticity of non-metallic plugging;
- guarantee the period of the ligature storage.

Ligatures groups (diversion):

1. Ligatures for grinding grain of aluminum (example: Al-Ti-B, Al-Ti-C);
2. Ligatures for modification of aluminum alloys (example: Al-Sr);
3. Ligatures for changing of the chemical composition of the aluminum alloys (examples: Al-Si, Al-Mn, Al-Fe, Al-Cr, Al-Cu, Al-V);
4. Ligatures to improve certain physical or mechanical properties (example: Al-B, Al-Be, Al-Zr).

The following requirements should be considered to ligatures [5]:

1. Sufficiently low melting point of ligatures which will ensure the minimum temperature of the master alloy;
2. The high rate of dissolution of the alloying metal and its homogeneous distribution over the volume of the melt;
3. A uniform distribution of metal ligatures the cross section of the ligature which is determined by the solidification rate and distribution of the alloying metal into the melt before casting ligatures;
4. The possibility of denting the ligature into separate pieces as "wafer" for more accurate weighing;



5. Resistance against corrosive effect of atmospheric gases and vapors;
6. The minimum number of non-metallic, oxide and gas inclusions in the surface and break of the ligature.

Alloys with fine grain structure have significant advantages over the coarse: the smaller the grains are the better their mechanical properties (tensile strength, elongation, impact strength). An effective way of grinding structure and improvement of mechanical properties of the aluminum alloys is a modification [2].

Additional requirements should be presented to the modified ligatures:

1. The smallest size of the intermetallic compounds. The smaller size of the intermetallic compounds is the greater number of its contained in the unit volume of the ligatures. The greater the potential centers of crystallization and the less flow of modifier is;
2. Low hydrogen content of the ligature;
3. The low content of metal impurities such as iron, silicon, et;
4. Lack of coarse oxide inclusions which accumulate intermetallic compounds with boron forms boride-oxide rings which reduces the effect of the modification acutely.

Modifying ligature can be divided into two types. The first type is ligature comprising primary intermetallics-allyuminidy (examples are: Al-Ti, Al-Sc, Al-Zr, Al-B) and the second - the master alloy with intermetallic compounds of two types: intermetallics without Al atoms and without aluminum atoms and aluminides ( Al- Ti- B, Al- Sc- B, Al- Zr- B, Al- Ti- C).

Nowadays there are several theories to explain this or that aspects of the process of modification:

1. Nucleation theory developed by British researcher A. Kibuli;
2. Theory of carbides modification;
3. Theory of peritectical reaction proposed by Japanese researchers K. Ivasi, N. Nasi, J. Asoto;
4. Theory modification by G.V. Samsonov and L.K. Lamihova.

None of the theories does not describe modification process completely. Firstly, this is due to the difficulty of modifying process and its dependence on the melting and casting conditions. Secondly, the influence of uncontrolled impurities and interaction of some components in aluminum alloys which can either amplify or attenuate the grain refinement.

Modification of sodium was applied for grinding the aluminum-silicon eutectic for a long time. However, the use of sodium modifier is complicated by a number of difficulties (high risk of unmodified or remodified structures. The presence of sodium in melt deteriorates its fluidity, increases the alloy tendency to the formation of gas porosity. The use of fluxes is based on chlorides and sodium fluoride and it causes the increase wear of melting equipment and is environmentally dirty due to the decomposition of sodium salts to form gaseous chlorine and fluorine. But the main thing is that the curing time of the melt after adding the modifier is low (typically it is about 30 minutes) due to the evaporation (sodium boiling point is 880 ° C) and oxidation (it has a great similarity to oxygen) of sodium).

Connection with the research is aimed at replacing sodium modifier as other elements. The most suitable is strontium which is from the studied elements. The interest in strontium is due to the fact that a relatively high boiling point is 1366 ° C. A consequence of the low volatility of strontium gives great advantages in the use of it as a modifier (ligature effectively changes the plate-shaped aluminum-silicon eutectic on grain, which significantly improves the mechanical properties of casting). Modifying effect occurs by adding strontium on the second minute after adding the ligature in the form of a rod into the melt and it lasts for 6-7 hours. When modifying strontium improves fluidity, it reduces the tendency to form cavities, increase strength and plastic properties of the alloys.

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## **THE COMPARATIVE ANALYSIS OF ENERGY EFFICIENT METHODS IN BUILDING CONSTRUCTION**

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The present paper considers the problem of energy efficiency in the construction and analyses various power-saving methods in the buildings. The choice of the theme is based on the fact that modern society consumes more and more energy and many residential buildings don't apply energy saving measures and modern equipment. Another important reason is the scarcity of non-renewable energy resources (oil, coal and gas). It affects the cost of their production and as a result the tariffs for end - users. Moreover, the environmental component in relation to energy saving is also extremely important. Therefore, the improving of energy efficiency is imperative for many reasons and it is a very serious component in the concept of sustainable development. The significance of energy efficiency in the buildings is well reflected in the quote by a famous architect Sir Norman Foster: "Environmental problems affect architecture at every level. Half of the energy consumption in developed countries accounts for the building, and another quarter - transportation. Architects can't solve all the world's environmental problems, but we can design buildings that require only a part of the energy consumed today. The location and functionality of the facilities, its structural flexibility and technological resources, orientation, shape and structure, its heating and ventilation system, the characteristics of the materials used in the construction - all these parameters affect the amount of energy required for the construction, operation and maintenance of buildings"[7].

The relevance of this work lies in the fact that nowadays, there are a great variety of power efficient measures, but not all of them we can apply in our climatic conditions. Additionally, these methods have different effects on energy efficiency. Therefore, the objective of our research was to choose the appropriate measures and to evaluate their impact on the economy of heating and ventilation costs.

To study and assess the ways of energy efficient buildings design, the Siberian Federal University hostel №27 was selected as the research object; as it is one of the most power efficient buildings in our city.

The studied parameters are:

- the building optimal geometry;
- energy efficient windows;
- glass area reduction;
- windows orientation with respect to the cardinal directions;
- rollingshutters;
- supply and exhaust ventilation with recovery;
- insulation thickness growth.

In compliance with each parameter change we made the Building Energy Rating Certificate and local cost estimate. We also calculated the growth in the value of 1 m<sup>2</sup> of apartment, as well as pay-back period for application of these parameters.

The comparative analysis of methods for the energy efficiency growth of considered object is shown in Table



1. Table 1 – The comparative analysis of methods for the energy efficiency growth of considered object

Method	Implementation costs, thousand roubles	The increase in the value of 1 m <sup>2</sup> apartments, thousand roubles	Savings, during the heating season			Pay-back period, years	Service life, years	The cost savings for heating and ventilation in service life, thousand roubles
			heat, MW·h / year	thousand roubles	CO <sub>2</sub> , t			
the building optimal geometry	-11147 - 0	-1,487 - 0	79	67	43	0	100 (lifetime)	6691 - 17838
glass area reduction	-7426 - 0	-0,991 - 0	20	17	11	0	100 (lifetime)	1658 - 9084
windows orientation with respect to the cardinal directions	0	0	16	14	9	0	100 (lifetime)	1393
energy efficient windows	139	0,019	69	59	38	2,4	30	1618
rolling shutters	12418	1,657	87	74	47	168,9	20	-10951
supply and exhaust ventilation with recovery	2970	0,396	684	581	372	5,2	20	8605
insulation thickness growth	1220	0,163	47	40	25	30,8	30	-32

Figures 1-3 show «Heat economy comparison during the heating period using different methods», «Comparison of implementation costs while using different methods», «Comparison of cost savings for heating and ventilation in service life by using different methods».

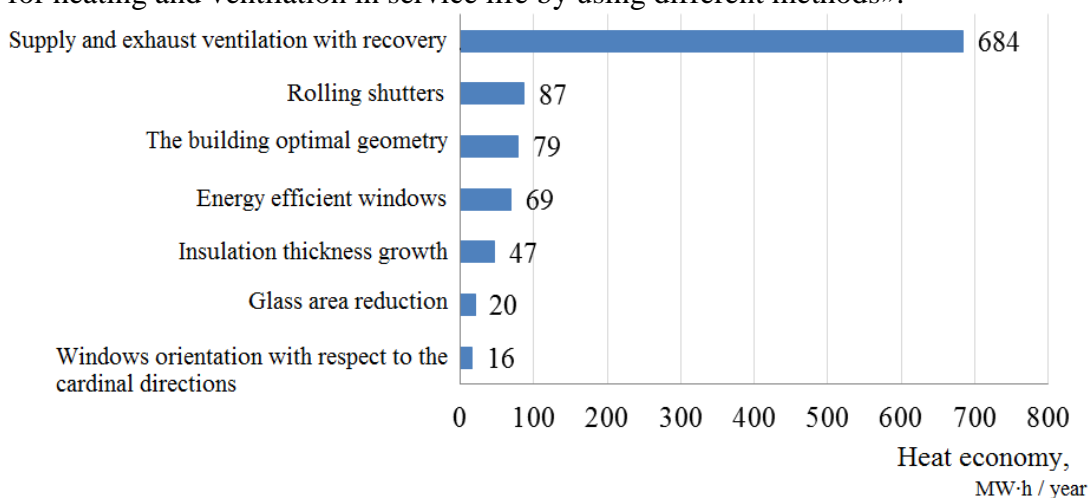
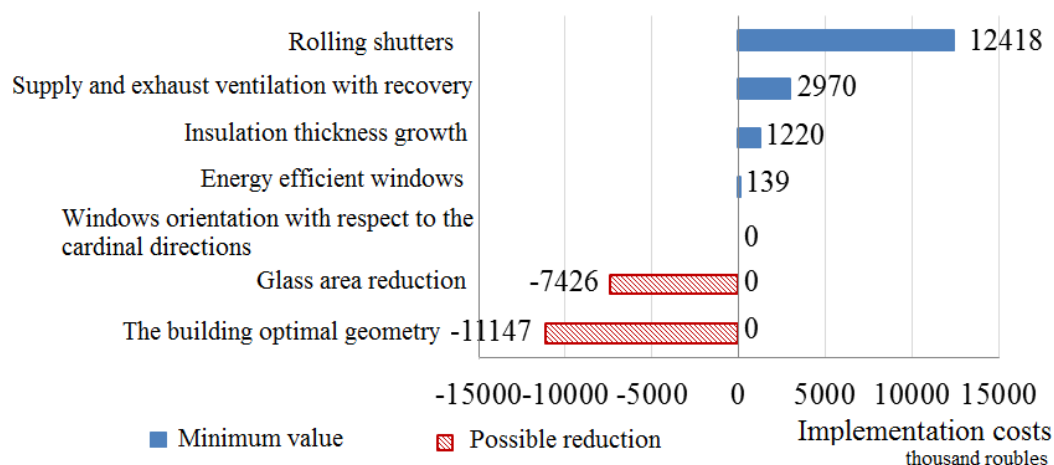
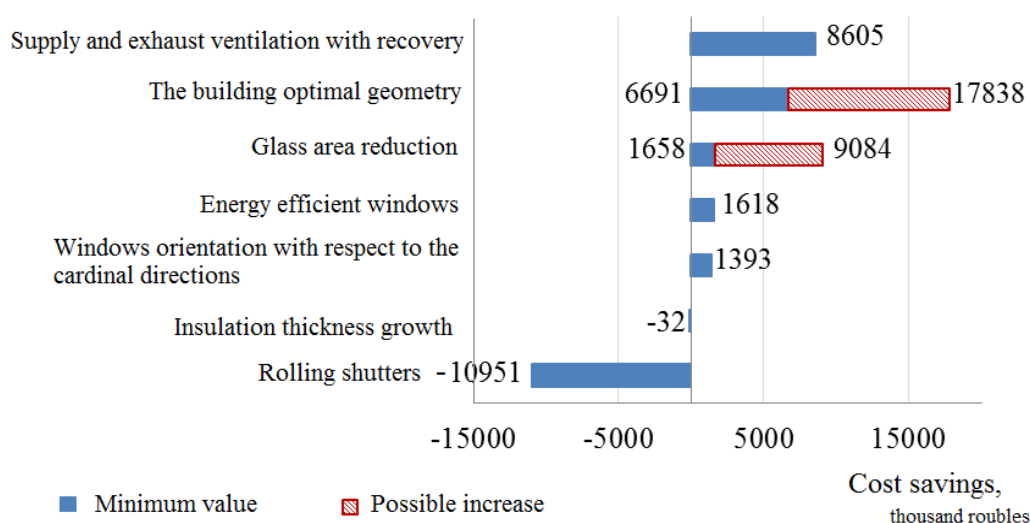


Fig. 1 - Heat economy comparison during the heating period using different methods



**Fig. 2 - Comparison of implementation costs while using different methods**



**Fig. 3 - Comparison of cost savings for heating and ventilation in service life by using different methods**

Analyzing the problem of energy efficiency and various power-saving features in the buildings, we came to the conclusion:

The most effective methods are the installation of a supply and exhaust ventilation with heat recovery and application of the correct building geometry.

Less effective principles are glass area reduction and correct windows orientation with respect to the cardinal directions.

It will be effective to increase the thickness of the insulation, if high-quality materials which serve more than 30 years are used.

Installation of rolling shutters is effective but not feasible at current prices on their device.

On application of these methods (except for rolling shutters) cost of 1 m<sup>2</sup> of the apartment will increase by no more than 578 rubles, depending on cost savings from implementation of these methods.

It should be noted that these conclusions are made for the specific building and under



certain climatic, market and other conditions and will not necessarily be fair in another cases. The issue should be considered while designing at the current environment.

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## **DEVELOPMENT OF ENERGY MANAGEMENT SYSTEM**

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Problems of energy efficiency and resource conservation to save our world are the most relevant in the age of information technology and innovation. Modern Russia is a big industrial country with huge plants located throughout the country, from North to South, and from East to West. Such industries as fuel production, thermal and electric power generation have been well-developed in Russia. It is well known that power generation contributes greatly to environmental pollution. Therefore the question of environmental protection, environmental safety, natural resources scarcity, and environmental management becomes very urgent. At present the problems of energy conservation and energy efficiency are actively solved at the state and regional levels, as these areas contribute to the modernization of the Russian economy and transfer it to an innovative way. Organizations of all types are trying to achieve and to demonstrate high environmental effectiveness. They do this in the context of tough environmental legislation, developing an environmental policy and other measures to protect the environment. At that attention of all stakeholders is increased in addressing environmental problems and maintenance of sustainable development. Besides, the solution of these problems may help to safe Earth's environment; reduce harmful emissions to the atmosphere and prevent global environmental catastrophe.

This article focuses on the development of energy and environmental management systems in the field of thermal and electrical power engineering as one of the most effective ways to solve the problems of energy efficiency and resource conservation in the country. The purpose of this article is to identify the main advantages of the implementation of the energy and environmental management systems for thermal and electrical power plants and other companies of power engineering. In the article it had been analyzed such figures as: the activities of foreign and Russian companies on implementation of energy and environmental management systems and the general statistics on the implementation of standards GOST ISO 50001:2011 «Energy Management System. Requirements and guidance for use» [1] and GOST ISO 14001:2011 «Environmental Management System. Requirements and guidance for use» [2].

The international standard ISO 50001 supports organizations in all sectors in their efforts to use energy more efficiently through the development of the energy management system. According to the developers, the introduction of the energy management system will contribute to the integration of energy efficiency in the overall concept of the organization's management and increase the transparency of the management in companies. Also, the Russian government pays great attention to energy conservation. For example the Federal Law № 261-FZ [3] "About energy saving" was adopted in November 23, 2009.

Energy Management System (SEnM) is a set of interrelated and interacting elements that are based on energy policy, objectives, processes and procedures, and to meet the goals [1]. The main activity in the field of energy management is to optimize energy costs through continuous improvement of the efficiency of production technology and processes related to the development, support and management processes [4].

The international standard ISO 14001 establishes the requirements for environmental management system which let organization to develop and implement environmental policy and objectives taking into account legislative requirements and information about significant

energy aspects [3]. This standard contributes to the environmental protection and preventing its pollution.

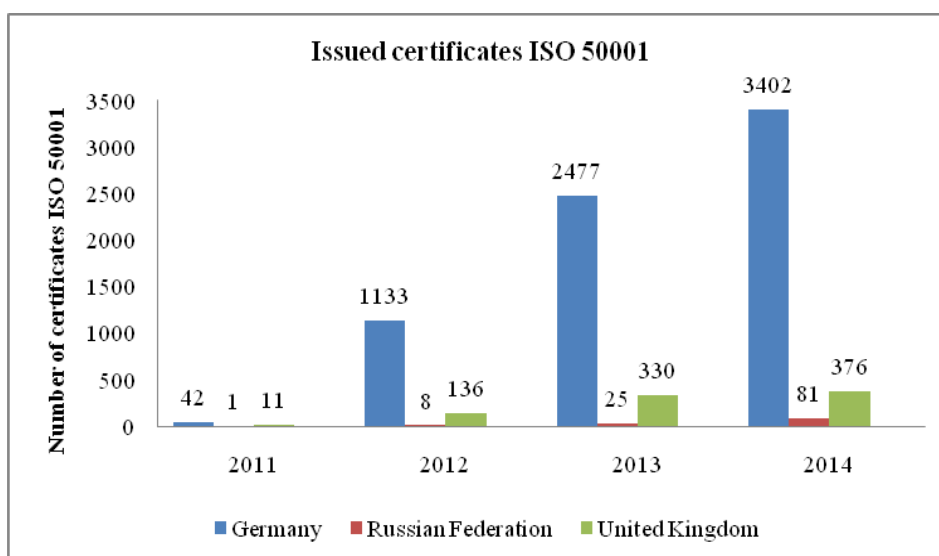
Like other ISO management system standards, certification to ISO 50001 and ISO 14001 is possible but not obligatory. It is important that both standards can create an integrated management system because they have similar structure, requirements and principles. ISO 14001 particularly supplement standard ISO 50001. Some organizations decide to implement the standards solely for the benefits it provides. Others decide to get certified to it, to show external parties they have implemented energy or environmental management systems.

It should be noted that ISO 50001 developed in 2011 is gaining popularity both in Russia and around the world. The number of companies adopting this standard, increased abruptly as can be seen from the review of the issued certificates ISO. This annual study shows the number of issued standards for energy management systems. Summary statistics is shown in Table 1 [3].

Table 1 - Statistics of issued certificates ISO 50001 around the world

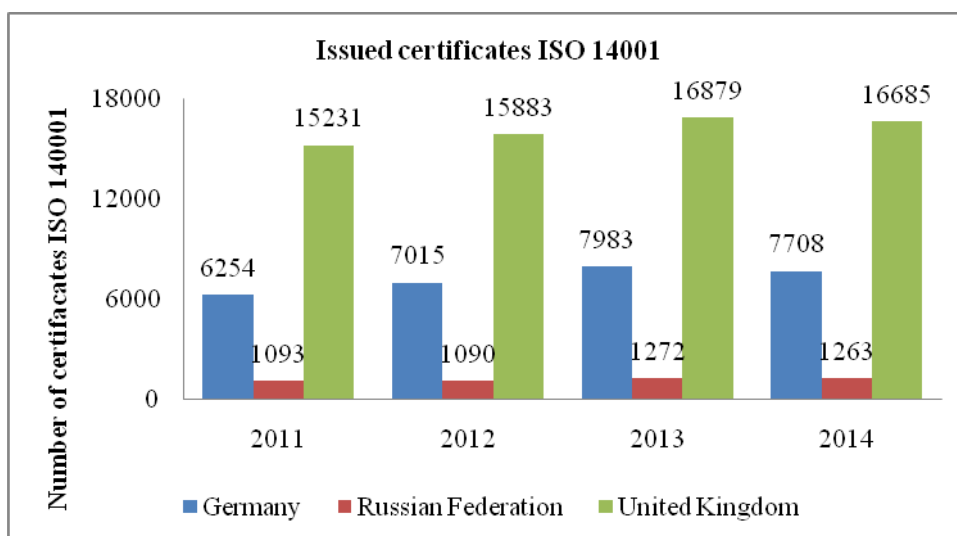
Year	2011	2012	2013	2014
<b>TOTAL</b>	<b>459</b>	<b>2236</b>	<b>4826</b>	<b>6778</b>
Africa	0	13	36	18
North America	1	9	34	85
Europe	364	1 919	3 993	5 526
East Asia	49	191	478	698
Central Asia	26	76	189	299

Germany is a leader in implementation of energy management system according ISO 50001. 3402 certificates were issued in German companies in 2014. It is more than 40 times greater than in Russia in the same year. Numbers of issued certificates ISO 50001 in Germany, Russian Federation and United Kingdom are shown and compared in diagram at picture 1.



Picture 1 – Numbers of issued certificates ISO 50001

Number of issued certificates ISO 14001 is much more than ISO 50001. It can be explained that international standard ISO 14001 was developed earlier in 2007. That's why this standard is more popular and well-known. Statistic of issued certificates is shown in diagram 2 at picture 2.



**Picture 2 – Numbers of issued certificates ISO 14001**

Thus, a relatively new standard ISO 50001, developed in 2011, is gaining popularity and becoming increasingly important as standard ISO 14001 developed in 2007. Russia has a growing number of companies to implement this standard. At the moment nearly 130-140 companies are implementing this standard in Russia. Basically it is the market leader and companies in the field of electric or thermal engineering.

Successful example of introducing SEnM is a Chinese company Delta Electronics, which manufactures advanced energy-saving equipment. Implementation of ISO 50001 on energy management system in the region Dongguan allowed to reduce the energy consumption by 10.51 million kWh at constant production capacity in the period from January to May 2011 compared with the same period in 2010 [5]. This is equivalent to saving of 13 million dollars.

Russia's experience in the implementation of ISO 50001 is not large, but now many companies in the field of electrical and thermal engineering have an active policy aimed at the creation of an energy management system in accordance with ISO 50001.

One of the most prominent representatives of having a successful experience of implementing the standard, is TNK-BP Holding (Tyumen oil company – British Petroleum) – one of the largest oil companies in Russia. In 2011, as a result of introduction of the system energy consumption per ton of oil decreased by 8.8%, while the volume of oil refining increased by 2% compared with 2010. Effect on the functioning of SEnM amounted to 161 million dollars. Energy savings amounted to 1.222 billion kWh. [5].

Thus, for example, foreign and Russian companies can benefit from creating an energy management system, compliance with the requirements of ISO 50001:

- development of corporate documents regulating energy management;
- involvement of all categories of staff in energy efficiency
- resource saving;
- reducing energy costs;
- improving financial performance;
- identification and elimination of non-productive costs;

- the guarantee of investment in energy-saving projects;
- raising of efficiency;
- increase in profits.

These factors and effects can lead to improvement of controllability of companies, ensure of investment attractiveness and maintaining the reputation of company. That's why implementation of energy and environmental management system ensures a stable competitiveness of the organization at national and foreign markets.

Thus, to solve the problem of energy efficiency, resource conservation and environmental pollution at power companies it is necessary to create a meaningful system of energy management at every enterprise according to the requirements of ISO 50001 and integrate it with environmental management system according ISO 14001. Therefore, now experts focus on the experience of foreign companies that have illustrated a strong example of implementation of ISO 50001 and ISO 14001.

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# SIMULATION OF TEMPERATURE CONDITIONS AND POWER PARAMETERS OF THE PROCESS OF THE COMBINED ROLLING- PRESSING OF AL-ZR SYSTEM ALLOYS ON CRP-400 EQUIPMENT

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It is difficult for domestic manufacturers of aluminum semi-finished products of small cross-section and cable products to compete with foreign producers as they use traditional methods of processing metals for production in spite of the high demand. To solve this problem, in recent years, combined methods of metal forming are studied, one of which is the method of combined rolling-pressing (CRP). Designing of technological modes CRP is rather laborious due to the large amount of computing. But physical simulation of CRP is a resource-intensive, labor-intensive and cost consuming process. The solution to these problems in the design of technological modes of forming new alloys by means of CPR method is the use of computer modeling packages through the application of the finite element method. This method is implemented in the software package Deform 3D which is designed for metal forming processes of research and is widely used by modern companies. So the design and modeling of technological modes of processing, various aluminum alloys using the Deform 3D is important.

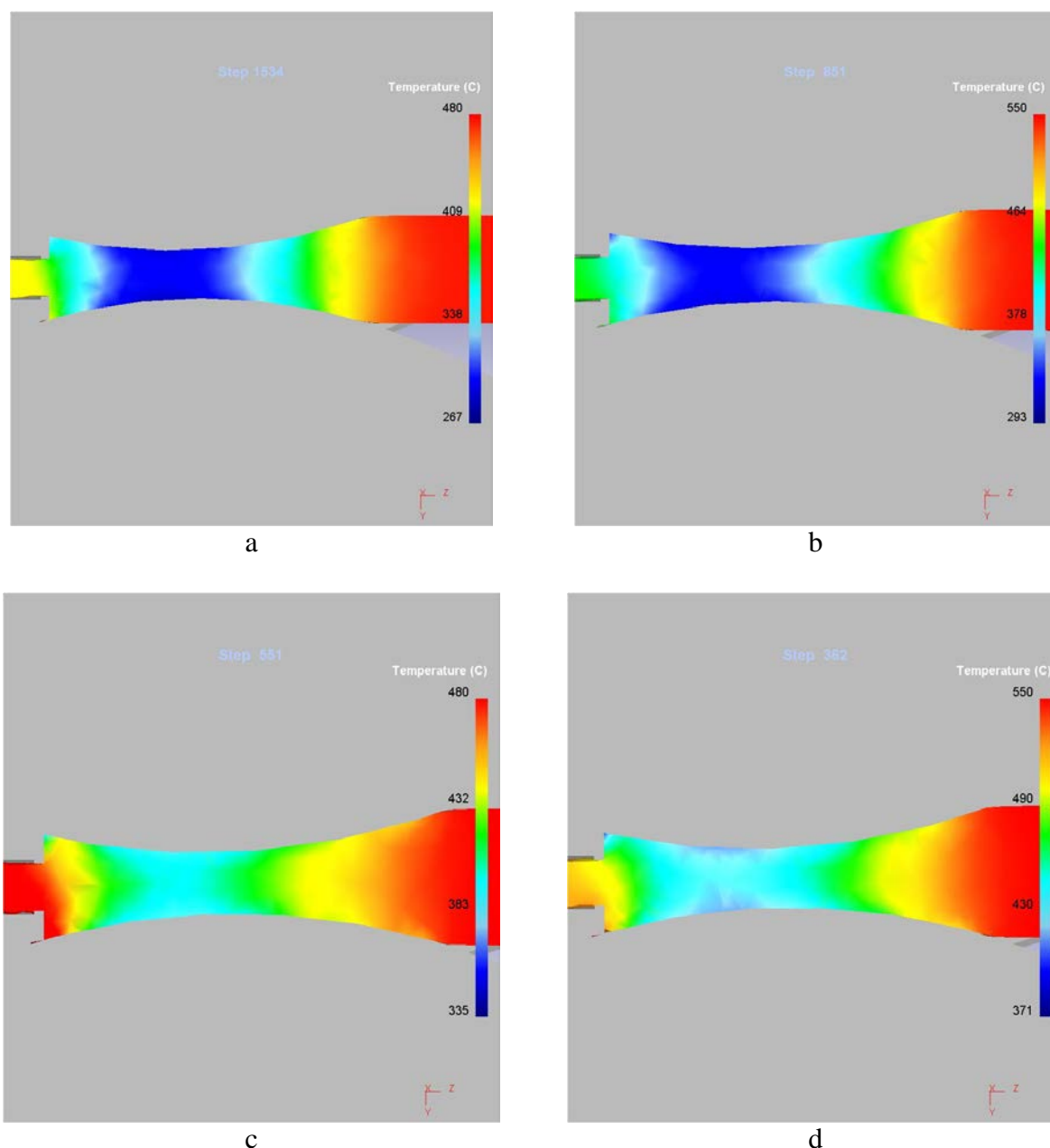
In the course of investigations patterns of change in temperature and speed and power parameters of the combined process of rolling-pressing of aluminum alloys CRP-400 installation with the caliber 20x20 mm were established. Application of wolves with the caliber 40x40 mm to equipment the CRP-400 leads to a significant increase of productivity. However, the implementation of the process significantly increases the load on the main components of equipment, requires more intense cooling of the tool at the steady stage of the process. Therefore, the problem of temperature conditions modeling Al-Zr system alloy processing to the CPR-400 using the equipment section rolls stream 40x40 mm caliber becomes topical. Simulation of the combined rolling-pressing process of experimental alloy of the system Al-Zr [3] on CRP-400 equipment with a vertical frame which was proposed in the paper [2] was conducted in a computing center of MF department MF, Institute of Non-Ferrous Metals and Material Science, SFU. The proposed alloy is replacing traditional electrical aluminum alloys, such as A5E, A7E and ABE and has improved physicomechanical properties. In this case the CRP-400 equipment has been selected due to the fact that today it is at the stage of industrial implementing in the "Plant of modern materials" (Zheleznogorsk).

The simulation was performed for the following parameters. The radius of the roller with the protrusion was 513 mm, the roller with the groove - 427 mm, roll speed  $n_1 = 4$  turns/min and  $n_2 = 8$  turns/min; billet heating temperature  $T_s$  480°C and 550°C, roll heating temperature of 20°C and the matrix. Billets sizes were 40x40 mm diameter rod produced - 9 mm.

In order to achieve this goal experimental aluminum-based alloy was selected with the addition of 0.15% Zr and 0.20% iron. This alloy has been chosen due to its high heat resistance at the operating temperature 180°C, relatively small for these alloys in electrical resistance, which is 0.0313 ohm • mm<sup>2</sup> / m, and its ultimate tensile strength  $\sigma_B = 136$  MPa.

The energy-power (Table 1), and temperature indicators (Fig. 1) were obtained by the simulation of the CRP process.

The following pattern of temperature distribution along the deformation zone has been obtained during CPR simulation of the process: in the rolling stage the billet is being cooled considerably at the rolls inlet due to the large temperature difference between the lowest billet and rolls (temperature reduction from 150 - 300 ° C), having passed through the zone the rolling billet is being depressed, fills the caliber and is being extruded through a matrix. The temperature of the billet in the pressing zone increases up to values of 380 to 480 ° C, and the temperature of the rod at the outlet of the matrix is from 400 to 500 ° C.



a –  $\omega=4$  turns/min,  $T_b=480$  °C; b –  $\omega=4$  turns/min,  $T_b=550$ °C; c –  $\omega=8$  turns/min,  $T_b=480$ °C; d –  $\omega=8$  turns/min,  $T_b=550$ °C

Fig. 1. – The temperature distribution and the deformation during process of CRP of AL-Zr alloy

Power parameters of CRP process, resulting of the simulation are presented in Table 1.

Table 1 - Energy and power indicators of CRP process

$\omega$ , turns/min	40x40					
	480°C			550°C		
	$P_{V1}$ , kN	$P_{V2}$ , kN	$P_m$ , kN	$P_{V1}$ , kN	$P_{V2}$ , kN	$P_m$ , kN
4	458	463	359	408	414	324
8	329	335	264	311	314	257

Thus, the simulation results of the combined rolling-pressing of billets cross section 40x40 mm have shown that the increase in productivity is possible by increasing the caliber formed by the rolls. Thus, in order to decrease power parameters of processing mode the billet should have a temperature of 550 ° C and rolls have speed of rolls rotation - 8 turns/ min. (Tab. 1).

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## **ALUMINIUM PLATE MARKET STUDY**

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### **1. Global plate demand.**

Rolled products demand from the automotive sector is expected to see unprecedented growth over the next decade, driving demand for flat rolled products. Activity in the aerospace sector is also expected to drive demand for plate products, driven primarily by China and solid build rates in the West. Indeed, China is developing its own aerospace company, Commercial Aircraft Corporation of China (COMAC) and the company's first locally made aircraft, the C919's first delivery is scheduled for 2018. Meanwhile, firm industrial activity will also ensure that plate consumption in general engineering applications will remain solid through the forecast period.

Plate consumption is expected to increase from 859,000 tonnes in 2014 to 899,000 tonnes in 2015, with the largest consuming regions - eastern Europe and North America - accounting for around 59% of global demand. The growing Asian region will account for 32% as Chinese demand is expected to expand at a compound annual growth rate of over 6% over the 2015 to 2020 period. Consumption in Eastern Europe, Central and South America, Middle East and Africa account for the remaining 9% of demand. Over the six years, global plate demand is expected to grow at an annual average rate of 4.4% to reach 1.1m tonnes in 2020.

The Chinese market is driving demand in Asia and we expect growth here to continue to outpace other regions even though firm aircraft build rates will result in growth in HT plate demand in Europe and North America. In South Korea and Japan, the shipbuilding sector will continue to drive demand while China will dominate the general engineering sector.

The accompanying chart shows the forecast annual growth for all flat rolled aluminium products against average global consumption between 2015 and 2020. It is clear that strong demand growth is expected in plate products even though absolute volumes will remain low. Note that the strong growth depicted in the 'other rolled products' sector is skewed by very strong demand growth in automotive body sheet applications.

### **2. Regional supply overview.**

Global plate supply totalled 872,000 tonnes in 2014, representing a 5.7% y-o-y increase. The largest producing region was Western Europe, followed by Asia and North America. The USA was the single largest producing country globally, accounting for 22% of global output in 2014, followed by China, which accounted for 18%. However, the growth in Chinese output between 2012 and 2014 significantly exceeded that of the USA, with supply expanding by 44,000 tonnes over this period, compared to an expansion of 10,000 tonnes in the USA.

### **3. Regional supply overview.**

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Looking forward, global plate production is expected to increase by 235,000 tonnes between 2014 and 2020, representing a CAGR of 4.3%, driven by strong output growth in Asia and Eastern Europe. China is the leading source of growth within Asia, with plate production forecast to expand at a CAGR of 12.9% over the 2014 to 2020 period. Japan is expected to also see output increases, but these will be at a more modest CAGR of 3.1% over the same period, equal to another 13,000 tonnes of additional supply.

In Eastern Europe, plate production is anticipated to rise by 31,000 tonnes of which Russia is expected to account for 23,000 tonnes. Russian output is expected to rise at a CAGR of 7.1%, driven by strong output at the KUMZ mill.

Growth rates in Western Europe are expected to remain subdued, with a forecast CAGR of 0.8% for the 2014-2020 period, however, this still amounts to around 14,000 tonnes of additional output. Growth prospects in North America look somewhat stronger and we expect output will rise by as much as 31,000 tonnes, representing a CAGR of 2.5%. All of this growth will come from producers in the USA as there is currently no plate production in Canada or Mexico. Growth in output in the USA in 2015 is expected to be modest, at 4,000 tonnes, with orders for the first four months of the year down by 17.5% y-o-y, although a stronger performance is expected in the second half of the year. China accounts for 18% of global plate production and 65% of production in Asia. Southwest Aluminum (Chalco Chongqing), NELA and Henan Wanda Aluminum are the main domestic producers, representing 62% of total Chinese plate output. A significant proportion, around 40%, of domestically produced plate is consumed in the general engineering sector where it is used in the production of industrial machinery, tools and moulds. Around 35% is also used in the production of cargo containers and rail cars. UACJ is expected to account for all of the growth in plate output in Japan and will see its share of domestic production rise from 70% in 2014 to 76% in 2020. This is primarily due to the anticipated growth in output from the company's Fukui plant which is expected to see production rise at a CAGR of 7.0% over the 2014 to 2020 period, reaching 36,000 tonnes of plate output in 2020. The Fukaya plant is forecast to see a modest growth in output of 2,000 tpy over the same period reaching 30,000 tonnes. UACJ's main competitor in Japan, Nippon Light Metal (NLM) is expected to see a decline in output over the medium-term with output from its Nagoya plant expected to decline by 2,000 tpy between 2014 and 2020.

With over 40% of current world supply, Europe (including Russia) is the world's largest plate producing region. Production in the region is mainly located in France, Germany, Russia, Romania, Switzerland and the UK. A substantial proportion of new plate supply over the next six years is also expected to come from the region. CRU forecasts strong production growth in Europe out to 2020 owing mainly to activity in the aerospace sector.

#### 4. Capacity additions.

The expected increase in demand from the aerospace sector has resulted in a number of investments and expansion projects in recent years as shown in the accompanying chart. As mentioned earlier, Alcoa announced in late 2014 that it would spend \$190m at its Davenport mill in the US in order to expand its product offerings into the aerospace and industrial markets. The investment will include the installation of a new 'very thick' plate stretcher, which will enable the production of the largest high-strength monolithic wing ribs in the industry. The expansion will allow Alcoa to serve its existing customers as well as supplying large wing ribs, fuselage frames and bulkheads. Construction is expected to be completed and production to start, in 2017. Meanwhile in China, initial capacity at Aleris Zhejiang is 35,000 tpy rising to 250,000 tpy when the plant ramps up fully.

#### 5. Market balance.



The global plate market was oversupplied by around 13,000 tonnes in 2014. This represents an increase in the level of oversupply from 2013, when the market oversupply only amounted to 2,000 tonnes. In contrast, 2011 saw the market in deficit, by around 5,000 tonnes. However, since then there has been strong output growth in Asia, with supply growth from China acting as the primary cause of the market moving from a position of deficit to surplus. Over the medium-term, the market is expected to remain in surplus but this will gradually reduce as demand for plate begins to catch up with production growth. Our forecasts suggest that 2014 represented the peak of the oversupply in the market with the surplus falling to 12,000 tonnes in 2015 and then declining over the medium term. Global demand is forecast to grow at a CAGR of 4.4% between 2014 and 2020, outpacing global supply which is forecast to rise at a CAGR of 4.1% over the same period thus eating into the current surplus and returning the market to a balanced state by 2019.

#### 6. Pricing structure of plate products.

Aluminium plate products, as with other flat rolled products are typically priced on the basis of LME metal plus a set conversion margin to cover the costs of rolling. However, unlike sheet products which are quoted on an LME plus (metal premium and conversion margin) basis, plate prices are typically quoted as a total price. As such, quoted plate prices are made up of three components – the LME price of primary aluminium, the metal premium and the conversion margin.

At any point in time a plate buyer may be paying different amounts for plate from different rolling mills as metal premiums often vary. Most buyers will tend to purchase from multiple sources with different relationships to the LME and different contract lengths in order to spread pricing risk.

#### 7. Global plate costs by plant.

The following table and chart shows the corporate and conversion costs for the global aluminium plate producers in 2014.

As shown in the accompanying chart, the Russian mills (Belaya Kalitwa and KUMZ) operate in the first and second quartiles of the cost curve. It is important to note that the cost curve production of both heat treated and non-heat treated plate. Given that heat treated plate commands better margins than non-heat-treat plate, mills which specialise in heat treated plate would fare better than many other mills which produce non-heat-treated plate.

#### 8. Summary and conclusions.

The key regions for plate production are North America, Europe (including Russia) and China, with these three regions representing 85% of global production in 2014. We are forecasting firm growth in these regions as activity in the aerospace and other transport markets will drive demand through the forecast period on the back of strong build rates particularly for single aisle aircrafts.

Demand from the general engineering sector will also remain firm over the next six years, especially in China which remains a manufacturing hub for plate consuming products. However, growth rates in China are set to suffer declines towards the end of the forecast period as economic activity eases off.

Given the expected increase in demand levels, there have been a number of investment projects in recent years. In Europe, Constellium, AMAG and KUMZ have all invested in expanding their plate capacity while Alcoa is currently expanding its product offerings into the aerospace market at its Davenport mill in the US. In China, there are also a number of expansion projects planned as domestic mills look to move from producing low value commodity type rolled products to higher value products. Indeed, the Aleris mill in Zhenjiang came on stream in 2013 and started supplying aerospace plate products at the end of 2014.

In the key European market, cast plate products are substituting commercial plate and this has resulted in lower demand from the general engineering sector.

North American plate demand remains firm and is attracting imports from as far afield as South Africa. Demand is firm in both the aerospace and industrial sectors.

In Japan and Korea, demand will continue to be supported by firm demand for LNG carriers.

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**DISCOVERY AND VALIDATION OF KEPLER-452B****Prus N.V.**

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This paper is about the discovery and validation of Kepler-452b, a transiting planet identified by a search through the 4 years of data collected by NASA's Kepler Mission. This possibly rocky planet orbits its G2 host star every  $384.843 \pm 0.007 - 0.012$  days, the longest orbital period for a small transiting exoplanet to date. The likelihood that this planet has a rocky composition lies between 49% and 62%. The star has an effective temperature of  $5757 \pm 85$  K and a  $\log g$  of  $4.32 \pm 0.09$ . At a mean orbital separation of  $1.046 \pm 0.019 - 0.015$  AU, this small planet is well within the optimistic habitable zone of its star (recent Venus/early Mars), experiencing only 10% more flux than Earth receives from the Sun today, and slightly outside the conservative habitable zone (runaway greenhouse/maximum greenhouse). The star is slightly larger and older than the Sun, with a present radius of  $1.11 \pm 0.15$  and an estimated age of  $4.56 \pm 0.8$  Gyr. It has likely been in the habitable zone and should remain there for another 3 Gyr.

Kepler-452b was discovered in a test run of the Kepler Science Operations Center (SOC) 9.2 codebase in 2014 May when J. Twicken inspected the planet search pipeline results to assess performance of an enhanced pipeline codebase for small, cool planets. This is the first planetary signature, which is noteworthy, given the long orbital period and the high fraction of multiple transiting planet systems identified by Kepler. The Kepler telescope obtained nearly continuous photometry in a 115 deg field of view (FOV) near Cygnus and Lyra for nearly 4 years. During this period (2009 May 13 through 2013 May 11), Kepler observed 111,800 stars nearly continuously and altogether observed a total of more than 200,000 stars over its operational mission. The Kepler observations were broken nominally into 3 month (93 day) segments, dubbed quarters, due to the need to rotate the spacecraft by  $90^\circ$  to keep its solar arrays pointed toward the Sun and its sunshade properly oriented.

Data validation applies several tests for the presence of background eclipsing binaries. The first is the odd/even test: DV fits a limb-darkened transit model to the odd transits and an independent model to the even transits, and then compares the depth fitted to the odd transits to that fitted to the even transits. In order to better determine the statistical significance of the transit sequence, we examined the bootstrap distribution for the population of null statistics for the out-of-transit data. This test relaxes the assumption that the observation noise is broadband colored Gaussian noise to establish a robust significance level for the detection statistic of the planet candidate. Due to the curiously small stellar radius of KIC8311864 for the effective temperature available at the time of the 2014 May planet search, it was clear that reconnaissance spectroscopy was called for in order to obtain a reasonable interpretation of the nature of the source of the transit-like features in the Kepler light curve. Two other analyses were carried out on the HIRES spectrum to better understand the role of instrumental systematic errors between the three sets of observations, and to better determine how to set the error bars on the resulting stellar parameters. The observed spectrum is first compared to a library of representative main sequence stars. The best match library spectrum is subtracted from the observed spectrum, and the residuals are then inspected for evidence of a secondary spectrum.

Since KIC8311864 is too faint for direct observations such as interferometry or asteroseismology, the derivation of stellar mass, radius and density relies on matching atmospheric properties to interior models. On average, KIC8311864 is slightly cooler, slightly

larger, and about 60% more metal-rich than the Sun. To ensure self-consistency, we adopted a single spectroscopic solution for the remainder of the paper. We chose the SpecMatch solution, which yields an intermediate temperature, conservative surface gravity, and metallicity consistent with most other methods. To account for the systematic differences between methods, we added the standard deviation of all methods for a given parameter in quadrature to the formal errors provided by SpecMatch. The final adopted atmospheric properties are listed in Table 1.

**Table 1 - Stellar Properties of KIC8311864**

Parameter	Value
Derived from high-resolution spectroscopy using SpecMatch	
Effective Temperature (K)	$5757 \pm 85$
$\log$ [Surface gravity] (dex)	$4.32 \pm 0.09$
Metallicity [Fe/H] (dex)	$0.21 \pm 0.09$
Derived from fitting Teff, $\log g$ and [Fe/H] to isochrones	
Radius ( $R_{\odot}$ )	$1.11 \pm 0.15$
Mass ( $M_{\odot}$ )	$1.037 \pm 0.054$
Mean Density ( $\text{g cm}^{-3}$ )	$0.84 \pm 0.40$
Age (Gyr)	$\sim 6 \pm 2$

As a consistency check, we also computed the age, mass, and radius of this star based on the MOOG analysis of the HIRES spectrum using Yonsei-Yale isochrones and the approach detailed of Ramírez, obtaining an age of 5.2 (3.4–7.5) Gyr, a mass of 1.07 (1.02–1.12)  $M_{\odot}$  and a radius of 1.12 (1.03–1.20)  $R_{\odot}$ . The values are in approximate  $\pm 1$  ranges of values. Note that the agreement in these derived quantities with those derived for the SpecMatch results is very high, giving us confidence that we have a reasonable degree of control over the systematics in the different analysis techniques.

We used the Markov chains to derive model dependent measurements of the transit depth, Tdep, and transit duration, Tdur. The transit depth is defined as the transit-model value when the projected distance between the star and planet is minimized. The transit duration is the time from first to last contact. We also convolved the transit model parameters with the stellar parameters to compute the planetary radius,  $R_p = 1.6 R_{\oplus}$  and the flux,  $F_p = 0.0012 F_{\star}$ . We also computed the impact parameter,  $b = 0.69$ , and the eccentricity,  $e \cos \omega = 0.03$ .

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**Table 2 - Planet Parameters for Kepler-452b**

Parameter	Value
<i>Transit and orbital parameters</i>	
Orbital period P (day)	$384.843 \pm 0.007$
Epoch (BJD - 2454833)	$314.985 \pm 0.015$
Scaled planet radius $R_p/R_{\star}$	$0.0128 \pm 0.0013$
Impact parameter $b \equiv a \cos i/R_{\star}$	$0.69 \pm 0.16$
Orbital inclination $i$ (deg)	$89.806 \pm 0.134$
Transit depth Tdep (ppm)	$199 \pm 18$
Transit duration Tdur (hr)	$10.63 \pm 0.53$
Eccentricity $e \cos \omega$	$0.03 \pm 0.75$

Eccentricity $e \sin(\omega)$	$-0.02 \pm 0.31$
<i>Planetary parameters</i>	
Radius $R_p (R_{\oplus})$	$1.63 \pm 0.23$
Orbital semimajor axis $a$ (AU)	$1.046 \pm 0.019$
Equilibrium temperature $T_{eq}$ (K)	$265 \pm 15$
Insolation relative to Earth	$1.10 \pm 0.29$

Following the statistical approach, we took the insolation flux levels defined for recent Venus and for early Mars to be the inner and outer boundaries of the wide or optimistic habitable zone, and the insolation flux levels for the runaway greenhouse and a maximum greenhouse as the inner and outer boundaries for the narrow or conservative habitable zone. The eccentricity of the orbit of Kepler-452b is poorly constrained by the photometric measurements, at best. With an orbital period of 384.84 days, and a mass of  $\sim 5 M_{\oplus}$ , Kepler-452b should exhibit a reflex velocity of  $\sim 45$  cm s $^{-1}$ . Also, there is little chance for such work, there is little chance of measuring its orbit through radial velocity observations in the near future. To investigate the effect of the uncertainties of the eccentricity of the orbit on the habitability of Kepler-452b, we examined the variation of the mean insolation flux as a function of eccentricity.

Given the similarities between the Sun and KIC8311864 with respect to mass and effective temperature, and the fact that the orbital distance of Kepler-452b is essentially 1AU, it is interesting to consider the habitability of this planet over the history of this planetary system. At  $\sim 6$  Gyr, KIC8311864 is slightly larger than the Sun and the host star's radius is  $\sim 10\%$  larger than the Sun. This planet has received  $\sim 10\%$  higher of radiation in its orbit at a level only this exoplanet system is a future version of an analog to our own solar system, with additional planets in the orbits corresponding to those of Mars and Venus, their insolation history would be very similar to their namesakes in the solar system. An exo-Venus would have spent only  $\sim 3$  Gyr in the conservative habitable zone of the host star on the main-sequence. At present, Kepler-452b is the only known planet orbiting this star.  $\sim 11$  Gyr spent

The identification of a 1.6-R  $G_2$  star at the mean separation of 1.05AU represents the closest analog to the Earth–Sun system discovered in the Kepler data set to date with respect to the orbit and spectral type of the host star. Moreover, the small radius of this planet provides a reasonable chance between 49% and 62% that it is rocky, although in this case it is unlikely to have an iron core of significant mass. Given our current best estimates the host star is 10% larger and 1.5Gyr older than the Sun; hence, Kepler-452b may represent the future environment that the Earth will experience as our own Sun evolves toward the red giant phase. The paucity of small planets in or near the habitable zone of solar-like stars, particularly G stars, makes the determination of the intrinsic frequency of Earth-size planets in the habitable zone of Sun-like stars difficult to determine robustly without resorting to extrapolation. Kepler-452b represents an important addition to the list of small planets in or near the habitable zone for its proximity to a G2 star. We are hopeful that this is only the first of many such planetary systems yet to be discovered in the fullness of time.

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## THE MODELING SYSTEM OF OIL REFINERY PROCESS

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The modern world level of development of chemical technology dictates strict requirements for quality and yield of their products. Industrial installations should be operated efficiently effective both in terms of resource and energy efficiency as well.

In order to solve this complex multifactorial problem it is necessary to use mathematical models, but formed on the basis of physico-chemical and preserving sensitivity to revision in the composition of the hydrocarbon feedstock and catalyst activity.

Mathematical modeling of industrial catalytic processes, refining and petrochemicals is an important way of improving technology, as well as for training of specialists of current level knowledge.

Relevant sections of this area are the following:

- development of systems testing methods based on computer modeling of physical and chemical bases of the various chemical processes;
- development of methods for studying the kinetics of processes in stationary and transient conditions and to increase a catalyst life;
- predict on catalyst of performance in real conditions of its functioning;
- mathematical modeling and optimization design of catalytic reactors;
- continuous monitoring of industrial plants, taking into account changes in the flow and chemical composition of raw materials, as well as technological modes.

The solution of the fundamental problems of the kinetic description of multicomponent catalytic processes are widely described in the literature 60-70 years last century. These studies have contributed greatly to the development of approaches to modeling metamathematical catalytic reforming of gasoline as one of the most common and high-tech industrial process.

During my research work, I will develop a mathematical model for the isomerization process. So, what is the isomerization?

Isomerization - chemical process of the conversion of a chemical compound into isomer.

This operation is primarily aims to obtain high-octane components for commercial and fine grades of gasoline from crude oil grades with low octane hydrocarbons by structural change.

There is isomerization process as follows: the formation of free radicals is a source of detonation, which is in internal combustion engines, thus unbranched alkanes during combustion often form the primary radicals, and consequently, the more branches receives molecule during the isomerization, the higher the detonation resistance and the octane number of the processed product.

Today, the isomerization can be performed for those only alkanes (butane, hexane and pentane) which are light. This is a fraction of the oil which has a boiling range in the 28-70 degrees Celsius and is known as light naphtha, gasoline or petrolane ether.

It is also currently held a serious work to create opportunities of isomerization of heavy alkanes. In studies of the sector using schemes such as:

- recycle;
- one-pass.

Isomerization recycle is increasing the octane number of the fraction. It is possible from 70 to 92. And these actions are carried out using a mixture of low-octane components separation and the subsequent return of these materials for recycling.

In turn, the one-pass isomerization, which also operates on the principle of increasing the octane number, but it can increase from 72 to 83 points.

In chemistry, the isomerization can be treated somewhat differently than in the oil industry. That the isomerization is the transformation of a compound in any of its isomer. During the isomerization may occur and change the carbon skeleton of the molecule, as well as the expansion or contraction cycle. For example, those hydrocarbons that have normal structure, under the action of aluminum chloride may become branched chain hydrocarbons. The simplest example - butane is converted to isobutene.

Similar transformations, as we have seen, occur mainly during oil processing. A procedure for the isomerization in the oil industry leads to the manufacture and production of gasoline with a high octane number. Without false modesty isomerization can be called one of the main processes in the creation and production of commodity-branded gasolines. With that, it must be in other areas of the chemical industry also is in question.

More attention should be paid to the main process conditions. There is primarily dominated by the pressure which is approximately 2.3 MPa. In this case, the reactor temperature will be 380-410 degrees Celsius, and the multiplicity  $\rightarrow 500 \text{ nm} / \text{cubic m}$ .

Three types of industrial processes of isomerization are designed in the modern world:

- high temperature isomerization at aluminum-fluorinated catalyst;
- medium-temperature isomerization on zeolite catalysts;
- low temperature isomerization on alumina, promoted by chlorine and sulfated metal oxides.

The development of these technologies and the improvement of the isomerization process has been studied by a large number of not only Russian scientists and their foreign colleagues.

My task is to find the basic technological parameters of the isomerization process, finding and calculation of the mathematical model of the process and the creation of the modeling system of isomerization process using linear programming elements.

At the moment, my job is to study the impact of changes in the basic technological parameters on the quality of the final product.

This study is carried out on the installation of the company MCB (micro catalyst bed) Vinci Technologies.

MCB - is a board automatic installation based on the mini-reactor volume up to 10 ml, combined with the furnace. A wide range of different options allows you to customize the installation for my problem.



***Pic.1 – Micro Catalyst Bed***

Installation of MCB is CE (Conformite Europeenne) marked and meets all the requirements of EU legislation, including the European directive for equipment operating under pressure.

This setting is ideal for research.

At the end of this paper, we obtain a linear program to monitor deviations of isomerization process and will be able to make recommendations to restore normal operation of the isomerization unit.

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## **THE ANALYSIS OF THE MAIN ACTIVITIES IN THE TERRITORY OF RESERVE «STOLBY» BASED ON LEGISLATIVE PROVISIONS**

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State nature reserves belong to special protected natural territories. According to the Federal Law of Russian Federation all reserves must bear the following tasks: implementation of protection of natural territories in order to preserve the biological diversity, and maintaining protected natural complexes and objects in the natural state; organization and conducting scientific researches, including preparation the Annals of nature; implementation of the state environmental monitoring (the state monitoring of the environment); environmental education and development of educational tourism; assistance in training of scientific personnel and specialists in the field of environmental protection.

During the study of activities carried out in the territory of the reserve its main areas have been allocated: financial and economic, scientific research, environmental protection, environmental education and tourist activities. Each of the above activities was analyzed in comparison with the Federal Law «About Specially Protected Natural Areas» (hereinafter Federal Law) and the Regulations of the Federal State Institution «State nature reserve «Stolby»» (hereinafter: Regulation) about the presence of allowable of paragraphs of one or another activity, as well as their discrepancy with the above documents.

Federal law allows the federal state budget institutions, which manages the state natural reserves, to have their own symbols (flags, pennants, posters, and other verbal, visual and volumetric designations or combinations thereof) reflecting the characteristics of these reserves<sup>[1]</sup>. And in the law there is no information prohibiting the use of symbolism or graphic designations to create products with the aim of implementation.

Information spelled out in the Regulations allowing realization of products with the symbol of the reserve and souvenirs.

The sale of various products (magnets, calendars, greeting cards) with the image of «Stolby» is carried out on the territory of the reserve and in the city of Krasnoyarsk in general at the moment.

Thus, it can be concluded that the Regulation does not contradict the Federal law on the item, and reserve in its turn does not violate and executes it.

According to the Federal law staying in the territories of the state natural reserves of tourists is only allowed with a permit. Fee is charged for a visit these areas.

According to the Land Code of Russian Federation it is necessary to create protected zones around the state natural reserves to prevent adverse anthropogenic impacts on these territories. «The activity that has a negative impact on the natural complexes of protected areas is prohibited within these zones»<sup>[2]</sup>.

Regulation prohibits staying persons that are not employees of the reserve or the staff of the authority in the management of which is a nature reserve «Stolby» in the area of strict nature protection and shall be allowed only in the presence of the official permission.

The regulation allows to conduct tours for visitors at the territory of the reserve and its protection area and the information centers of the reserve; to provide services for organizing and conducting children's environmental camps, student and school environmental practices; allows to provide services related to accommodation, food and recreation visitors, with a visit of the excursion equipped ecological paths and routes, viewing platforms, recreation; and also allows to provide the rent of vehicles.

Today the administration of the reserve provides a variety of paid services such as accommodation of visitors in specially equipped places, accommodation in tents in a tent camp. Also, tourists can visit the nature reserve for free.

According to the Land Code of the Russian Federation «on the lands of specially protected natural territories of federal significance prohibited the movement and parking driven vehicles that are not related with functioning specially protected natural territories»<sup>[2]</sup>.

According to the Federal Law staying in territory of reserve visitors is allowed only with the permission, and with the aim cognitive tourism for a fee. The Position and activities carried out in territory of the reserve are contrary to the Federal Law. According to the Regulation the ban on visiting the reserve refers only to the territory of the strict nature protection. At present the territory of tourist-excursion area in the reserve is available for visits on certain days and hours, and free of charge, and official permission is only required for access to the territory of the strict nature protection. The Administration of the Reserve offers services on organization and conducts children's environmental camps, fee excursions with guide services in different paths; services associated with accommodation in specially equipped places, as well as in scientific complex «Narym» residing in tents in a tent camp, meals and recreation of visitors. The listed activities are permitted in accordance with the Regulation, but it absolutely contradicts to the Federal Law, and that is the main question posed, and requires a rational decision.

One of the main objectives prescribed by the Federal Law imposed on state nature reserves is the implementation of research tasks.

The Regulation stipulates that «research activities in the reserve and its protective area should be directed to: the study of natural systems, long-term monitoring of the dynamics of natural processes, in order to assess, forecast environmental conditions, the development of scientific bases of environmental protection, the conservation of biological biosphere diversity, reproduction and rational use of natural resources»<sup>[3]</sup>.

Since the autumn of 1925 various research activities has been carried out on the territory of the reserve. Since the creation of the reserve there has been published 19 issues of the Proceedings of the reserve «Stolby», 15 monographs, over 500 scientific and popular scientific articles.

One of the main tasks assigned to reserves is to perform research activities. The reserve «Stolby» performs this task. The Regulations allows some activities such as cattle grazing, picking mushrooms and berries, firewood and commercial timber that are not allowed by the Federal Law and the Land Code of the Russian Federation.

The second of the major tasks, written in the Federal Law and conferred upon state nature reserves is «implementation of protection of natural areas for the conservation biological diversity and maintaining the natural state of protected natural complexes and objects. In the territories of state natural reserves is prohibited the introduction of living organisms for the purpose of their acclimatization»<sup>[1]</sup>.

According to the Regulation on the territory of the reserve is also prohibited any activity which is contradicts objectives set before that reserve and including a special protection regime of its territory<sup>[3]</sup>.

In addition to the activities that are prohibited, the Federal Law describes events and activities allowed in state nature reserves and aimed at: «preserving the natural state of natural complexes, recovery and prevention of changes of natural complexes and their components as a result of anthropogenic impact»<sup>[1]</sup>.

The protection of natural complexes and objects at the reserve «Stolby» is carried out by the special state inspection, the employees of which are in the staff of the reserve. They conduct explanatory conversations among tourists about the rules visiting the reserve's territory and take part in fire-fighting activities.



The immediate proximity of the city to the borders of the reserve is the cause of increased anthropogenic load, as well as the degree of affection by the offenders. Most of the impact falls on the territory of the tourist excursion area, which is located in the protection zone, but fixed on the reserved territory. Today on the territory a large number of offenses is indicated. Visitors make fires, especially in fire-risk period, engage catching fish using illicit fishing tools, mushrooms and berries tear, throw the garbage. Preservation of nature in general and its further existence depends on observance of the rules of attending the «Stolby». Based on statistics, written on the official website of the reserve, thanks to the strengthening control the number of offenses on the territory of the reserve and in the protection zone has been reduced.

Implementation of the state environmental monitoring is a third of the main tasks assigned to reserves prescribed in the Federal Law and the Regulations.

Environmental monitoring is the system of observations, evaluation and forecast of conditions of the environment. Its main purpose is to analyze and organize information about the environment, about the reasons for its change, that is, about the sources and factors impact on the admissibility of these changes and pressures on the environment in general and to prevent critical situations.

In recent years, monitoring studies came to the forefront because of increasing anthropogenic pressure on the environment, and databases are formed which are required to assess the condition of nature reserves and adjacent territories.

It is recognized to consider an important part of environmental monitoring «Annals of Nature» - the main scientific document of nature reserves, which keeps the individual facts, the results of measurements and observations of natural processes and phenomena at the territory of the reserve and its conservation area. Most of natural reserves carry out observations under this program.

In the natural complex reserve «Stolby» are conducting studies of phenomena and processes on the program «Annals of Nature», and environmental monitoring is also carried out.

Activities of the reserve entirely satisfy the requirements of the Federal Law and the Regulations. Reserve staff conducts annual researches under the program «Annals of Nature». Learn the changes in the flora, lead a card file, create schematic maps. Lead monitoring number and composition of the fauna populations; monitoring of climate change and anthropogenic load on the ecosystem of the reserve.

The fourth of the main tasks, written in the Federal Law, «entrusted to the state nature reserves is environmental education and development of the educational tourism. «Environmental education activities: is observation of various natural objects and phenomena, identification and explanation of their properties and characteristics»<sup>[4]</sup>.

«Environmental education activity aims at formation of ecological thinking of visitors, understanding the severity of environmental problems and the depth of the relationship between nature and human society»<sup>[5]</sup>.

The specialized division on environmental education was established in the reserve to deal with the organization and conduct of educational works. Russian Ministry of Natural Resources monitors its management, coordinates and controls their actions. «Environmental education activities in territory of reserve and within its protected area is carried out by methods which do not contradict the established regime of protection»<sup>[3]</sup>.

The main areas of environmental education activities in the reserve are: working with mass media; advertising and publishing; creation of video products; organization of the centers for visitors; organization and conduct of ecological excursions in the protected zone and territory of the reserve in the prescribed manner; work with students, interaction with the

teachers' housing and education authorities; organization of environmental events and actions; facilitate the preparation of specialists of the corresponding profile.

The reserve «Stolby» occupies an important role in the field of environmental education. Elena Krutovskaya, who created a reserve nursery «Shelter doctor Aibolit» where the visitors had the opportunity to see animals of wildlife, started environmental education activities in the reserve.

According to the official website of the reserve, the specialists from environmental education department pay great attention to extracurricular education of students holding lectures and showing materials about all special protected natural territories in Russia, introducing the flora and fauna of the reserve «Stolby» and all of the Krasnoyarsk territory.

Shares «Clean Stolby», «Day of birds», «Day of Earth», «Stolby without fire!», «Hang a bird feeder will delight little animals», «Environmental KVN «Protect, do not use!»» are held for tourists annually. One of ecological trails is called «The book of nature». It is equipped with information stands «telling» about the flora and fauna of the reserve.

Activities of the reserve in the sphere of environmental education meet the requirements of the Federal Law and the Regulations. The administration of «Stolby» runs a lot of environmental actions in order to maintain the purity of the territory, help animals and prevent fires. Apart from these shares are held different due to celebrations, for example, Maslenitsa and New Year, and quests and expeditions that are not acceptable in the protected reserve.

According to Federal Law the task of developing of educational tourism lies on state natural reserves.

The Regulation says that in the territory of reserve in the part adjacent to the city of Krasnoyarsk, a tourist-excursion area is located. The area was created for environmental, moral and physical education of people. Visiting the tourist-excursion area is allowed all year round and the procedure and rule of visiting are set by the administration of the reserve. Sites, historically established huts, and two sports centers can be accommodated on the territory of the tourist-excursion area and the buffer zone. The buffer zone corresponds to a regime of strict nature protection and is allowed to be visited only in agreement with the administration of the reserve. Staying on the strict nature protection area is only allowed to the employees of the reserve, other persons can do it only with permission.

All activities, which have been analyzed within the territory of the reserve, are allowed by law but require an additional settlement based on legislative provisions. The tourist-excursion area bears the largest recreational load nowadays, so it is vital to enter access restrictions to reduce the anthropogenic load coming from a large number of visitors.

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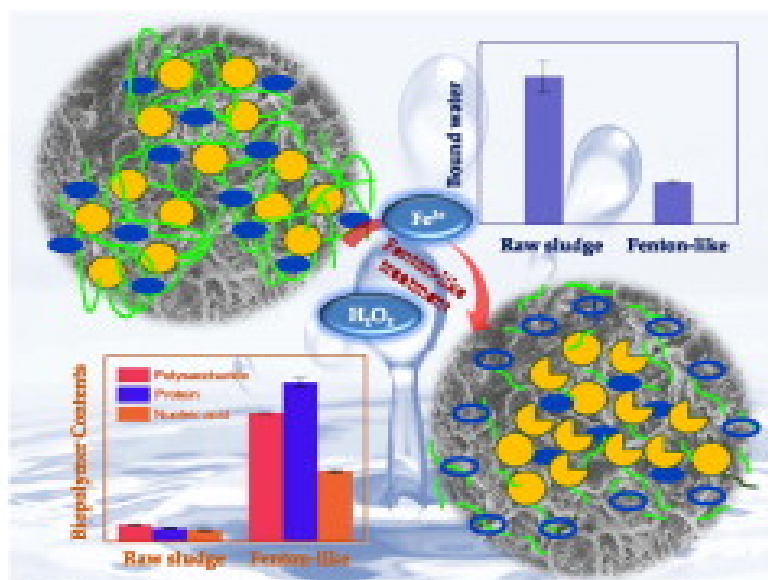
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## NEW METHODS OF WASTEWATER SLUDGE DEWATERING

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Bioleaching by sulfur oxidizing bacteria has been regarded as a novel dewatering process for the sludge treatment. Since the bioleaching process is a comprehensive biological and chemical process for sludge treatment it is necessary to explore the dewatering mechanism of sewage sludge improved by bioleaching. Separate sulfuric acid addition and  $\text{Fe}^{2+}$  addition did not result in significant decrease of sludge resistance filtration indicating that the chemical acidification and  $\text{Fe}^{2+}$  addition are not the deciding factors for the improvement by bioleaching.



The mechanism of the enhanced sludge dewatering by Fenton-like treatment

Figure 1 – Diagram of sludge dewatering method Fenton

The presence of high moisture content in sewage sludge aggravates the disposal costs and restricts its application. Sewage sludge is traditionally conditioned by dosing organic/inorganic chemicals. However, after the treatment the moisture content and inorganic solid mass remain to be a high level. In this work, a Fenton-like dewatering process, i.e., a combination of sulfuric acid, hydrogen peroxide and ferric sulfate was developed. Uniform design was used to optimize the composite conditions and the effects of Fenton-like treatment on sludge dewatering were examined.

The optimized production of a novel bioflocculant M-C11 produced by *Klebsiella* sp. and its application in sludge dewatering were investigated. The optimal medium carbon source, nitrogen source, metal ion, initial pH and culture temperature for the bioflocculant production were glucose,  $\text{NaNO}_3$ ,  $\text{MgSO}_4$ , and pH 7.0 and  $25^\circ\text{C}$ , respectively. A compositional analysis indicated that the purified M-C11 consisted of 91.2% sugar, 4.6% protein and 3.9% nucleic acids (m/m). A Fourier transform infrared spectrum confirmed the presence of carboxyl, hydroxyl, methoxyl and amino groups.

– The extracellular polymeric substances in bioleached sludge decreased considerably with the protein and polysaccharide reduced by 97.42% and 76.00%, respectively. During the bioleaching process the number of microbial genres in the bioleached sludge gradually decreased and the dominant bacterial genus (*Acidimicrobium ferrooxidans*) shifted from 7.48% to 26.49% at the end of bioleaching. While many factors influence the dewaterability of the sludge the bio-substitution which led to the decrease of EPS is the deciding factor for the dewaterability improvement of the bioleached sludge.

– The results show that after the treatment of the Fenton-like reaction, the moisture content of sludge and the dry solid mass decreased from 80.0% to 66.1% and from 12.9 to 10.6 g/L. The mechanism for the enhanced dewatering performance was explored and the degradation of abundant extracellular polymeric substances, the lysis of the sludge cells and the release of bound water and typical metals within the sludge flocs were found to be mainly responsible for the enhanced dewatering performance. In addition a surface thermodynamic analysis with the extended theory shows that the higher hydrophobicity and less stable sludge flocs also contributed to the decrease in moisture content. Our results confirm that such a Fenton-like treatment exhibit excellent performance in enhancing sludge dewatering and metal leaching and is a promising pretreatment approach for sludge disposal.

– The microbial flocculant exhibits excellent pH and thermal stability in a kaolin suspension over a pH range of 4.0 to 8.0 and a temperature range is from 20 to 60°C. The optimum bioflocculating activity was observed as 92.37% for 2.56 mL M-C11 and 0.37 g/L CaCl<sub>2</sub> dosages using response surface methodology. The sludge resistance in filtration (SRF) decreased from  $11.6 \cdot 10^{12}$  to  $4.7 \cdot 10^{12}$  m/kg which indicated that the sludge dewaterability was remarkably enhanced by the bioflocculant conditioning. The sludge dewatering performance conditioned by M-C11 was more efficient than that of inorganic flocculating reagents of such as aluminum sulfate and polymeric aluminum chloride.

The study of the new sludge dewatering methods have been revealed the following features:

- bioleaching is a comprehensive and synergistic technique including many reactions;
- single factor cannot cause significant dewaterability improvement;
- the number of microbial genres decreased significantly in bioleaching sludge;
- the Fenton reaction time was shortened to 5 min.;
- through optimization experiments, 96% of SRF reduction efficiency was achieved;
- the composite conditioner acted both as an oxidant and a coagulant;
- the results were confirmed by high-pressure filtration experiments;
- low cost;
- benign biodegradability;
- the insignificance of secondary pollution;
- bio flocculant favorably adjusted to a specific pH of the slurry and salinity.

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## **SMALL SATELLITE PORTABLE COMPLEX OF ELECTRICAL TESTS**

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Small satellite is a satellite with dry mass below 180 kg. Over the last 50 years, more than 860 microsattellites (10–100 kg), 680 nanosatellites (1–10 kg), and 38 picosatellites (0.1–1 kg) have been launched worldwide. <sup>[1]</sup> Small satellites have recorded data on the terrestrial and space environment near the moon and Earth, helped in the search for planets on other star systems, and demonstrated various telecommunications systems.

Technologies have progressed so rapidly, particularly in the electronics area. Combined with the changes in the system engineering, management, production process, they can permit small satellite to be far more efficient and cost effective than today's large satellite.

Small satellites missions are made possible through miniaturization technologies. Miniaturization is the act of creating systems of ever-smaller scales and thereby increasing the functional density of the product. Devices have a comparable capability, but are of smaller size than their predecessors. <sup>[2]</sup>



***Pic. 1 –Cubesat, type of miniaturized satellite for space research that is made up of multiples cubic units***

In spite of the size modern satellite systems are still complex, with hundreds or thousands of electrical, mechanical and chemical elements working together. Small satellites are currently using advanced power generation and energy storage technology, chemical and electric propulsion, miniaturizing technology of attitude determination and control system, thermal control system, command and data handling technologies, integration system, launch system, deployment system, ground system.



In the satellite development process testing is one of the most important phase which is held during the whole production process. The electrical tests show that all of the components can operate together as planned and not let the electronics fail due to static charging or high-gradient electric fields. At this point electrical tests are held on the stationary test equipment only in the producing company.

The small satellite portable complex of electrical tests is a testing equipment which allows making tests of the battery charges, tests of the voltage regulators, tests of the batteries with external power supply, tests of the batteries with solar cells as power supply and many others.

The complex implements the following functions: measurement of electrical parameters, formation of current commands, working with the interfaces such as SpaceWire, simulation of an operation of the cutters.

There are three main milestones in the production process of a small satellite portable complex of electrical tests: packaging of equipment, software, switching device design.

The main functions of the software are gathering and processing information about the state of the satellite, manual and automatic commands output in the form of electrical signals, automated options control, automated reporting, visualization of the results.

Switching device is designed to provide the electrical interface. It is a panel with mounted connectors. They are connected directly to the modules of the workplace with the transition cables.

The main advantage of the small satellite portable complex of electrical tests is size which will allow making tests not only in the producing company but also on the spaceport. Also, it will work with different satellite platforms.

Small satellites will play an expanding role in the national security and commercial space marketplace. As their capabilities have improved they provide solutions to survivability, cost, flexibility, modernization, and even environmental needs.

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## SECURE CIVIL GLOBAL NAVIGATION SATELLITE SYSTEM FOR TODAY

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Global Navigation Satellite System (GNSS) is a satellite system that is used to pinpoint the geographic location of a user's receiver anywhere in the world.

GNSS employs a constellation of orbiting satellites working in connection with a network of ground stations.

Having the coordinates from four satellites, our user's device can calculate our current location. This is the main purpose of the navigation and it is widely applied in different fields of peoples' activity.

High-integrity applications of secure GNSS are the following:

- secure electronic communication;
- financial transaction assurance;
- fraud detection and non-repudiation;
- asset tracking and route auditing;
- Internet and online security;
- cryptography and key distribution;
- information and asset protection;
- smart cards and access control;
- personnel security;
- hazardous waste transport and compliance.

All these services rely on secure GNSS to a certain extent.

There is also a growing demand for location-based services such as hardware configuration and management, virtual site licenses, digital rights management etc.

Different studies show that GNSS security threats exist now and will increase in the future.

Due to the low received power of GNSS signals, the most common attack is denial-of-service by jamming or intentional interference. Spoofing will be more harmful, because it attempts to misrepresent the user's true location at the same time avoiding detection of the attack itself. Hacking the satellite-to-receiver signal interface opens GNSS to the same types of attacks that daily plague personal computers, corporate mainframe systems, and the Internet.

Nowadays different methods of protection from the threats exist. They mostly require additional equipment or use special secret codes. Some GNSS signals are specifically designed to prevent spoofing or to deny unauthorized access — encrypted signals such as the GPS P(Y) and M-code, or hidden signals such as the GLONASS P-code. These signals produce asymmetry, meaning that the service provider has the encryption mechanism while an attacker does not. That is why an attacker will not be able to generate the authentic encrypted signal for use in a spoofing broadcast or in an injection attack. Civil users do not have access to the codes, and even authorized military GPS users require special hardware, which is both expensive and access-restricted.

The research, described in the article [1], has created a method to provide the anti-spoofing benefits of secret codes, without needing access to the codes themselves. This

capability is achieved by joint processing of the signal received at one location with a nearly synchronous signal received at a remote (preferably trusted) station.

Signal authentication is a new method that uses hidden attributes fundamental to the GPS satellite broadcast — and cross-compared between two receivers — to authenticate signals and the location solutions they generate. In fact, this method is based on mathematical processing of the received signals and allows to detect spoofing relying on the results of calculations. Basic steps of signal processing are the following:

- 1 To record GPS raw data at location 1 (the user device) and location 2 (the reference station).

- 2 To transmit a data snapshot from the user device to the reference station for processing, along with a timestamp of the data snapshot.

For each satellite of interest in a data set pair (i.e. a user device and a reference station):

- 3 To perform Doppler frequency wipe-off.

- 4 To estimate carrier-phase to allow signal separation into components.

- 5 To correlate the signal from the user device with the signal from the reference station; slide the correlation window until a peak of sufficient magnitude appears.

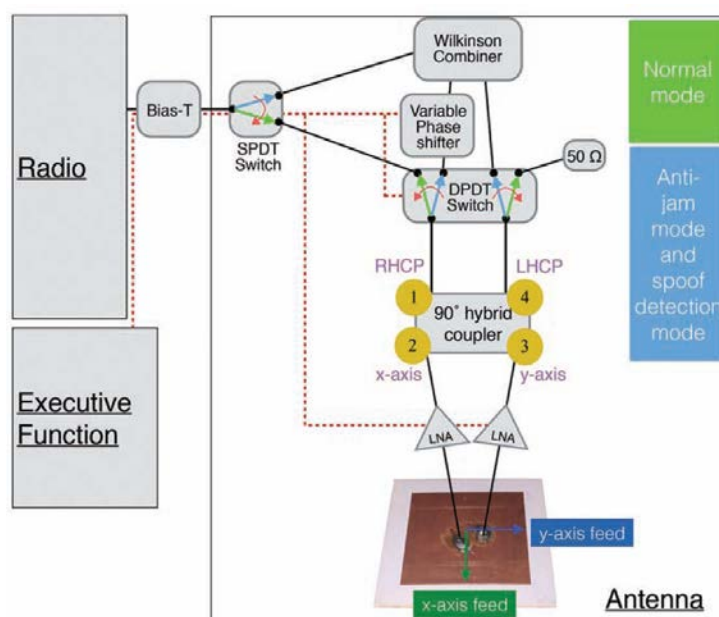
This joint processing technique provides both signal authentication and position verification because the appearance of the correlation peaks guarantees the presence of the hidden encryption signatures, and the analysis of several of these peaks allows computation of the position.

Supporting infrastructure of trusted reference stations, receiver technology and communication links are required to apply the signal authentication method.

Users can experience the following benefits of the method: low number of required reference stations, remote data processing, security functions moved from the user device to the authentication processor, simple user device and reasonable cost.

One more method of providing security for the civil GNSS is a single antenna method [2].

Figure 1 shows the high-level schematic diagram of single-antenna system and operational modes.



**Fig. 1 – The high-level schematic diagram of the single-antenna system**

When the switches are in the *green position*, the block diagram represents a standard GNSS antenna. When the switches are in the *blue position*, the diagram shows the implementation of anti-jam and spoof detection.

This new technique was verified and tested. During the field trials the antenna was mounted on a metal trash can that simulates the cross-section of an airplane fuselage. Then the antenna and the trash can were put atop of a small ladder. They measured signal from the real satellites and from the simulator which operated as the spoofer and the jammer. All the measurements were analyzed, and the researchers could make a decision, which signal was real, and which one was intentionally spoofed.

The following conclusions can be made. Using quite simple equipment and wide mathematical background, the researchers achieve great results for providing GNSS security. As for the signal authentication method, it can support many position, navigation, and time applications at very reasonable cost without any expensive equipment and using standard means of GNSS. Regarding the method of the single antenna, it can provide two functions, anti-jamming and anti-spoofing by means of one circuit, and all its elements are available off-the-shelf.

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<http://www.insidegnss.com/node/4626>



The main method to the study of motion, ironically, was the principle defining why the movement does not occur. This approach is called the "principle of virtual displacements." To understand this principle, we have to imagine a material point in space, which is under the force can make a virtual movement (in other words it is not necessary that this movement happened in reality). The first wording of the principle is: "The system motionless only in then case when total virtual work of all forces equal to zero." This formula works for free material points. In the case when kinematic constraints are imposed on the material point, the principle is: "In the fixed system, virtual work of the reaction forces always equals to zero for any virtual displacement, which does not violate the specified kinematic relations."

The brilliant French scientist D'Alembert, proposed the method of disseminating of the "virtual displacements principle" on motion case [1]. This method is called the "principle of D'Alembert," the wording following "If we add the inertia forces to the applied forces, any system of forces is in the equilibrium." By introducing the term "effective force", which is the sum of the "active" of the applied forces and the inertia forces, the wording of the "virtual displacements principle " in the case of the dynamics becomes: "Complete virtual work of effective forces equals to zero for all virtual displacement, compatible with given kinematic conditions" .

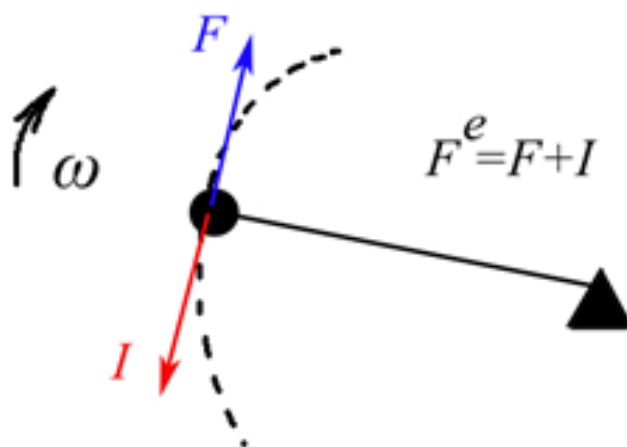
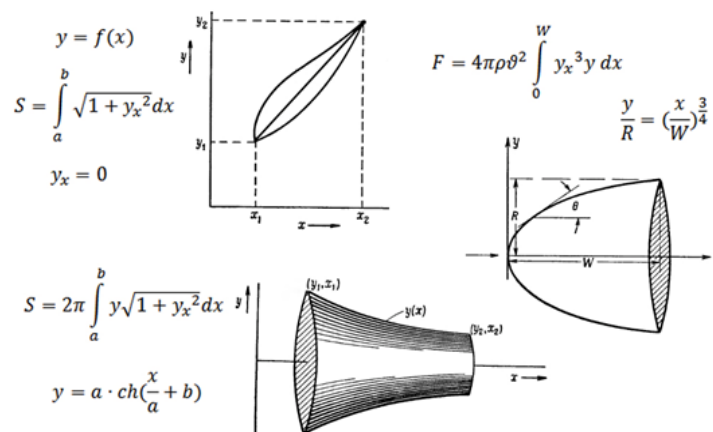


Figure 1 – The principle of d'Alembert

"The principle of D'Alembert" played a crucial role in the development of science of motion studies, but its mathematical form was not perfect. To make this principle mathematically perfect became possible thanks to the work of Euler, Lagrange and Hamilton, the result of which was the principle of "stationary action." The principle is that the time integral of the effective work force goes to the definite integral, called "Action". The physical interpretation of this principle is the following: "True motion occurs when a certain integral, called the action, takes the smallest or the largest value in an interval of time."

There is a class of engineering problems solution of which brought to the development of an entire branch of mathematics called the variational calculation. The figure 2 is devoted to such problems.





**Figure 2 – Examples of variational problems**

Imagine that we need to determine the curve of shortest length connecting the two given points. Intuition tells us that it is a straight line, but this problem can be formalized as follows. The length of any curve given by equation 1, can be calculated using the definite integral 2, solving the problem so that the integral 2 is minimum, we obtain a solution in the form of the vanishing of the derivative of the curve. This decision corresponds to the set of all straight lines.

The second problem is formulated as follows: "To determine the shape of the curve joining two given points so that the area formed by the surface of revolution was the lowest." Solving this problem is similar to the first, we get the equation of the curve called "catenary".

The last problem we consider is dedicated to the definition of the optimal form of a solid body moving in the stream. In the form of a definite integral, we describe the force acting on the body in the stream to determine the conditions under which the integral takes a minimum value, we find then in the form of parabola power of  $\frac{3}{4}$  a body will experience the least resistance.

Problems of this type, there are many, and they had found a common solution. This solution is a solution of the fundamental problem of variational calculation, called "The problem with a fixed boundary." This solutions defines the requirements for the function, in which a given functional depending on the given function, takes the smallest or the largest value, ie, steady-state value.

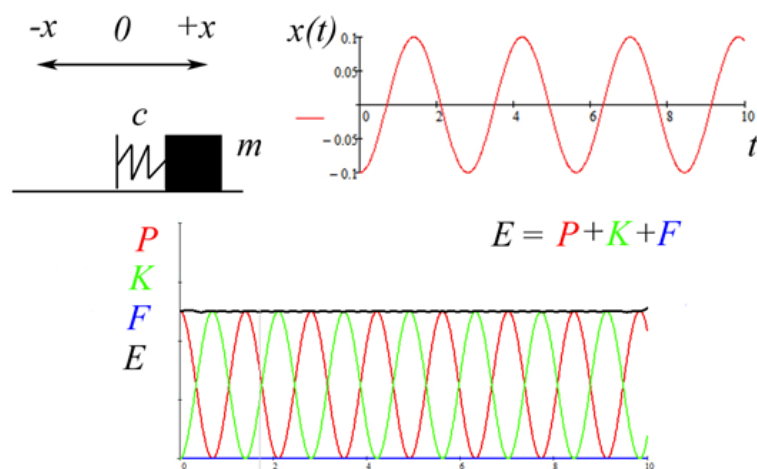
This decision reflects the mathematical interpretation of Euler's famous phrase: "In the world there is nothing, what would not have been visible sense of a high or low."

Integrand, part of the "Action" which is, called the Lagrangian, and is a characteristic function of the system, which determines all dynamic processes occurring in the system. One of the main characteristics of this function is its invariance under coordinate transformations. This mathematical wording has the following physical interpretation: "When moving or rotating mechanical system in space or time, this mechanical system is not changed." In general, there is an infinite set of possible transformations of coordinates, but not all of them satisfy the invariance of the Lagrangian with respect to them.

The transformations under which the Lagrangian is invariant mechanical of system are particular interest. The definition of such transformations is dedicated to Emma Noether's theorem [2]. The invariance of the Lagrangian, are permanent and some other values that we call "momentum, angular momentum and energy." Transformations of coordinates in which the system, there are some constants, called the symmetry transformations.

Let me demonstrate the physical interpretation of the law of conservation of energy in the two examples. The first one is an oscillator without friction. On the basis of the characteristic function of the system we obtain the equation of motion and its solution.

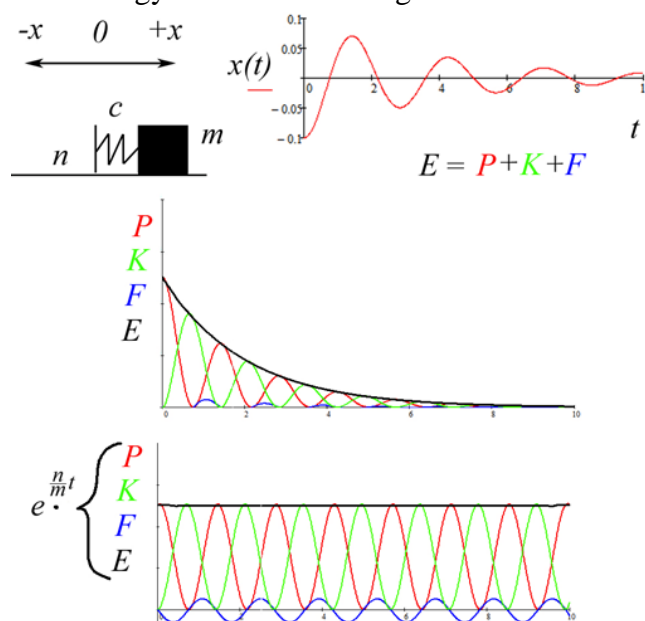
Applying the characteristic function of Noether's theorem concerning the conversion of "time shift", we get a function that is constant in time, it is called 1 "full mechanical energy of the system."



**Figure 3 – The oscillator without friction**

Let us consider an oscillator with linear friction. We do not get the time constant value or such a system, applying to the characteristic function conversion "time shift,"

However, there is a "special coordinate transformation" with respect to which, for the system according to Noether's theorem, there is some constant with the dimension of energy and saves time. Moreover, this feature provides a dimensionless factor (figure 4), reducing that we obtain the variation of energy in line with the figure 3.



**Figure 4 – Oscillator with friction**

Thus, what we call the "law of conservation of energy" is just a special case of the invariance of some characteristics of the mechanical system, a group of transformations.

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# METHOD FOR TURBOCHARGING SINGLE CYLINDER OF FOUR-STROKE ENGINES

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This paper presents a feasibility of a method study of turbocharging single cylinder of four-stroke internal combustion engines. Turbocharging is not conventionally used with single cylinder engines because of the timing mismatch when the turbo is powered during the exhaust stroke and when it can deliver air to the cylinder during the intake stroke. The proposed solution involves an air capacitor on the intake side of the engine between the compressor and the intake valves.

There is a real need in the Indian agricultural sector for any technology that can provide more power for minimal cost. The technology presented in this paper could create a broad impact on equipment such as tractors, light vehicles, generators, and water pumps increasing their specific power and making them affordable to new users.[1]

We propose to turbocharge single cylinder engines by adding a volume between the turbocharger and the engine intake that would act as a buffer and smooth out the peaky nature of a turbocharger operating under pulsing inlet conditions.

The capacitor acts as a buffer and would be implemented as a new style of intake manifold with a larger volume than traditional systems. The shape and size of the air capacitor is important. The analysis presented addresses three critical design factors: capacitor size, capacitor charge time, density gain of the air fed into the engine.

*Air capacitor sizing.* The goal of this analysis was to find the fill time and appropriate size for the air capacitor in order to assess the feasibility of the concept. The most basic model of the system is shown in Fig 1.

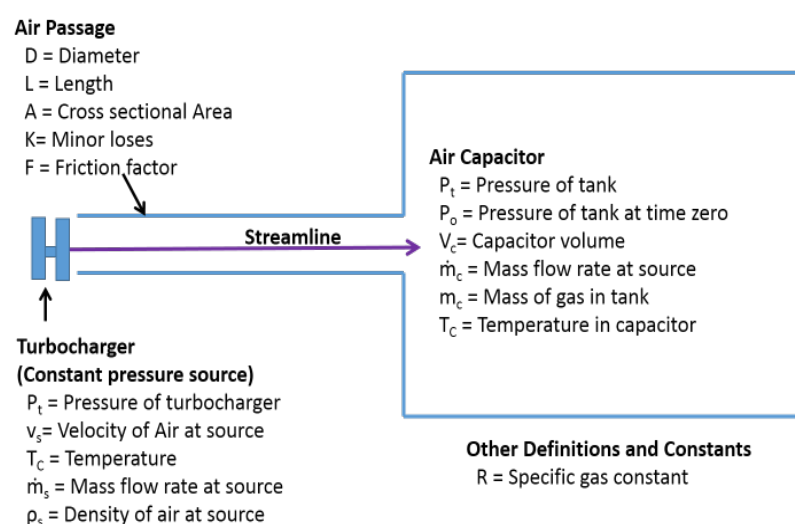
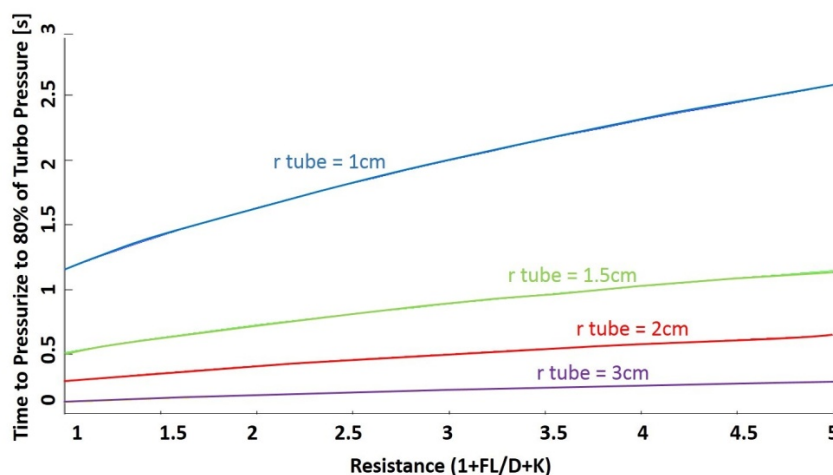


Figure 1 – Diagram of constant pressure source system

Our target is to design the system in such way that there is no more than 25 % of pressure drop in the capacitor during the intake stroke when it runs in steady state. The analysis shows that the capacitor volume should be a bit of four and a half times the engine volume. This means that for a 0.8 liter engine the volume would be approximately 3.5 liters.

The script looked at a series of tube diameters and tube resistances. The y axis of this plot shows the time it takes the capacitor to pressurize to eighty percent of the turbocharger pressure. The x axis of the plot shows the sum of the dimensionless resistances: the major losses, the minor losses, and the velocity losses. The fill time is heavily dependent on the tube diameter. [3]

Fig.2 shows that the fill time is significantly less than a second for a tube diameters greater than two centimeters.

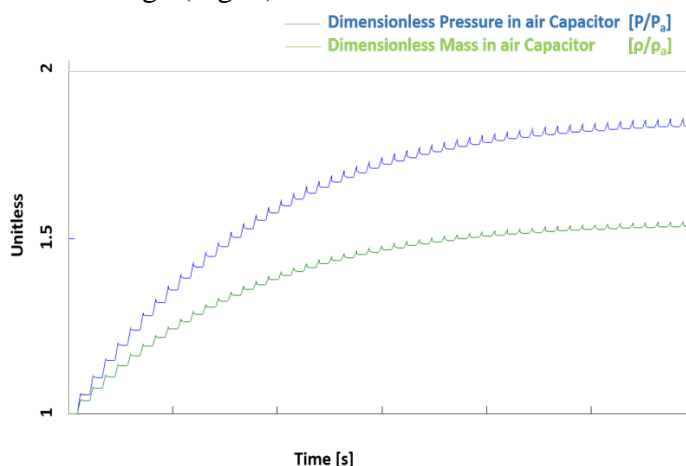


**Figure 2 – Graph showing fill time as a function of the resistance and tube radius**

This fill time corresponds to lag time which is how long it takes for the system to reach steady state which is how long it takes to get the power boost from the turbo charger

*Model of flow through intake into engine.* The model described in this section accounts for the air leaving the capacitor and entering the engine. Our analysis considers a four liter capacitor, a two atmosphere turbo pressure, a 0.8 liter engine moving at 2000 RPM and an engine with a compression ratio of 12:1. The capacitor reaches steady state in about half a second with a pressure almost equal to the turbo pressure.

*Heat transfer out of the air capacitor.* The pressure inside a fixed volume increases while the density stays constant when temperature increases. Using the matlabzero inertia turbo model, we calculated how the density in the capacitor varies relative to pressure in the capacitor if there is no heat exchange (Fig. 3).



**Figure 3 – Plot showing density decrease due to thermal effects of isotropic compression**

We calculated how the density in the capacitor varies relative to pressure in the capacitor if there is no heat exchange. The density gain would be at least 50% without cooling the air and up to 80% with ideal cooling. [2]

Our research shows that:

- the capacitor has a volume between 4 and 5 times larger versus of the engine capacity;
- the charge time is less than two seconds;
- the density gain would be at least 50% without cooling the air and up to 80% with ideal cooling.

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## PROBLEMS OF COMMERCIALIZATION CHAIN FUNCTIONING

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Economists know four levers of long-growth of people welfare: innovation, which modifies quality of work force, growth of capital-labor ratio and increase amount of employment. Today, innovation is the most effective way to modify economics criterion. Data from China and South Korea are confirming possibility of economic growth through innovation.

Elements of national innovative ecosystem have been created in Russia for the last 20 years. However, specific weight of innovation commodities, work, services in all volume of dispatched commodities, works, and services by industry companies is inferior developed countries (25-30%).

Moscow and St. Petersburg are the main centers and their innovative activity is higher than the average by 70-75%<sup>[1]</sup>. At the same time only about 7% of the total number of innovative companies in Russia are implementing innovations at the international and national level<sup>[2]</sup>. It shows, that exiting innovation structure to infrastructure is used to facilitate the commercialization chain, isn't fully cope with the assigned functions and innovation centers show very poor results in international relations (Moscow occupies the 13th place in the ranking of ecosystems<sup>[3]</sup>).

In order to succeed innovation optimization state measures is not enough. There must be a fundamental redesign of the motivation system, competences and relations between the participants of innovation activity. Therefore, a top priority in the development of improving efficiency of the innovation infrastructure measures is the identification and analysis of obstacles to the implementation of innovations. In this connection, this article focuses on the allocation of problems, their sources and effects.

Innovative infrastructure objects should implement interaction with universities and research institutes. They also should transfer intellectual property objects, which are created from research and development. However, they cannot fully cope with their functions in current form.

The reason of this are: universities and research institutions which usually create these elements for formal perform of innovation development programs. Another reason, the lack of functionality, is the lack of business competences by staff from university agencies working with projects<sup>[4]</sup>, and this also applies to managers.

If say about business disinterest, then reason of that is university inabilities to convert business requirements into concrete terms of reference (ToR) for scientists. Furthermore, they usually require already formed ToR<sup>[4]</sup>. However, this feature is one of the keys that encourages businesses to apply to research institutes and universities. In addition, there are not enough mechanisms of stimulate link between science and business, which now is focused on implementation of R&D from universities and research institutes, so many businesses create a special department or refer to other business representatives, which are aimed at R&D.

Many truly innovative projects are not able to overcome barriers and go to commercialization stage. The emerging vacancy space aspire to take a team who understand and know how to present formally their projects in the form, which is required by infrastructure. Although many of them may even do not have a scientific and practical basis.

All of this is a result of the problems described above.

Business incubator is one of the basic elements for ideas transformation into practice in real companies. They are mainly controlled and financed by the government. At the same time accountability of these institutions is formal, for example, the efficiency criterion may be the number of residents or the number of projects in a particular area. Only few business incubators aim to achieve business survival after leaving the incubator.

However, even this is not enough. We should help to startups to develop further participation strategy in innovation infrastructure, both as a user (to determine what further support is needed, and how they can effectively use it) and as an actor (to provision of mentoring and other support to other residents, including the provision of services for less than the market price, etc.). It allows to make the entire infrastructure more efficient and make it a self-organized.

Another problem of these stage is the lack of services that can offer innovative infrastructure [4]. This list of services is often limited to:

- information support (publishing information about the company on the site, etc.);
- accounting support;
- to lease space at a low price (it is interesting not only innovative companies);
- legal assistance (execution of contracts, etc.).

Innovative enterprises need more assistance to finding and renting high-tech equipment necessary to carry out R&D. For example, business incubators should provide access to the equipment of research institutes and universities. It would also help to reduce downtime of equipment in universities and research institutes.

Such a situation is observed when working with funds that provide financial support as a grant. The mechanism of funds work is not clear. They do not have clear indicators of project evaluation and requirements to the application which are often unclear even for themselves even if you members of the fund.

With all of this, the data structures do not have a clear hierarchy, where it is not clear to who from employees can help you. This is the reason why supervisors and their requirements may change during the preparation of the application.

Since these structures are the government (or are financed from the budget), they also have a large bureaucratic apparatus that can push back the project for 3-5 months.

All of this create the braking effect for projects at transition to the startup stage, but for innovative projects that may cause causal "death".

A consequence of these reasons is: many start-ups and innovative projects can be refused further finding in innovative infrastructure, and at their place come specialized teams that are able to cope with the bureaucracy and show the formal result. Thus, a sufficiently large part of the financing of this phase is directed away from innovation.

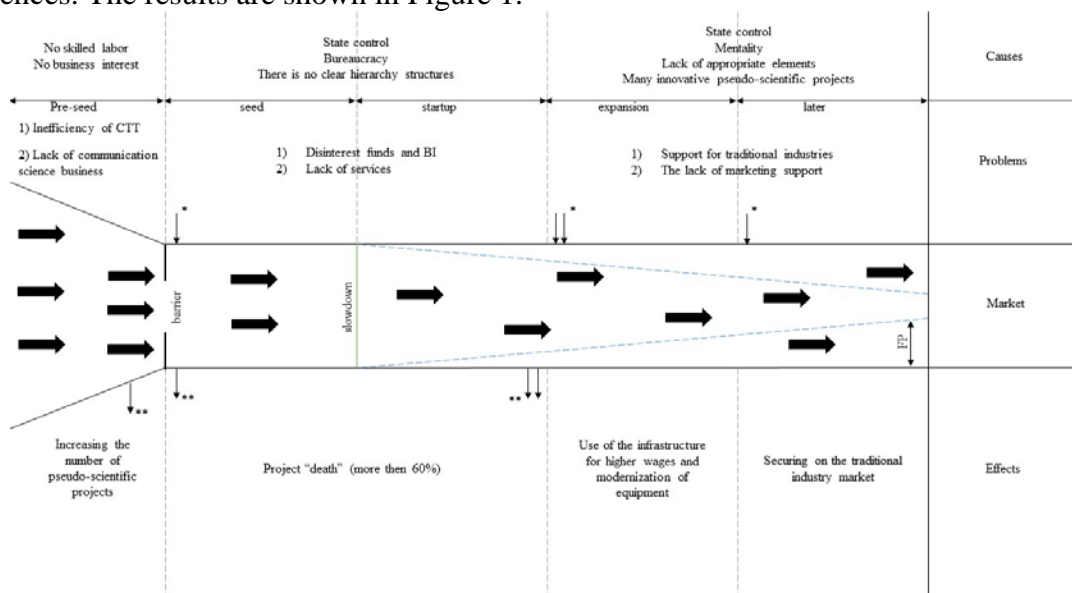
At a later stage of commercialization, where innovative companies intend to create full-scale production, increase their power and enter to larger markets, they are faced with problems of financial support from the innovation infrastructure.

Existing elements of financial support seek to reduce risks, to carry out the orders of the government in terms of the cost of innovation impact. They think, that invest in innovative enterprises seems a very dangerous idea. Because they require much more time to implement expansion strategy (compared with the traditional business), and there are big failure risks on the market (at least in the extent to which it is planned). Moreover, as in previous stages of the chain of commercialization it was enough infusion of traditional projects under the guise of innovation, which at this stage seek to improve production, which, in principle, meets stage targets. Financial support for these enterprises is more attractive. Private investors hold the same opinion.

In addition, at this stage, innovative companies need specialized marketing support, which is not able to provide the existing elements of the infrastructure innovation. Now there is a tendency to business replenishment of the space<sup>[4]</sup>.

As a result, the traditional business is strengthening its position on the market, which hampers the emergency of innovative companies with breakthrough technology at least at the regional level.

Classification was conducted according to the commercialization stage, after analyzing the existing problems facing the innovation infrastructure, as well as their causes and consequences. The results are shown in Figure 1.



**Fig. 1 -The flow of innovative projects in the innovation infrastructure**

(\* -the input stream of projects related to traditional business or pseudoscience, where the number of arrows indicating the flow volume;

\*\* -output stream of innovative projects where the number of arrows indicating the flow volume;

FP- number of pseudoscience projects in the total number of projects implemented in the innovation infrastructure)

As seen in Figure 1, the existing innovation infrastructure is more conducive to the development of traditional business, aimed at increasing production volumes by upgrading equipment or obtaining additional revenue in the form of grant support. These companies sometimes consider grants as interest-free loans and simply are not fulfilling the conditions.

In addition, the chain of commercialization in fact rarely leads an innovative project through all the stages. Because the mechanisms of its work displace innovative enterprises. It also increases the number of false projects at every stage, who earn on writing grant applications. However, it also creates an opportunity for scientists, who can use these experts to formalize the application and increase the survival chances.

The best solution of these problems is use of systematic approach, which implies a change of the principles of work as a whole innovation infrastructure, and some of its elements in particular. One of the possible ways out is offered in the form of gradual transfer of existing elements in complete control of private business with minimal participation of the state (only in the partial financing of projects in the promising areas of science and technology, as well as the development of basic sciences).

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## PROBLEMS OF COMMUNICATION AND MOTIVATION INNOVATIVE INFRASTRUCTURE

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The significance of comprehensive and effective interaction among the elements of innovative infrastructure is introduced in The World Bank<sup>[1]</sup>. It shows, that, a clear understanding of the principles and the sequence of work can help to identify and establish the appropriate performance indicators for each infrastructure elements. But, it is possible only if there is an access to reliable information and the clear definition of whose, who responsible for fixed work.

The reason for weak links between innovative infrastructure elements is distinguished between the founding members. Because only some of them belong to the business sector, but the bulk belongs to the State. In this case, it is obvious, that, the State is aimed at solely strict horizontal connection and various structure of control. At the same time small business has vertical links in addition to horizontal ones. It leads to rapid problem solving and maximum optimization of the document circulation in decreasing of the volume. European experience shows that, the State must only provide a favorable business environment and supply the necessary services to facilitate their work. In accordance with «Global innovation ration», 2012<sup>[2]</sup>, the State also should provide more state orders for the small innovative companies (SIC).

A similar opinion is described in the book «National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning»<sup>[3]</sup>, the author present a great emphasis on cooperation, which introduced as one of the main innovative infrastructure element, expanding to interact not only within the inner structure, but also with specialized agencies performing functions of the communication center for the industrial field. He suggested to interact it not only in inside the structure but also with in the specialized agencies, which perform the functions of the communication center for the industrial field.

As it is revealed in Borisova's work<sup>[4]</sup>, that the existing innovative infrastructure elements are not able to maintain a balance among the interests of science, business and government, but this balance is always shifted in away, which most affects on each separate element. Thus, large companies usually belong to business sphere.

Some authors try to find the solution of this problem in creating of a single information space, which will perform all the functions described earlier. However, according to this approach we should take into account that the existing technology platforms and some online recourses are aiming to search goal, but they do not implement it. Therefore, it is necessary to analyze the barriers preventing their effective work and upgrade them or develop other mechanisms.

Besides, the problem for the information databases creation and functioning, exclusively for formal reporting in developing programs, is still relevant. Those, that are really are being created for these goals are usually faced with the difficulties of registration in business corporations and further use, for example, «Startbase».

The problem is in shortage of methods of elementstimulating, including business<sup>[5]</sup>. It caused by the increasing of the government role in economy. Most large enterprises, such as Gazprom, have a significant impact on economy<sup>[6]</sup>. In this regard, the business sectors shows a decrease in incentive of doing business<sup>[5]</sup>, including innovative business sphere.



Scientific paper by Plotnikova S. A.<sup>[7]</sup> distinguishes the tax credits as the main method of stimulating innovative infrastructure. The author points out that this is not enough, because it is necessary to pay attention to the problem of the lack of public control, which may include mandatory report publication about activities and effectiveness in the context of received public funds and its distribution.

Today, many of the innovative infrastructure elements do not provide open access to reports and only few of them provide short reports about a small part of the funds allocated to them (about 15-20%).

The lack of united indicators can be identified as the main reason of the lack of the stimulating methods. Therefore many elements work exclusively for fulfillment of the quantitative indicators, but it cause the losing quality. Thus, definite number of residents and allocated funds are, as the main measure of effectiveness for many business incubators. The average survival of small innovative companies, after using their services, is on average 27%, while in Europe and North America 86-87%.

As a result of the fact that many infrastructure elements are state, the employees of these institutions have a fixed salary, as opposed to business, where salary depends on the qualitative and quantitative evaluation of the performed work. State employees are not interested in improving the efficiency of their activities and in the full implementation of the functions assigned to them. As a result it can cause a situation when the employee does not answer the phone or may be absent from work.

To solve this problem is not enough to have tax benefits, which traditional companies can also use. They are essentially ordinary landlords under the guise of technology parks and industrial parks, so they are not building up specific interaction network among companies within their area of activity. As a consequence, the innovative companies remain without mentoring support and cannot understand the features of doing business, and they do not have plan or the mechanisms for their further integration into the innovation infrastructure in order to help the rest of the residents of industrial park or technology park. This is related to the desire of owners of technology parks or industrial parks to get a permanent income with minimal risks. The state is interested in regular payments taxes from companies-resident, but innovative enterprises are unpredictable and may become bankrupt at any time.

As a result, it can be observed that the existing innovation infrastructure should be redesigned for enhance its effectiveness. It refers to the mechanism of interaction between the individual elements and the development of a more flexible system of motivation, taking into account the peculiarities of dealing with innovative venture projects.

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## PROTOTYPE DEVELOPMENT OF MILLING MACHINE USING CAD/CAM

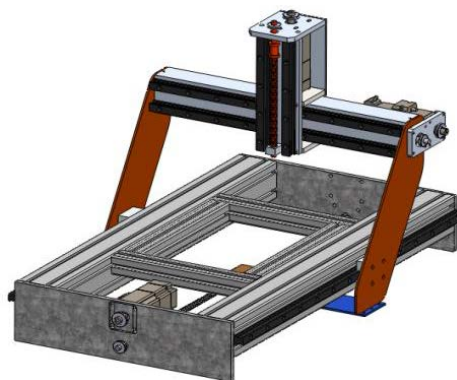
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During the economic crisis the companies should meet very stringent requirements in terms of operational efficiency. In its turn the production could not be effective without proper equipment. There are not only improvements of technological hardware but software and providing equipment. [1]

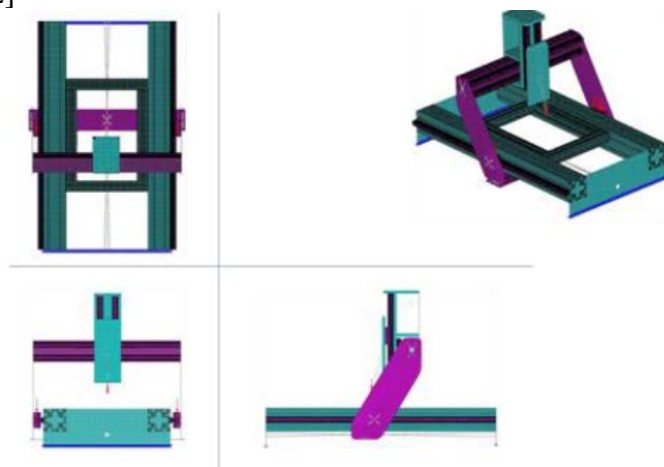
The application of information technology in the manufacturing allows significantly improving the product quality reducing the time of manufacture and production of complex products with full quality and the technological developments in the stage of project development. Among the most effective technologies allowing to execute these requirements belong to the so-called CAD/CAM/CAE (computer-aided design, technological preparation of production and engineering analysis).[1]

In earlier times when the computers had not been developed there had been a representation of using conventional media in designing. Ancient architects used a text abstractly to describe the design process. 2D drawings were later introduced and only expressed abstract visual thinking. The attempts have been continued to identify the nature of different design tools. Last years, digital technology has been developed and matured at an unprecedented rate. This growth has led to a converging phenomenon that erodes the traditional boundaries of computing. Compared with conventional design media it is worth employing computer technology meaningfully to bring significant changes in the process of systems design and maintenance. The conventional approach involves the use of drawings and models as means of representing the basic convention. The type of models used in the design process can either be a physical or digital model. Both types were used as a means of solving complex problems that 2D drawings were unable to handle. 3D CAD models are three-dimensional computational representations of objects drawn in the x, y and z axes and illustrated in isometric, perspective or axonometric views. These views are achieved simply by rotating the viewpoint of the object. In general a 3D CAD model of an object provides the following advantages: (a) an object can be drawn once and then can be viewed and plotted from any angle; (b) A 3D CAD object holds mathematical information that can be used in engineering analysis, such as finite-element analysis and computer numerical control technology; and (c) A 3D CAD object can be shaded, rendered and assigned various materials for visualization. 3D CAD models can be generated by the use of various types of CAD software systems.[2]



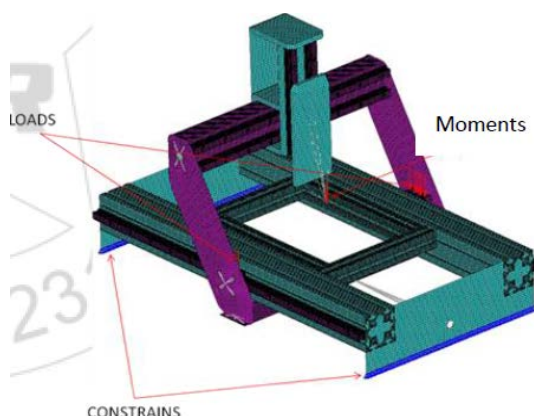
*Figure 1 -CAD model of milling machine*

The finite element method (FEM) is one of the most used methods in engineering. These methods and programs based on it are fundamental usage in CAD. FEA / FEM are indispensable in all engineering analysis where high performance is required. The main purpose of the study is to see a practical application using FEA to improve design of a typical mechanical component.[2]



**Figure 2 - Hyper-mesh model of proposed milling machine**

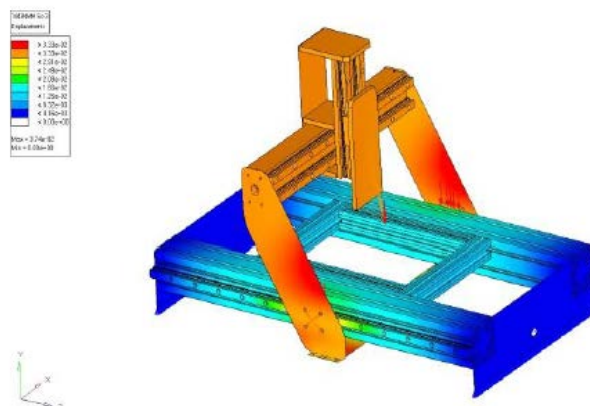
Materials used for milling machine are steel and aluminum. In this fig. the element of machine shown by blue is steel material. Likewise portion of machine shown by purple is Aluminum. In this hyper mesh model there are 463973 total elements and total nodes are 554403. These elements are in 2D as well as in 3D. 2D elements are shaped like triangular and rectangular. Similarly, 3d shapes are in pentahedral and hexahedral shapes. Bluish colored element denotes that part is fixed and constraint. Red colored arrows which are near the gantry denotes loads applied to worktable and red colored arrows which are near spindle denotes moment.[3]



**Figure 3- Boundary condition applied to milling machine**

#### *Defining Boundary Conditions:*

- 1) To define a problem which results in a unique solution it must specify information on the dependent (flow) variables at the domain boundaries. Specify fluxes of mass, momentum, energy, etc. into the domain.
- 2) Defining of the boundary conditions involves:
  - a. Identifying of the location of the boundaries (e.g., inlets, walls, symmetry)
  - b. Supplying information at the boundaries
  - c. The data required at a boundary depends upon the boundary condition type and the physical models employed.



**Figure 4 - Finite elements results**

The results of the stress analysis of a complete milling machine reveal that the maximum stress occurs in the frame where the overall mechanism for the movement is mounted. The maximum stress value is 14 MPa and the allowable stress of the M.S material is 24 MPa. Therefore, we can conclude that the design is safe enough for its application and working. If the stress increases beyond the allowable stress of the material it occurs a failure.

#### *Part Programming Using CAD/CAM*

A CAD/CAM system is a computer interactive graphics system equipped with software to accomplish certain tasks in design and manufacturing functions. One of the important tasks performed on a CAD/CAM system is NC part programming. In this method of part programming elements of the procedure are usually done by the part programmer instead of the computer. There are two main tasks of a part programmer in a computer assisted programming:

- a) Defining the part geometry
- b) Specifying the tool path.

The proposed methodology is used to automate both of these tasks.

We can conclude that the use of CAD/CAM systems will allow not only reducing the development time of the project and the means of production to create test models. All the necessary research for future designs can be made by means of the system and to obtain a sufficiently accurate and objective result. Same thing is with the machining simulation. You can build the handling of complex curved surfaces and a full scan without the use of a test work piece with the help of these systems. Such systems will be successfully applied not only in serial and mass production but in the unit which produces unique and highly sophisticated products. The cost of failure of such productions can exceed several million.

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## THE CURRENT DISTRIBUTION IN AN ALUMINIUM ELECTROLYSIS CELL WITH COPPER COLLECTOR BAR

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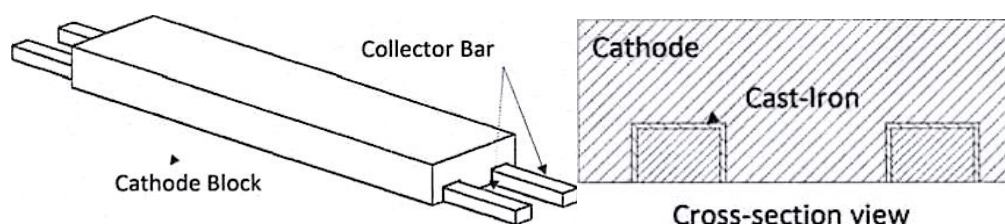
Understanding the magneto-hydrodynamic forces generated due to the external magnetic field and current density distribution within the cell (current in cell linings) is important in the optimization of cell dynamics. It is well documented that these factors play a crucial role in establishing the metal-pad stability of the cell. Conventional cells use the cathode-collector- bar assembly to carry the current through molten aluminum, the cathode and the steel collector-bar to nearest external bus. The electrical conductivity of the steel is so poor relative to the molten aluminum that the outer third of the collector bar carries the maximum load, which in turn increases the horizontal components of the current within the cell.

Also considered to optimize current distribution throughout the cathode lining. Various shapes and sizes of cathode assembly. Obtained data show that use of a steel rod instead similar size copper bar can keep the voltage of 150 mV. There is a reduction of more than 70% in current density value due to the copper inserts.

A high demand for aluminium and the associated high energy costs force smelters to push their Hall-Heroult process to its limits such that maximum production is achieved using existing plants with minimum of capital outlay. One method of achieving this is by reducing the inter-polar distance (ACD) through magnetic compensation.

In a typical Hall-Heroult cell, current passes from the anode to the nearest external bus through electrolyte (bath), molten aluminium, cathode blocks and collector bars. Tarapore determined the horizontal current in the metal by measuring the current in steel collector bars[1]. Fraser reported the existence of current gradients due to ledge thickness. Recently, the authors predicted the impact of sidewall inclination on current distribution in the side-channel[2]. Cathode blocks are arranged in parallel and contain the metal pool that has the negligible current resistance. The flow of electrical current through the molten aluminium and the cathode follows the path of least resistance. Thus, the current traverses in skewed path in the cathode to the nearest collector bar position, which has an adverse effect of generating horizontal component in molten metal. Recently, Kaenel and Antilie proposed a cathode design that could alter the current distribution significantly in the metal pool. The design allowed a deeper pool in the central region to improve the current distribution.

Conventional cathode blocks have at their lower surface one or two slots or grooves to receive steel collector bars with cast-iron. Cast-iron is provided to facilitate the electrical contact. Those slots are machined typically in near rectangular shape as shown in the Figure 1. Dupuis recently reported different slot configurations on the basis of thermo-electrical modelling and suggested different shapes to provide better contact. Several researchers have pointed out the importance of improving the contact resistance between cathode and collector bar in order to maximise the voltage gain from the cathode-collector bar assembly. In some cells, the cathode sizes are changed to accommodate the anode width to decrease the horizontal current.



**Figure 1. Schematic representation of cathode-collector-bar assembly**

In this work, an attempt has been made to improve current distribution within the metal through cathode-collector-bar-assembly design. Steel and copper collector bars of different sizes are to be used to study the impact of their conductivities on current distribution both in molten metal and cathode. The main objective of the paper is to study the effect of the collector bar assembly on overall current distribution within the cell.

Voltage drops are obtained for both horizontal and inclined collector bars at different lengths. The maximum cathode-collector-bar (steel) assembly voltage drop is predicted to be in the range of 208 to 290 mV depending upon the collector bar lengths. Similar voltage drop is also reported by Dupuis et al [3]. The discrepancies between these comparisons may be attributed to cathode height or its width or many other possible differences between the models. In general, the equipotential lines in the cathode assembly are in good agreement.

Voltage gain increases with increased length of the collector bar which is due to increased electrical conductivity. The patterns of these field-lines are mainly determined by the size and shape of the collector bars and the cathode. Equipotential lines are rarely parallel indicating the existence of non-uniform current distribution throughout the cathode. However, the stratification of the equipotential lines increases with increase in length of the collector bar and this improvement can be enhanced with inclined collector bars.

In general, the voltage drop increases non-linearly as the length of collector bar reduces. This clearly indicates that the mean least-resistance-path from cathode surface to cathode-flex (collector-bar output) is a function of length of collector bar. The results show that there is an opportunity of saving nearly 8 to 10 mV while using inclined collector bars. The figure shows two sets of graphs representing 50 and 100 mm heights of collector bars respectively. The voltage gain is approximately 50 mV when using 100 mm collector bar, which may be attributed to the decrease in mean least-resistance-path length. Dupuis and Haupin have also reported similar voltage gain due to change in collector bar height. It is to be noted that a 2D analysis overestimates the voltage gain (saving) as it does not take account of width factor in the analysis, nevertheless, it clearly demonstrates the importance of geometric factors particularly the length and shape (inclination) in regards to the overall electrical field distribution.

There is a significant saving (>100 mV at 60 % insertion) when compared with equivalent size of steel collector bar. The height of copper collector has less impact in terms of voltage saving due to the high electrical conductivity of copper.

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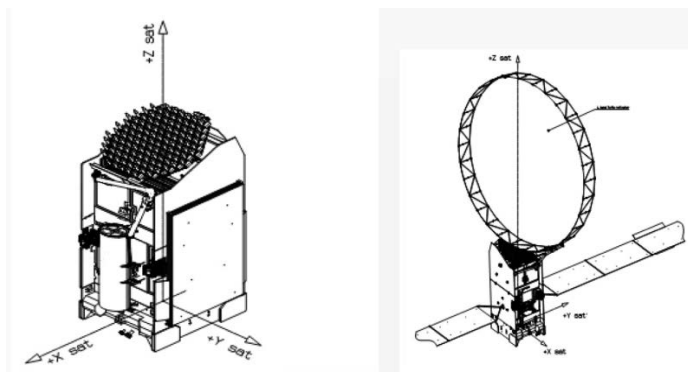
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## REVIEW OF RF SENSING SYSTEM FOR SATELLITE ANTENNA APPLICATION

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Every year the requirements for satellite capacity are increasing. And now it is 100 Gbit/s. The new generation of satellites is called High Throughput Satellites and they have multi-beam antenna to achieve high gain and frequency reuse. Coverage of multi-beam antenna systems for satellite applications consist of a large number of contiguous high gain spot beams. These coverages are typically achieved by interlacing pencil beams. Typically beam width could be varied from  $0.3^\circ$  to  $1.5^\circ$ . Example of multi-beam antenna is shown in Figure 1.



**Fig. 1 – Multi-beam antenna for MUOS Satellite**

How we can see multi-beam antenna is a reflector antenna which uses antenna array like a radiating system allowing to create numbers of pencil beams with big electromagnetic energy into beam. It's necessary to achieve a high satellite capacity.

Though there is a disadvantage in application of multi-beam antennas. It is the offset from the Edge of Coverage (EOC). The performance of these very narrow pencil beams is seriously affected by satellite swinging on the orbit during the day. For example, a pointing error of  $\pm 0.12^\circ$  will result in EOC gain degradation of approximately 3 dB for a cell size of  $0.75^\circ$  (EOC gain 4 dB below peak gain). As a consequence, these communication systems generally require closed-loop antenna tracking system to minimize the performance degradation due to pointing error<sup>[2]</sup>.

Onboard RF Tracking System to maintains the coverage of spot beam over specified area. Various available auto-track techniques (like program track, step-track, monopulse etc) which help to mitigate the effects of roll and pitch. Monopulse is preferred over other options, wherever high pointing and tracking accuracy is required. The main advantages of monopulse RF Sensing System are:

- independent of the received signal level (error angle information is taken from input signals ratio);
- sensed the error in roll & pitch axes simultaneously.

The basic principles of monopulse method was developed by Donald R. Rhodes in 60's. Rhodes defined the following three postulates of monopulse method:

- «Postulate 1: Monopulse angle information appears in the form of a ratio»;

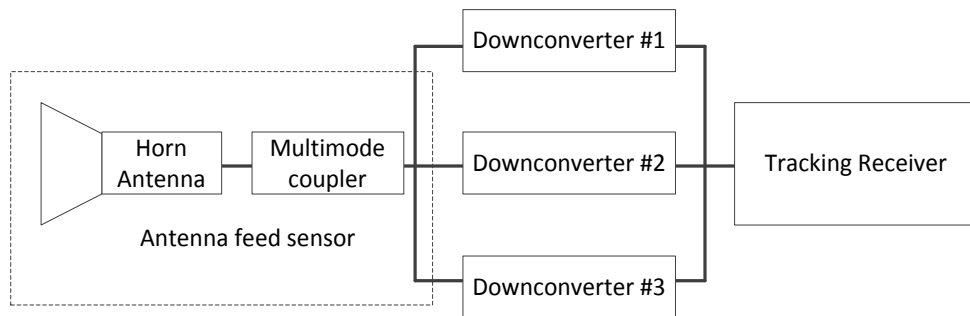
- «Postulate 2: The sensing ratio for a positive angle of arrival is the inverse of the ratio for an equal negative angle»;
- «Postulate 3: The angle-output function is an odd, real function of the angle of arrival»<sup>[1]</sup>.

For ease of understanding, we can define tracking task like a finding one of monopulse ratios:

$$r_m(u) = \frac{P(u)}{P(-u)} \quad (1)$$

$$r_m(u) = \frac{P(u) - P(-u)}{P(u) + P(-u)}$$

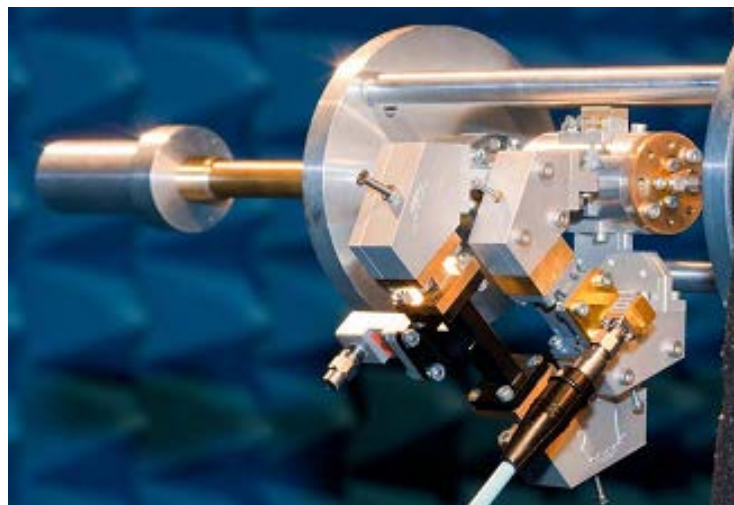
Modern RF sensing system is a complicated measurement system which consists of various devices. The main purpose of RF Sensing system is the correction pointing error angle. Usually, this system is installed into communication channel which allows to use it for correction angle and for transmitting or receiving signals. Generally, monopulse tracking systems consists of the following components:



**Fig. 2 – Block diagram of Monopulse RF Sensing System**

Let's consider the structure of modern monopulse RF Sensing System in details and clarify how RF Sensing System works.

Antenna feed sensor is the system which has two components. The first one is a horn antenna, the second – the multimode coupler. These two components are called an antenna feed sensor. Examples of horn multimode coupler and antenna are shown on Figures 3 and 4 respectively.

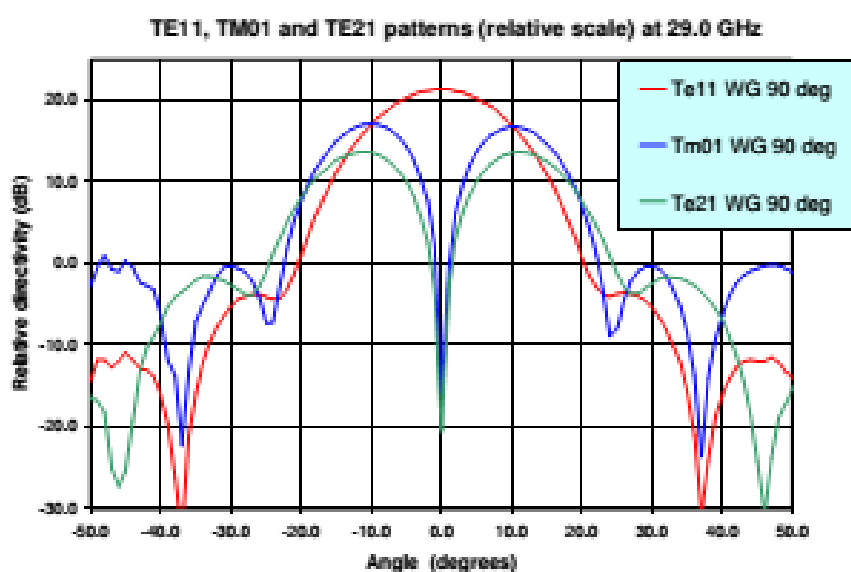


**Fig. 3 – Multimode Monopulse coupler**



**Fig. 4 – Multimode feed horn Antenna patented dy MDA**

Antenna feed sensor performs an important function in the RF Sensing System. It forms sum and sum-difference antenna patterns which are used to find tracking function. Antenna patterns which are formed in antenna feed sensor are shown in Figure 5.



**Fig. 5 – Antenna patterns**

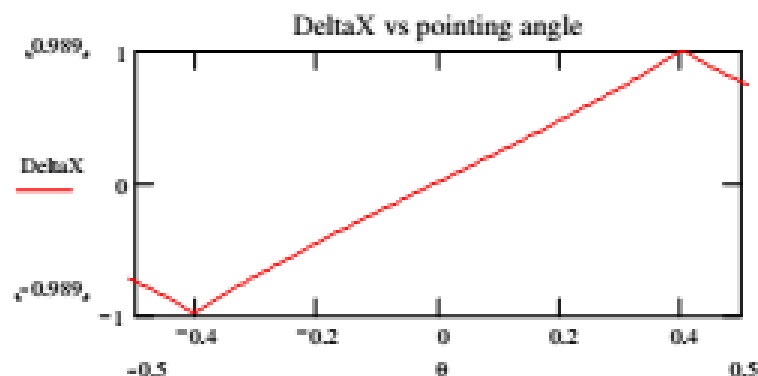
Signals from Antenna feed sensor are amplified and down-converted for further digital processing. Example of Receiver assembly is shown in Figure.6.





***Fig. 6 – Tracking receiver assembly made by Thales Alenia Space***

The main purpose of Tracking receiver is calculation tracking function. In other words the receiver calculates the ratio of difference signal to sum. Tracking function is shown in Figure 7. The slope of tracking function is varied in different systems. It's depends on the accuracy what of expected results. In modern RF Sensing System accuracy of finding pointing angle error is  $0.005^\circ$ .



***Fig. 7 – Tracking Function***

In conclusion I would like to add that nowadays antenna pointing task has become a complicated problem. Investigation in RF Sensing System will allow us to achieve good quality in satellite communication.

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## TECHNOLOGY OF PURIFICATION OF RETURNABLE WATERS FROM KNOT OF DEHYDRATION OF RAINFALL OF CITY SEWER CONSTRUCTIONS

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Return water (waste water, filtrate, fugat), detachable from sewage sludge during its processing, especially when using the deep stabilization in anaerobic conditions, highly polluted by nitrogen and phosphorus compounds. These threads can return to the head of sewage treatment plant to 20-30% of the nitrogen and phosphorus from their quantities coming from sewage water. This greatly increases the load on the biological treatment plants with which they cannot handle. The load caused by the return of sludge water in the main stream, can be reduced by using a chemical, physical or biological treatment [1].

In the list of the best efficient technologies [2] to clean the return flows from the sludge treatment is offer:

- the use of ANAMMOX bacteria to remove nitrogen;
- nitrification-denitrification;
- sedimentation of phosphates with receiving fertilizers.

Process of ANAMMOX includes two separate processes. The first process consists in a partial nitrification of a half of ammonium to nitrite by the bacteria absorbing ammonia. Further the remains of ammonium and nitrite during the process of ANAMMOX which is carried out by the second group of bacteria turn into molecular nitrogen and nitrate. In Russia the process of ANAMMOX was never used in relation to problems of city treatment facilities. In Danilovich's works results of laboratory researches on anaerobic oxidation of ammonium in returnable streams from processing of the fermented deposit are described. Efficiency of removal of ammonium reached 99% [3]. The advantage of this process is low energy consumption which makes no more than 35% of usual process nitrification-denitrification and also the lack of need for additives of organic substances. Disadvantages: low growth rate of biomass, a possibility of toxic influence, the required temperature has to be not lower than 20-22°C<sup>0</sup>.

The principle of a method nitrification-denitrification consists of denitrification through nitrite. Process differs from nitrification-denitrification in the fact that a nitrification is carried out to receiving nitrite of an ion which in the course of a denitrification is transferred to atmospheric nitrogen. Process demands thin regulation of pH. Advantage of process is in decrease in consumption of oxygen by 50% unlike a nitrification - a denitrification.

The method of sedimentation of phosphates with receiving fertilizer is based that at addition of salts of magnesium in returnable waters phosphates and ammonium nitrogen in a fluidized layer of sand form granules of a struvite (magnesian ammonium phosphate). This method allows to receive directly from pollution of a granule of fertilizer, but rather power-intensive, demands magnesian reagent and is effective starting with the high concentration of phosphorus (from 50-70 mg/l).

The researchers conducted in PROFESSIONAL "Mosvodokanal" have shown that process of removal of phosphorus in the form of a struvite takes place in conditions when concentration of phosphorus in the form of phosphates - ions in drain water doesn't exceed 30 mg/l, with a high speed (residence time till 1 o'clock), under a condition addition of ions of magnesium in drain water before achievement of a ratio of phosphorus to magnesium as 1:1,5 [4].

The aim of our work was the clarification of availability of sludge water from condensation of draught of primary clarifiers, phosphates in the form of struvite formation.

The experiment was conducted on sediment treatment facilities or depots on the city of Krasnoyarsk. Sediment defecate during the day, drain water nitrogen content ammonium salts and phosphates and  $MgCl_2$  solution was added, containing 1 mg Mg in one ml. Drain water containing phosphates 34,75 mg P, nitrogen ammonium salts of 50 mg/l phosphorus to magnesium Ratio ranged from 1/0,86 to 1/2,2, pH change ranging from 7,3-9,97. After reagent processing sludge defecate during the 1:00 and clarified water nitrogen ammonium salts and phosphates content. Experimental results are presented in the table 1

Table 1. The influence of additives of  $MgCl_2$  on the removal efficiency phosphates and nitrogen ammonium salts of drain water.

Dose $MgCl_2$ , mg Mg/l	0	5	7	7	7	7	0	2
The ratio of P/Mg,	1/0,86	1/1,3	1/1,5	1/1,5	1/1,5	1/1,5	1/1,7	1/2,2
pH	8,87	8,11	8,3	8,85	8,98	8,97	9,37	9,32
C ( $PO_4^{3-}$ ), mg/l	0	0,3	7,7		7,7	0,3	0,3	7
C ( $N(NH_4^+)$ ), mg/l	0	9	8,4	0,1			0	9,4
Nitrogen removal efficiency of ammonium salts, %	reduced nitrogen concentrations of ammonium salts is almost never happens.							
Phosphates removal efficiency, %	1,2	9	0,2	2,7	9,1	6,1	0,5	9,9

As can be seen from the above data, the maximum phosphate removal occurs when processing the drain water  $MgCl_2$  at a dose of 20 mg/l at a pH of 9,37. Removal efficiency increases of phosphate With the increase of pH. Reduced nitrogen concentrations of ammonium salts in all experiments were observed. Obviously, struvite it wasn't formed. We hold that the drain water processing technology needs further research.

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**ARCHITECTURAL DESIGN:  
A RESIDENTIAL COMPLEX FOR AUTISTIC PEOPLE «ISLAND»**

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Autism is a disorder of psychological development, which is characterized by motor disorders and speech and leads to disruption of social interaction<sup>[1]</sup>.

Autism is a serious problem of the 21st century. According to the 2007 data of the World Health Organization (WHO) the number of people with mental and neurological problems, including autism, is steadily growing. Globally these diseases account for 11% of all health problems<sup>[2]</sup>.

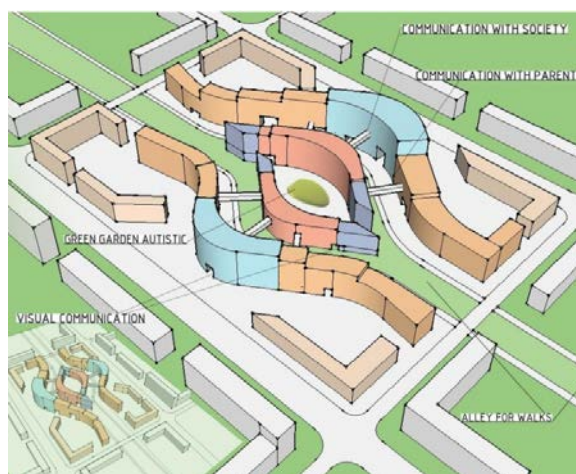
Such actualities require a complex approach to deal with them and must involve both medics and representatives of other socially-oriented fields aiming to provide a proper social well-being. We consider the problem in terms of architecture. Autistics should be provided with comfortable living conditions and set social ties with common people.

Everyone needs some personal space. So do autistic people. Living in their own world, having their own logic and feelings, they tend to retreat and withdraw from other people. It often makes the society perceive them negatively.

The goal of the project is to create an urban environment, an island-like area allowing for favorable conditions to develop social abilities and overcome fear of citizens. The center of the neighborhood will be provided for autistic people of various categories: the disabled who require some constant care; partially able-bodied who need a weekly care; and active working age people who are able and willing to work but such a diagnosis hinders to employ anywhere. It is the care for the more disabled that is supposed to be a workplace for them.

The concept represents a complex neighborhood which consists of a core (autistic housing) and surrounding protective chains of buildings: the intra-public area, which, in turn, is followed by housing for autistic residents's parents and eventually outer angular houses – for healthy citizens.

The conceptual design and general plan are shown in Figures 1, 2.



**Fig. 1. Residential complex «Island». General view.**



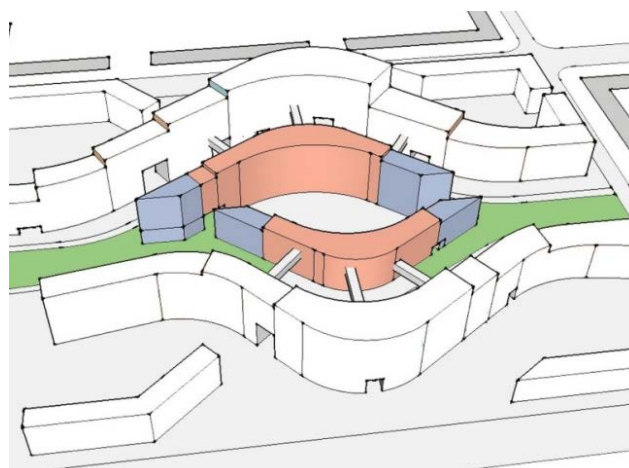
**Fig. 2. General plan of the complex**

The yard is almost closed along its entire way. It has some small passages that serve as visual communication with the following part. Autistic people, inclined to seclusion though, will have an opportunity to witness a life beyond their circle. They will see the life in the public area (alley) and may want to «get out into the community». The house is provided with all the necessary services: shops, pharmacies and other medical service (shown in purple). In the center of the yard there is a greenhouse to do the gardening.

*Public area (alley)*

The public area is a pedestrian link between the parts of the neighborhood. However people walking along the alley cannot get into the internal part inhabited by autistic residents. The alley zoning is realized with green bushes and trees. Besides, along all the way it is equipped with guiding signs, drawings for pedestrians.

The principle of houses and alley location can be seen in Figure 3.

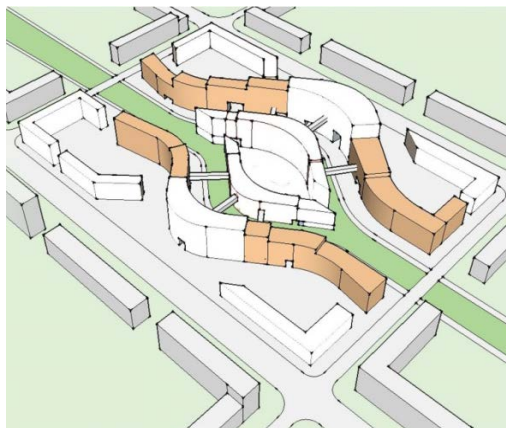


**Fig. 3. Functional zoning and servicing for autistic people**



Parents always want to look after their children, even if they are over 30. Moreover if a child needs some special care. Simultaneously the autistic people should be given some independence. The project provides visual communication by keeping the height of the houses for autistic residents lower in relation to that of their parents' houses. The buildings have operated roofs from where parents can watch their children.

The location of parents' houses can be seen in Figure 4.

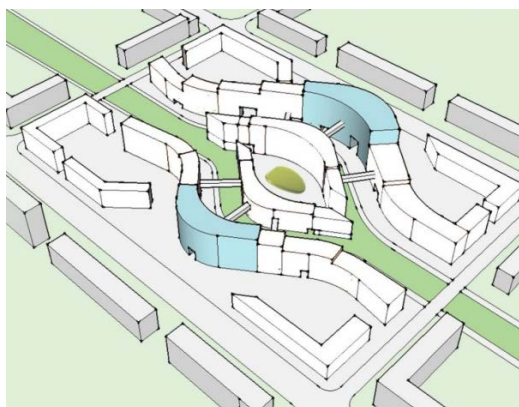


***Fig. 4. Houses for parents of autistic children (marked in orange)***

#### *Cultural and Business Center*

A lot of autistic people are able to live independently and to do light work. There are a lot of those who are keen on drawing, music, and mathematics. The cultural and business center is a place where they can develop their talents. The center is has a variety of functions and is accessible to visitors outside the neighborhood.

The Center location is represented in Figure 5.



***Fig. 5. Business Center (shown in blue)***

These houses are typical buildings and differ from the neighboring blocks neither in yards nor in services and the like.

#### *Linking*

Autistic residents' houses have both closed and open communications with the outside world. The closed links are those from an autistic person's house to a parent house. Thus parents can come to their children and provide some needed care. In turn, autistic residents can also visit their parents without leaving the house. That is very important since leaving the house a person gets into the society which is not always comfortable for autistic people. Also their houses are provided with closed passages to the cultural and business center. Open links are arches through buildings allowing free outside/inside passage.

Autistic people live in a specific vacuum protected by parents' houses. Being in a closed space they still get in touch with the outside world through linking (open and closed) points. Autistic people are not deprived of feelings. So affecting their curiosity may try to involve them into the society! Another factor to get them from their inner world is communication at work at the cultural and business center. First, autistic people may not want to make contact but gradually the center will become a commonplace, and people will become friends.

Autistic people can go through three stages of self-sufficiency. The first step is to create a community of familiar people. The second is to enter the public zone. The third is to go beyond the neighborhood.

This project can be easily implemented since there is nothing extraordinary in the layout of the houses. However, it will bring a number of the following advantages:

- Price. The cost of these homes does not differ that of from conventional houses;
- The simplicity of the construction. There is no need to invent new planning. Parents houses may be typical;
- The proximity to the society. According to the concept autistic residents are purposefully settled inside the urban area rather than in the outskirts. The modern society cannot communicate with such people. It would be nice to create a symbiosis of different social layers including autistic people.

The whole idea is not to invent new formulas of architecture, structures, technologies, and in the zoning district and functional saturation, the game on the psychology of autism.

Such projects and ideas are not just relevant, they are necessary in today's society, the main thing to give the initial impetus to the plans of specialists in the field of architecture and urban planning.

Thus, the idea is not to invent new formulas of architecture, structures, technologies, but to zone the neighborhood and make it more functional taking into account the autism psychology.

Currently similar projects are of great relevance. They claim the collective approach to achieve a successful result.

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