

# Modern scientific research and their practical application

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This volume contains research papers of scientists in the field of ART, ARCHITECTURE AND CONSTRUCTION.

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## CONTENTS

**SCIENCE of ART, ARCHITECTURE AND CONSTRUCTION**

J21202-111	ECO-ARCHITECTURE OF TOMORROW: IDEAS AND CHALLENGES	Denis Markov
J21202-624	Aleksandro-Oshevsky monastery: yesterday and today	Kutukova E.S.
J21202-477	NEW HYDROPHOBIZATION COMPOSITION	Usachyova J.V., Chucklanov V.J.
J21202-652	MAKING A GREENER PLYWOOD PRODUCTION	Krivorotova A.I., Dovbysh J.M.
J21202-804	FLOW VALUES AT OUT FLOW THROUGH HOLES IN THE BOTTOM OPEN FLOW	Kalyakin A. M., Chesnokova E. V., Sautkina T. N.
J21202-805	SYNTHESIS ACCORDING TO FLOW RATIO OPENINGS (MOVING FLUID)	Kalyakin A. M., Chesnokova E. V., Sautkina T. N.
J21202-803	ON THE LAW OF INTERNAL DISTRIBUTION OF VALUES OF PIPELINES FOULING	Sautkina T. N., Kalyakin A. M., Chesnokova E. V.

**CID: J21202-111**

**Denis Markov**

**ECO-ARCHITECTURE OF TOMORROW: IDEAS AND CHALLENGES**

*Saint-Petersburg State University of Architecture and Civil Engineering  
Russia, St. Petersburg*

*The article talked about the examples and problems of ecological architecture of the nearest future, which it called to solve in an era of global challenges. A number of conceptual projects, which help to understand that modern eco-architecture plays a significant role in promoting sustainable development and resource conservation in the modern world are given.*

*Keywords: architecture, ecological building, ecology, energy-efficient buildings, energy efficiency, energy conservation.*

We live on the threshold a transition to more high-quality, technologically innovative kind of art in which the fusion of architecture, biology and technology will be one of the main morphological principles. Cities of the future as them represent architects this is a concentration of the new eco-responsible social order, technologies for renewable energy and the rational use of natural resources.

The architecture offers solution of global problems by planning the development of mankind in the future. Consider a few examples of solutions to global problems in the framework of eco-architecture. Environmental refugees – is a problem that is becoming increasingly important for modern states, so the architects offer their ideas for solving it. For example, the project "floating Ecopolis for environmental refugees", as defined by the author himself, a Belgian architect *Vincent Callebaut*. The project «Lilypad» – is a giant floating city (Fig. 1), designed for 50,000 people, environmental refugees who are forced to leave the land as a result of natural disasters. The project joined innovation of cybernetics and the various green technologies. Thus, the "double skin" structure would be made of polyester fibers covered by a layer of titanium dioxide (TiO<sub>2</sub>), which would react with ultraviolet rays and absorb atmospheric pollution via a photocatalytic effect. Titan under ultraviolet light breaks down air pollutants by photocatalytic reaction. The floating

city would also include the full complement of renewable energy technologies, including solar, thermal, wind, tidal, and biomass to produce more energy than it consumes. [1].



**Figure 1. «LilyPad» – floating city concept by Vincent Callebaut**

An interesting project that allows us to understand what the approaches in sustainable architecture are in the near future, the project demonstrates the architects from *Mekano Studio* called «Seeds of Life» (Fig. 2).

A city piled high of trash, they call it ‘garbage city’ and it seems unstoppable. People started to get used to the situation which will lead to a huge trash covering the whole city and from another point, garbage can’t be moved outside the city. The problem leads to another, as there is lots of diseases and pollution. The city is populated by a community of homeless people called Zabbaleen, as they coexist with the trash, so they collect, sort or resell Cairo’s waste [2].

It is planned that homeless will be most actively involved in waste management and construction of this unusual skyscraper. Thus sustainable architecture is actively involved in solving social problems of the largest city in North Africa.



**Figure 2. «Seeds of Life» by Mekano Studio**

Another trend that will continue to develop the architecture of the future – the active implementation of digital technology in many aspects of life of citizens. Experts say that in the XXI century global computerization would have the same effect on urban development, as the car in the last century [3]. At present, South Korea is constructing a city that has no analogues in the world, *New Songdo city* (Fig. 3).



**Figure 3. New Songdo City by New Songdo International City Development LLC (NSIC) with the participation of Cisco Systems, Inc.**

*New Songdo city* from the beginning designed as a "digital city": electric cars and cars with hydrogen engines will be connected to a single city network, pneumatic chutes deliver the trash right on the methane factory producing fuel for engines, and intelligent electronic road signs will automatically change depending on the density

of road and passenger traffic. *New Songdo city*, as conceived by its creators has become a center for testing of new concepts of urban development and information systems management of urban services.

In conclusion it should be noted that the architects of present days work for the future, for a more eco-friendly and sustainable energy-efficient future, where it is possible to realize the social projects that improve the welfare of all citizens of the our world. Because, as said the Pritzker Prize 2011 Winner, the Portuguese architect Eduardo Souto de Moura, "there is no ecological architecture, no intelligent architecture, no fascist architecture, no sustainable architecture – there is only good and bad architecture" [4].

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**CID: J21202-624**

**Kutukova E.S.**

**Aleksandro-Oshevsky monastery: yesterday and today**

*State university of management, Moscow*

*In this report is considered the history of emergence, formation, destruction and revival of Sacredly Aleksandro-Oshevsky monastery of the Kargopolsky region of the Arkhangelsk region as center of spiritual life.*

*Keywords: belief, monastery, revival, sacred, spiritual, icon, architecture, monument.*

### **Sacred Aleksandro-Oshevensky monastery: history**

Saint Alexander founded a monastery on the river Churiega, inflow of river of Kena, in the 60th of XV century. On that place Alexander received a sign from God therefore the place is chosen successfully – in a river bend, on slightly sublime place which is not filled in fullwatering. The complex of the monastery was well visible from the top and bottom reaches of the river. Here, in a bend, still there is a grove connected once with a pagan cult. The monastery should promote the statement of Christianity. Also Saint Alexander's life writings (zhitie) testifies about emergence of the monastery: «In Kargopolsky area there is a volostka - Sloboda zavoma (old Russian words, mean a definite place, called - Sloboda zavoma), over the river Churiega and on the one side of this river there is a place, that is necessary for a monastic structure». (Barsov E.V.). But what conditions were necessary for a place, that is "necessary for a monastic structure"? First of all it is the proximity of the river, providing permanent fishery and convenient communication with the Novgorod trading way, passing on river Ken and Onega to Northern Dvina and the White sea. Also Saint Alexander's life writings notes the picturesqueness of the place.

Based on life writings, it is possible to follow the history of construction of monastic temples. The first - Nikolsky - was erected still by Saint Alexander, the second - Uspensky - arose at his successor abbot Maxim. In the late thirties XVI century Nikolsky temple was replaced with a new one, built by "woodmaster" Vasily. The second temple - Uspensky was also renewed. In the middle of the XVI century both churches burned down, however soon were restored. This time both churches staid till May 6, 1706 when the monastery was almost entirely burned down by a lightning. After that fire in the Aleksandrovo-Oshevensky monastery mainly stone constructions began to be erected, the part from which remained up to nowadays. (Milchik M. I. Wooden architecture of Russian North. L., 1981, p. 78).

During the whole time of the existence the monastery hasn't become big and hasn't acquire lot of wealth, but for the whole Northern region it was, as for average

Russia - Troitse-Sergiyeva Lavra. Countless Monasteries and pustinki of the extensive North ( little places, somewhere faraway from all people, where monks live and pray) has come from this monestery, and also such saints as sacred Saint Pakhomy Kensky, Antony Siysky, Nikodim Kozhezersky, Kirill Stryinsky. Founders of the Makaryevsky monastery on Hergozera, the Vazengsky, Makaryinsky, Spassky desert were also natives from the Oshevsky monastery. In spiritual communication with Saint Alexander was also St. Damian's Yuryegorsky monastery (in Diodora`s schema). So in Russian North extended the tradition of the monastic feat going from Sergy Radonezhskiy.

The first letter of grant in favor of a sacred monastery gave in 1540 tsar John Vasilyevich (Grozny) on the right "to possess land", peasants before 650 "souls", on fishing, gratuitous saltern and free sale of salt. Also the subsequent governors of Russia didn't forget a monastery. From "Olonets Diocesan sheets" (1907-1908) we can know that the monastery had 30 cows and 10 horses, the arable and haying lands, wood plots, fishery work and the capital of 23 thousand roubles.

The shape of a monastery before a devastating fire of 1706 was restored due to the icons - it was depicted here. On some the monastery from the river from the East is shown, on others it is presented from the West. The main place in it is occupied by temples. Main of them, Nikolsky, treated to the tent crosswise churches. On icons prirubs(A small wooden outbuilding, structurally related to the larger part of the building), covered by barrels are well visible. Transition from them to vosmeric is executed in the form of the two circles of kokoshniks. The Odnoglavny kletsky temple shown on icons from South side of Nikolsky church, was Alexander Oshevskiy's limit, in which there were relics of the sacred. Height of church consider to be 40 meters, and Uspensky - 35 (L.Glinevich. И да откроется вам! Kargopolye, 1991, 19th deck.).

In the XVII century иконы with the image of the Oshevsky monastery were widely adopted: they carried glory about sacred and its monasteries across the whole Russia. Then in the Moscow Uspensky cathedral the special holiday in honor of Saint Alexander was established.

Article published in the newspaper "Olenetsky week" No. of 25.5.1912, under the name "Religious procession in the Aleksandro-Oshevsky monastery from Kargopol and back" tells us how the vicar of the Olenetsky diocese Preosvyashchenny Varnava, the bishop Kargopolsky, undertook travel with religious procession to the Aleksandro-Oshevsky monastery ("from Kargopol to a monastery of 42 beliefs") The lord moved independently on crew, making thus services in local churches, told edification words, and then, caught up with religious procession and, having left crew, strode behind it, admiring a procession. In the evening he left to the Oshevsky monastery, having visited by the way temples. Since morning having made a liturgy in a monastery, he moved towards to city religious procession with a monastic course. After the arrival of the incorporated religious procession in a monastery of Saint Alexander the clergy permanently served public prayers at the crayfish of the sacred. Then there was a night service which was served by three church workers of a monastery together." Preosvyashchenny served in the top church the Lord with the Archpriest, 14 priests and two celibate priests, with archdeacon and a set of deacons. On the right choir sang psalm readers of the Kargopolsky Spasopreobrazhensky monastery, and on left - chorus of Oshevsky maidens under control of the local peasant. On "lithium" came at the same time from three churches.... there was an uncountable set of the people, but the order was exemplary... In a fencing, before a temple window - close crayfish, nightlong vigil was continued and the acathistus to the sacred was read. Next day the celebration proceeded, and several days later religious procession left back in Kargopol".

The received data allow to draw a conclusion of a great influence of a monastery, both on pilgrims, and on the neighboring Kargopolsky region, having created in it a special system of life. The Distribution of influence of a monastery also considerably was promoted by its ground possession as inhabitants of monastic villages and workers at salterns and other farms of a monastery acquired also views of monks on the way of life.

### **Monastery today**

The stone monastery which partially remained up to nowadays, repeats former wooden only in the most general terms. On the contrary there is a Sacred grove which remained still from paganism. Earlier from the monastery to a grove conducted a picturesque avenue, with disembarkation of east roses . In a grove there was a chapel of St. Alexander, replaced at the beginning of the XX century by obetny crosses which remained even today.

After October revolution of 1917, in 1922 in a monastery left only the last prior fr. Dosifey and monk Dimitrii (the appendix 3 – the sheet monashestvuyushchy). In the same year, due to the initiative of communist N. Popov, the "shell" with the relics of the sacred Alexander were opened, on the eyes of locals, representatives of volost and district Councils. But they found it empty, as relics of the sacred were under a bushel. Since that time, the monastery was considered closed (The builder of communism. 1998. On March 22. Arkh. Region, Plesetsk area). All tyrants of a monastery were repressed.

Since 1923 in a monastery was a school. Since spring of 1930 began the new destructive period of collectivizations in the history of Oshevsk. The monastery was reduced to ruins. Inhabitant of Oshevsk, an employee of the local library, Berezina E.E. remembers that while there was a school in a monastery , there was an order. In 1967-68gg., when school transferred to the village center, the period of final plunder of a monastery began – a brick monastic fencing were taken away, monastic constructions were destroying. However even in those days local people came secretly to pray over relics of the Saint. In filings of Kargopolsky newspapers it is possible to find out data that in 1968 the subject of restoration of a monastery was mentioned. In 1970 the Moscow students worked in its ruins, tried to make something, to support, to tidy up ...

During numerous visits of a monastery and meetings with a local population we practically bit by bit collected "general" opinion about the importance of a monastery for modern inhabitants of Oshevsk. So, for the Epiphany in 2007 the festive service with a rank of illumination of water took place in the rural temple, then all people, who had come went on Churyegu's river in Jordan. Local grandmothers, grumbling

and not keeping up with youth, hobbling on deep snow, exchanged words: « I am going to go in a monastery in the evening, to take water. It will be real there, Kreshchensky». It should be noted the fact that in 2007 the monastery wasn't operating yet and services in it were made several times a year by the local priest. Today the acting as the deputy of a monastery is celibate priest Kiprian who more than two years has been living in a monastery. During this time the roof of the brotherly case is restored, heating in Nikolsky temple is carried out, and thanks to the attraction of means of businessman from St. Petersburg the scheme of a bell row is now worked out and the first seven bells for which the temporary belfry is established are bought. Due to the diligence of people from Moscow and Petersburg residents created a monastic site on the Internet. Drawing up of the monastic chronicle was begun, which part will be the sheet made in this research.

Monastic services are renewed. On holidays local parishioners, people from neighboring villages, pilgrims from Moscow, St. Petersburg, Arkhangelsk and other cities of Russia and the neighboring countries are flown down to a monastery.

The Aleksandro-Oshevsky monastery had years of success, there were times of tests and ruins. But what ever happened, the monastery found forces to revive. It is possible to argue surely that the strength of mind put by the founder of a monastery – St. Alexander – was transferred to this place and till that day invisibly keeps both monastic structures, and people, who works here.

**CID: J21202-477**

**UDK 678.844**

**Usachyova J.V., Chucklanov V.J.**

### **NEW HYDROPHOBIZATION COMPOSITION**

*Vladimir state university of a name of A.G. and N.G. Stoletov*

*Given article considers possibility of creation of new hydrophobization composition.*

*Keywords: hydrophobization materials, limiting wetting angle, water absorption*

Concrete and ferroconcrete structures used in industrial, civil, residential and agricultural buildings are subjected to corrosive changes in temperature, acid precipitation, the chloride ions, presented in concrete, etc. To increase the resistance of concrete, is used high density concrete, special cement, the surface insulation in the form of colors, linings and waterproofing coatings, the introduction of air-involved, plasticizing and sealing agents.

Therefore the purpose of the presented work was the investigation of possibility of creating water emulsions OPPS-TEOS used as a water repelling agent in the construction industry. This will dramatically reduce the cost of water-repellents and can solve the problems associated with fire and explosion.

It's rather difficult to determinate the optimal composition of the water-repellent emulsion, since it is necessary to take into account the ratio of TEOS and OPPS. Therefore, the complete active bifactorial Box-Wilson experiment had been used for optimization. It allows do the statistical data manipulation by varying of two components. [1].

The water-repellent effect was determined by the limiting wetting angle. It had been done by photomicrography of water droplets at water-repellent surface of the concrete samples. Solids, which form a water contact angle  $\alpha_K < 90^\circ$ , are hydrophilic, and with the boundary angle  $\alpha_K > 90^\circ$  - are hydrophobic.

The maximum values of contact angle achieved with the following ratios: TEOS - 5.5 wt. hours, OPPS - 5.5 wt. h. At these values the optimum structure is reached and interaction and sufficient concentration for creation of a strong polymolecular layer is completely carried out. Multilayer layer is more resistance to external factors in a contrast to the monolayer layer with a tendency to hydrophobization[2].

The investigation of water absorption was carried out on standard concrete samples, which had been covered with different ratio of TEOS and OPPS emulsions.

As a result, the smallest valuation of water absorption was observed in the processing of concrete with emulsion in a ratio of TEOS - 6.2 wt. hours, OPPS - 5.7 wt. parts on 100 wt. parts of water.

An optimum offset to higher concentrations of OPPS and TEOS due to the partial overlapping of pores with concentration increasing. The reducing of the contact angle and increasing of sealing as interconnected processes may be expected[3].

The investigation of space hydrophobization with introduction of water-repelling agent directly into the concrete, was also studied. Frost resistance was conducted on samples of concrete. It was determined using the bases method, where the criterion was the number of freeze – thaw cycles. After that the change of ultimate compression strength was more than 5%.

Thus, the space water-repellency as compared with the surface one can dramatically improve the frost resistance of building materials. However, we must remember that in case of space water-repellency the consumption of relatively expensive water-repelling agent increases almost two orders comparatively with the surface one. Therefore the space hydrophobization is reasonable to carry out for critical structures, which are operated in harsh conditions, in terms of the effect of aggressive factors.

A principle ability of the practical use of an aqueous emulsion of OPPS-TEOS as a water-repellent material for the processing of ferroconcrete structures and monuments for its protection from adverse factors has been shown. The need for the development of new waterproofing materials was identified.

**CID: J21202-652**

**Krivorotova A.I., Dovbysh J.M.**

### **MAKING A GREENER PLYWOOD PRODUCTION**

*FGBOU VPO "Siberian State Technological University"*

*Increasing environmental plywood products based on synthetic resin is achieved by modifying their bark extracts of softwood timber while maintaining the strength properties of the material.*

*Keywords: plywood, synthetic resin, modification, environmental friendliness.*

In the initial stages of adhesion to the wood used mainly glues of animal and vegetable origin. The impetus for improving the adhesive was the development and manufacture of plywood chipboard.

Synthetic adhesives are largely forced out of industrial glues of natural origin because of its advantages: low cost of starting materials, the practical inexhaustibility of resources, the possibility of a broad regulatory properties of adhesives.

Against these advantages, synthetic resins have disadvantages. Partial removal of which is achieved by modification of the resins.

Studies have been conducted influence of extractives of wood bark of the Siberian species on the properties of synthetic resins, adhesives and composites based on them. When modifying adhesives should be considered indicators of the need to preserve the basic properties of resin-level requirements of standard or improve them. The data obtained in the study of the physicochemical properties of adhesives based on carbamide-formaldehyde resin grades KF-MT-15 and phenol formaldehyde resin grade SFG-3013, modified by water extractive substances bark of fir and larch, led to the conclusion that the introduction of extracts in urea-and phenol-formaldehyde resin is not a significant degradation of their properties. Guaranteed shelf life of modified adhesive without altering the basic physical and chemical properties of 72 hours.

To investigate the physical and mechanical properties of plywood were manufactured in the laboratory samples trinadtsatisloyno plywood grade FSF, and FC, using adhesives with different recipes.

The resulting samples were examined for plywood are the physical and mechanical properties such as tensile strength in the shear layer of glue, the ultimate strength in static bending strength, water absorption and release of free formaldehyde. Determination of optimal molding plywood products on the basis of the modified adhesive and determination of the optimal amount of modifying agent was carried out according to the B3-plan.

The greatest strength of the samples, using a modified adhesives have samples made with adhesive containing 25 m.ch. extractives (depending on the species used

for veneer shear strength of glue layer after boiling for 1 hour is for the FSF and FC 0,6 to 1,5 MPa, tensile strength in static bending for the PSF and FC, respectively, from 30 to 60 MPa and 25 to 55 MPa), which meets the requirements of the standard. The number of emitted formaldehyde depending on the type of extract added corresponds to the emission class E1.

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**UDK 532.543**

**Kalyakin A. M., Chesnokova E. V., Sautkina T. N.**

### **FLOW VALUES AT OUT FLOW THROUGH HOLES IN THE BOTTOM OPEN FLOW**

Problem solved in this paper is to determine the flow rate of water flowing through the hole in the bottom of the open channel.

When at rest the water used for this purpose known formula.

$$Q = mS\sqrt{2gH} \quad (1)$$

when  $Q$  – flow of the effluent;  $S$  – area of the aperture through which the liquid follows;  $m$  – dimensionless flow coefficient;  $g$  – acceleration due to gravity;  $H$  – depth of the liquid.

It is logical to assume that with increasing speed from 0 up to some relatively small value of the formula (1) is able to give correct results. If you put to use (1) to a moving stream in the channel, there may be three ways to solve the problem.

1. Find the dependence of the flow, which would take into account the average water velocity in the channel. Obviously, the flow coefficients dimensionless, so the average speed should be part of a dimensionless parameter, which can be configured in different ways. To the best choice, we note that it is more convenient to have it a small value, taking into account the fact that the velocity of the flow in most cases more than the average flow rate is possible to choose

$$\frac{V_{cp}}{V_{ucm}} \quad (2)$$

2. Leaving the flow coefficient value, known for the normal expiration at zero speed, all the features of the influence of flow velocity associated with the pressure  $H$  (the value  $H$  in this case is not to represent the depth of flow), which will depend on the mean flow velocity in the channel. In particular, the experiments shown in the bottom of the channel of the same order with depth was observed that the air is sucked in a jet flowing out of holes. This indicates that the pressure at the bottom of the moving flow may be less than atmospheric pressure.

3. Enter the value of the mean flow velocity in the expression for the rate and magnitude of pressure  $H$ .

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**UDK 532.543**

**Kalyakin A. M., Chesnokova E. V., Sautkina T. N.**

## **SYNTHESIS ACCORDING TO FLOW RATIO OPENINGS**

### **(MOVING FLUID)**

It is obvious that in addition to the requirements of the desired dimensions for the dependence of the flow rate shall comply with the limiting case

$$j_{V@0} \approx j_0, \quad (1)$$

when  $V$  – average fluid velocity in the channel;  $j_0$  – discharge coefficient for the case when the fluid is at rest.

In our opinion, as an argument (and a small parameter) it is possible to select the dimensionless ratio

$$\frac{V_{cp}}{V_{ucm}}, \tag{2}$$

when  $V_{cp}$  – average fluid velocity in the channel,  $V_{ucm}$  – velocity of the fluid through the hole. Then the desired relationship will take the general form

$$j = j \left( \frac{V_{cp}}{V_{ucm}} \right) \tag{3}$$

The function  $j$  in (3) can be expanded in a Maclaurin series:

$$j \left( \frac{V_{cp}}{V_{ucm}} \right) = j(0) + j'(0) \frac{V_{cp}}{V_{ucm}} + j''(0) \left( \frac{V_{cp}}{V_{ucm}} \right)^2 \times \frac{1}{2} + \dots \tag{4}$$

The resulting expression gives an approximate value for the coefficient of discharge. Refine it can be taking a greater number of terms.

This form for  $j$  the condition (1), and the value  $j(0)$  can be taken from the known value for a typical end of the tank. The numerical values  $j'(0)$  and  $j''(0)$  can be found from the experiments.

Finding the coefficients of the expansion is possible by various approximate methods, in particular, the method of least squares.

In conclusion it is necessary to make the following observation: at some average rate of water flow in the channel pressure can become so small that  $V_{ucm} \gg 0$  the expansion parameter in (4) becomes very large. In this connection it is necessary to impose restrictions on the rate  $V_{cp}$  or change the format for the discharge coefficient  $j$ .

**CID: J21202-803**

**UDK 621.6: 628.8**

**Sautkina T. N., Kalyakin A. M., Chesnokova E. V.**

**ON THE LAW OF INTERNAL DISTRIBUTION OF VALUES OF PIPELINES FOULING**

The study of the causes of internal fouling of pipelines is a complex task due to the variety of influencing factors. Research in this area have shown that the main causes of corrosion are the composition and the mechanical stress of the material, physical and chemical conditions in the surface layer, the environment, and various chemical compounds that are present in water, pH, oxygen concentration. The inner pipe fouling leads to prorzhavleniyu, reduced cross-section up to the complete blockage and stop the flow of water at the point of demand.

Analysis of the state the research question, confirmed that corrosion and biological fouling effect on the performance of the pipeline, its durability and quality of the transported water.

In connection with this research is to develop methods to evaluate and improve the reliability of pipelines with the use of a probabilistic approach based on the theory of risk.

To study the laws of the height distribution of fouling pipelines have been measured the heights of fouling pipelines.

On the basis of field data has been constructed histogram of the amplitudes irregularities, which confirms that the modal values of the heights of fouling shifted to small quantities. In this regard, the empirical distribution curves of height values fouling checked for compliance with Charlie distribution.

As a theoretical distribution used Charlie distribution of the following.

$$f(u) = \frac{1}{\sqrt{2\rho}} \times e^{-\frac{u^2}{2}} + \frac{C_1}{1!} \times \frac{de^{-\frac{u^2}{2}}}{du} + \frac{C_2}{2!} \times \frac{d^2e^{-\frac{u^2}{2}}}{du^2} + \dots + \frac{C_n}{n!} \times \frac{d^ne^{-\frac{u^2}{2}}}{du^n},$$

when  $\frac{1}{\sqrt{2\rho}} * e^{-\frac{u^2}{2}}$  – the law of normal distribution of the normalized random

variable is continuous;  $\frac{1}{\sqrt{2\rho}} * \frac{de^{-\frac{u^2}{2}}}{du}$ ;  $\frac{1}{\sqrt{2\rho}} * \frac{d^2e^{-\frac{u^2}{2}}}{du^2}$ ;  $\frac{1}{\sqrt{2\rho}} * \frac{d^ne^{-\frac{u^2}{2}}}{du^n}$  – derivatives of 1st, 2nd ... nth power of the density of the normal distribution;  $C_0, C_1, C_2, \dots, C_n$ , – constant coefficients of the distribution.

Pearson and Romanovsky criteria showed that the fouling parameters are in good agreement with the law of the distributions of Charlie. Consequently, for statistical data processing, as well as for the derivation of the basic formulas for risk assessment of parameters of fouling can be used Charlie distribution.

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