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Section 1. Biology

Madrimov Rajabboy Masharipovich,
PhD, the Faculty of Biology
E-mail: madrimov91@gmail.com
Nabieva Gulchekhra Mirergashevna,
National University of Uzbekistan,
Doctor of Biological Sciences, the Faculty of Biology
E-mail: gulchekhra-nabieva@rambler.ru
Gafurova Lazizakhon Akramovna,
National University of Uzbekistan,
Doctor of Biological Sciences, Professor,
the Faculty of Biology
E-mail: glazizakhon@yandex.ru

CHARACTERISTIC FEATURES OF GUMUS STATE IN GRAY-BROWN SOILS OF THE PITNYAK OASIS IN THE WESTERN PART OF UZBEKISTAN

Abstract: Group and fraction composition of humus of the Pitnyak oasis in the Khorezm region has been studied in the paper. In connection with the irrigation of the Tashsakin plateau soils, a transition of fulvate type of humus in virgin gray-brown soil to humate-fulvate and fulvate-humate types in irrigated gray-brown and gray-brown meadow soils is observed. Long-term irrigation and cultivation of meadow soils of the alluvial-lacustrineriverbed of Daudan have led to the formation of humus of a humate type, formed oftightly bound compounds in the form of calcium humates and organic-mineral substances.

Keywords: oasis, humus, humic and fulvic acids, gray-brown soils.

Introduction. As the most important factor in the diversity of processes occurring in the mineral part of soil and formation of the soil profile, humus to a great extent determines physical, physicochemical, biochemical, microbiological properties and fertility of soils.

The content and composition of humus largely depends on geographic, zonal and climatic conditions of soil formation and anthropogenic activities associated with irrigated agriculture. In addition, humic state and humus composition in soils determine the classification of soils, which is very important in the compilation of soil maps of different levels.

Long-term studies of soils in the desert zone (natural soils and anthropogenically altered, i.e. irrigated ones), allow to establish certain regularities in the soil formation of gray-brown soils, distributed in vast areas of the Ustyurt plateau, Devkhana plateau, the Malikchul plain, and the Tashsak plateau on which irrigated agriculture is currently developing [4].

Over the past decades in the Khorezm region, the level of farming has reached a maximum, creating the preconditions for changing soil-melioration conditions. This led to a rise in groundwater level, because of which a redistribution of water-soluble salts, gypsum, carbonates and nutrition elementswas observed. In addition, with the construction of the Tuyamuyun waterworks, the development of adjacent lands occurred, including the Pitnyak oasis.

Objects and methods of research. Actually, the Pitnyak oasis, located in the southeastern part of the Khorezm region, is a district of the Tashsakin plateau, a fragment of the ancient Daudan riverbed, to which the Zaunguz Karakums adjoin in the south and southwest.

On the surface the plateau is covered with strongly calcareous gravelly loams, under which lie loose sands and sandstones with interlayers of pebbles, conglomerates and marly clays of Pliocene age [2]. The area of the ancient Daudan riverbed is composed of alluvial-lacustrine deposits, heterogeneous in texture.In the past, the Amu Darya deposits (lacustrine facies) and sediments introduced by irrigation waters for the long-term history of agriculture played the main role in its formation [7]. Evidence of the latter in various parts of old riverbed of Daudan and, especially, in the areas close to settlements, are the remains of broken pottery from earthenware, found in agro-irrigation layers of soil.

Proceeding from above, it follows that the study of group and fractioncomposition of soil organic matter in connection with anthropogenic activity at different stages of formation of hydrological regime under different conditions is of great interest.

Analysis of group and fraction composition of humus was conducted according to the Tyurin'smethod in modification byV.V. Ponomareva and T. A. Plotnikova, and the qualitative composition of humus was classified according to "Methodical instructions ..." by M. M. Tashkusiev [6].

At the site under research, virgin gray-brown typical soils, freshly irrigated gray-brown, gray-brown-meadow and meadow-marsh soils of the Tashsakin plateau with morphogenetic features characteristic for them are studied [5]. Old-irrigated meadow soils are studied in the alluvial-lacustrine facies of the Daudan riverbed.

Results and discussions. As is evident from the studies, in spite of the fact that in irrigated meadow gray-brown soils of the plateau and old-irrigated meadow soils of old riverbed of Daudan, due to intensive decomposition of organic matter characteristic of desert zone soils, the quantitative parameters of humus are insignificant — from 0.450 to 0.873%; various variants of the redistribution of carbon of organic acids are notedin its qualitative and fractional composition, due to the conditions of soil formation.

Analysis of the humus content in virgin gray-brown soil, taken as a reference, shows that the type of humus is a humate-fulvate one — $C_{h.a}/C_{f.a}$ –0.59–0.87 in the upper humus-accumulative part of the profile (Table 1). In total, the hydrolysable substances account for 55.38–61.82% of the carbon amount in the fine-grained part of the profile.

In the fractional composition of humic acids, fraction II, which is related to calcium, is predominant: 7.44–19.31%. Fraction III, related to clay minerals and sesquioxides, is 4.06–8.05%. Fraction I of free humic acids is 1.54–2.20%, which indicates a weak degree of humus formation.

Against this background, it is obvious that humic acids are most strongly bound in the form of calcium humates and clay minerals, which is observed in the Malikchul soils [3].

Among the fulvic acids, fraction II, which is related to calcium –12.3–20.9%, prevails against the background of a low content of fraction III-2.78–5.18%.

I-a and I fractions occupy intermediate position, in sum making 13.5–17.21%, theyprevail over fraction II related to calcium. The predominance of fractions I-a and I in the horizon of clay formation of gray-brown soil is evidently due to the intensity of the flow of new formation of humic substances under severe hydrothermal conditions.

Table 1. – Fraction-group composition of humus in soils of the Tashsakin plateau and old riverbed of Daudan

Depth, cm	Total carbon,%	Fraction of humic acids				Fraction of Fulvic Acid					$C_{h.a}+C_{f.a}$	$C_{h.a}/C_{f.a}$
		1	2	3	Sum	1a	1	2	3	Sum		
Section – 1. Virgin gray-brown soil												
0–1	0.1170	1.54	19.31	4.96	25.81	9.23	4.27	12.31	3.76	29.57	55.38	0.87
1–8	0.1261	2.30	1498	4.28	21.56	9.43	7.78	15.54	3.25	36.00	57.56	0.59
8–21	0.1330	1.73	7.44	4.06	13.23	8.95	6.99	21.43	5.18	42.55	55.78	0.31
21–41	0.0969	1.86	13.31	8.05	23.33	14.45	0.52	20.85	2.78	38.60	61.82	0.60
Section – 2. Freshly irrigatedgray-brown soil												
0–26	0.3042	0.59	13.41	8.64	22.64	1.77	3.06	2.26	4.04	11.13	33.77	2.03
26–40	0.1922	0.62	14.788	4.32	19.72	4.47	2.87	8.53	6.03	21.90	41.62	0.90
40–70	0.0386	3.11	2.58	4.40	10.09	11.14	3.88	13.21	8.81	37.04	47.13	0.27
Section –12. Freshly irrigated gray-brown-meadow soil												
0–22	0.2450	0.94	23.38	8.45	32.77	1.75	6.41	3.18	7.63	18.97	51.74	1.73
22–36	0.0933	1.93	32.26	15.97	50.26	9\8.04	10.18	15.54	5.36	39.12	89.38	1.28
36–60	0.0785	1.53	12.35	9.04	29.92	6.88	3.56	12.61	4.58	27.63	50.55	0.83
Section – 14. Freshly irrigated meadow-marsh soil												
0–30	0.1117	2.59	23.9	16.02	42.51	7.69	3.41	11.72	11.72	34.54	77.05	1.23
30–40	0.0724	2.48	18.37	11.46	32.31	8.97	0.13	9.98	4.55	23.63	35.09	1.36
40–82	0.0607	2.96	13.51	11.36	27.83	3.46	7.08	7.41	5.60	23.55	51.38	1.18
Section – 16. Old-irrigated meadow soil of old riverbed of Daudan												
0–30	0.4444	0.52	15.79	7.94	24.25	1.68	2.03	3.14	4.34	11.19	35.44	2.16
30–70	0.3106	0.58	21.28	6.31	28.17	2.76	0.81	3.21	4.18	10.96	39.13	2.57
70–85	0.2197	0.54	15.25	7.55	23.34	3.91	0.18	5.14	3.77	13.00	36.34	1.79

A different picture in the qualitative composition of humus is observed in freshly irrigated gray-brown meadow soil of the Tashsakin plateau. Against the background of a smaller number of hydrolysable substances — 33.77–47.13%, in the qualitative composition of humus, significant changes occurred in these soils as a result of irrigation. Humus of the arable horizon is represented by humate type — $C_{h.a}/C_{f.a}$ — 2.03. Humus of the underlying "B_1" horizon is of humate-fulvate type, and in the horizon "B_2" it is of fulvate type.

Humic acids are mainly represented by calcium humates — 13.4–14.78% in the humus-accumulative part of the profile. Intermediate position among humic acids, as in virgin analogues, is occupied by fraction III against the background of too low content of free humic acids in I fraction.

In the composition of fulvic acids, the same pattern is observed as in the case of a virgin analogue of gray-brown soil, that is, the fraction II related to calcium is prevalent. Intermediate position has the sum of I and I-a fractions-4.83–14.02% of the carbon amount. However, in fraction III, related to clay minerals and sesquioxides, there is some increase in its amount compared to virgin gray-brown soil, the content of which is 4.04–8.8% of the carbon amount. Apparently, irrigation, strengthening the soil-forming process, especially in the upper humus-accumulative part of the profile, led to a change in group composition of humus due to the formation

of humic substances firmly related to organomineral part of soil.

The transition of soils of the automorphic series to a semi-hydromorphic and hydromorphic ones, i.e. irrigated gray-brown soils to gray-brown meadow and marsh-meadow soils with a change in their morphogenetic properties, leads to a significant increase in the content of hydrolysable substances, especially due to humic acids (sections 12 and 14). The content of humic acids in the most biologically active part of the profile – in horizons "A_n" and "B_1" is from 32.77% to 50.26% of the carbon amount. Among them, the largest portion is allocated, as in previous soils, to humates of calcium of fraction II and humic acids, tightly related to organomineral part of soil – fraction III. Among fulvic acids, which in the total amount to 18.97–39.12%, a large portion is allocated to fraction II. However, fraction III-7.63% prevails in the arable horizon of gray-brown-meadow soil (section 12), and fraction II – 15.31% (fulvic acids related to calcium) prevails in meadow-marsh soil (section 14).

So, the fixation of humic substances in freshly irrigated gray-brown soils of different water content regime occurs due to humates and fulvates of calcium – in the arable horizon, and in the lower horizons – due to free fulvic acids related to sesquioxides and aggressive fractionI-a. The latter finds its clear expression in meadow-marsh soil (section 14).

In old-irrigated meadow soils formed on alluvial-lacustrine deposits of Daudan, the humus formation is due to fractions II and III of humic acids. Free humic acids of fraction I are characterized by a low content – 0.54–0.58% of the carbon amount. Among fulvic acids, there is a tendency to reduce the amount of fraction II, and fraction III, related to clay minerals and sesquioxides, remains at the level of 3.77–4.34%, that is, the same as in virgin gray-brown soil and irrigated gray-brown soil and freshly irrigated meadow-marsh soils, with the exception of their arable horizon.

In terms of the content of total amount of hydrolysable substances, the old-irrigated meadow soilsdiffer in smaller values – 35.44–39.13% than freshly irrigated gray-brown meadow and meadow-marsh soils. At such content, most of the hydrolysable substances are formed by a group of humic acids, which in total amount to 23.34–28.17%. An amount of fulvic acids in humus-accumulative layer representing the agro-irrigation horizon is 2 times less – 10.96–13.00% than humic acids. Therefore, the ratio $C_{h.a}/C_{f.a}$ is equal to 2,16–2,37, that is, its magnitude is higher and the type of humus is represented as a humate one.Such a singularity of humus was noted in earlier studies by V. V. Valiev and S. Sidikov [1], in residual-marsh soils of the Amu Darya delta, periodically flooded for irrigated pastures. The fulvate-humate type of humus with a ratio of $C_{h.a}/C_{f.a,}$ equal to 1.55was observed by N. R. Sharafutdinova [8], in irrigated meadow-alluvial soils of the lower part of the Amu Darya delta.

Conclusion

Thus, the above analysis of the composition of organic matter of soils in the Pitnyak oasis in connection with the statements inscientific literature suggests that intensive irrigation, which affected the hydrological regime of soils, led to significant changes in group and fraction composition of humus. The transition of fulvate humus to humate-fulvate one, and then to fulvate-humate one, along with an increase in the content of hydrolysable substances, is an evidence of an improvement in the quality of organic matter.

In old-irrigated meadow soils of alluvial-lacustrine facies, which differ in their relative cultivation, humic acids (among the hydrolysable substances) show a primary role in humus formation, creating the strongest bonds in the form of calcium humates and organomineral compounds.

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Section 2. Materials Science

Turaev Erkin,
Ph. D., Independent researcher,
Sottikulov Elyor,
Independent researcher,
Djalilov Abdulakhat,
doctor of Chemistry, professor,
director of Tashkent Scientific Research
Institute of Chemical Technology,
Uzbekistan, Tashkent
E-mail: turaev08@yahoo.com

IMPACT-RESISTANT MATERIALS BASED ON POLYPROPYLENE/POE

Abstract: The influence of the polyolefin elastomer was studied on the izod impact strength and the thermal properties of polypropylene. Estimated the effect of POE on the izod impact strength and thermal properties of polypropylene.

Keywords: polypropylene, polyolefin elastomer, modification, HDT, Izod impact strength.

Introduction: The driving force behind the development of polypropylene compounds is the increasing use of them in the automotive industry, demonstrating a steady growth trend. Modern technologies for the manufacture of cars present increasingly stringent requirements for polymer composite materials, both in terms of their consumer characteristics and manufacturability, which should provide high-performance molding of complex configuration parts.

At present, the world's leading producers of polypropylene (LyondellBasell, Sabic, Lotte, etc.) offer a wide range of polypropylene compounds for various purposes. However, simply mixing the ethylene-propylene elastomer with the polypropylene matrix and the filler does not provide the composite material with the required level of impact strength, modulus and melt flow index. Consequently, there is a need to develop methods for improving the structure of a filled polymer mixture, which can most effectively be accomplished by using methods for modifying mixtures during extrusion [1].

In most studies, it is noted that the amount of elasticity is mainly determined by the volume fraction of the ethylene-propylene elastomer [2].

The purpose of this work is to study the effect of polyolefin elastomer on the properties of polypropylene-based compounds.

Experimental method: The work used polypropylene grade JM350 with a melt flow index (MFR) of 10 g/10 min produced by Lotte. Engage 8100 polyolefin elastomer is an ethylene-octene copolymer with 1 g/10 min of MFR manufactured by Dow. Stirring of the composition of the compounds

was carried out in a laboratory two screw extruder at temperature of 180 °C –210 °C and a screw speed of 80 rpm. Previously, all components were mixed manually for 15 minutes and loaded into a laboratory extruder. Samples for testing were prepared by injection molding.

Results: Table 1 gives the physical and mechanical properties of obtained compounds.

When the elastomer is added at a concentration of 5%, 10% and 20% (by weight), the density of the compounds decreases insignificantly by 0%, 0.5% and 1%, respectively, which is facilitated by a low density of the elastomer itself (ρ = 0.869 g/cm^3).

The addition of elastomer to base polypropylene leads to a decrease in MFR. In the case of the addition of elastomer, 5%, 10% and 20% of MFR compounds decrease by 17%, 30% and 50%, respectively. From the results obtained, it can be seen that the elastomer has a stronger effect on MFR. The addition of a low-flow elastomer (MFR = 1 g/10 min) contributes to the melt viscosity treatment. As a result, the fluidity of the compounds decreases.

Table 1. – Physico-mechanical properties of compounds

№	Physical Characteristics	Unit	Test Standard	JM350	JM350–95% +E8100–5%	JM350–90% +E8100–10%	JM350–80% +E8100–20%
1.	Density	g/sm^3	ISO1183	0.9	0.9	0.895	0.89
2.	Melt flow index	g/10m	ISO-1133	10	8.3	7	5
3.	Flexural Modulus, 2 mm/min	MPa	ISO-178	1130	1040	980	880
4.	Tensile Strength at Yield, 50 mm/min	MPA	ISO-527	25	22	19	16
5.	Elongation at Break	%	ISO-527	70	89	120	140
6.	Izod Impact notched (+23 °C)	J/m^2	ISO-180	6.5	6.9	7.8	8.8
7.	Izod Impact notched (–30 °C)	J/m^2	ISO-180	4.0	5.6	6.3	7.4
8.	HDT at 1.8 MPa	MPa	ISO-75–2	48	46	41	37
9.	Shrinkage after 48h	%	ISO-294	1.49	1.46	1.44	1.43

As expected, in general, it can be noted that when the elastomer is added at a concentration of 5%, 10% and 20%, the flexural modulus in bending is reduced by 9%, 13% and 22%, respectively. Due to the elastic properties of the elastomer particles. Also, the elongation at break is increased by 1.27, 1.71 and 2 times, respectively.

The addition of an elastomer contributes to an increase in Izod impact strength with a notch at + 23 °C by 6%, 20% and 35%, and at –30 °C by 40%, 57% and 85%, respectively.

The heat resistance of composites is reduced by 4%, 14% and 23%, respectively. It has also been found that the addition of an elastomer contributes to a slight reduction in shrinkage of the base polypropylene.

The results of the study, given in this paper, allow us to draw the following

Conclusions: It is possible to reduce or increase the impact strength values by adding / reducing the elastomer. It is also possible to adjust the melt flow index of the compound. It is established that, with the help of an elastomer, it is possible to radically change the properties of the base polypropylene and bring it to a completely new level.

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Section 3. Machinery construction

Vasenin Valery Ivanovitch,
associate professor, candidate of technical sciences,
department of "Materials, technologies and design of machinery"
State National Research Polytechnical University of Perm,
E-mail: vaseninvaleriy@mail.ru
Bogomjagkov Aleksey Vasilievitch,
senior teacher,
Sharov Konstantin Vladimirovitch,
senior teacher

DEFINITION OF THE RESISTANCE TO LIQUID FLOW DURING CONFLUENCE AND ROTATION OF THE STREAMS

Abstract: A drop of 1.5 times the coefficient of resistance to the rotation of the flow of liquid into the gate was detected when the liquid was supplied to the gate from both sides as compared to the one-way supply. This can be explained by the appearance of a second swirl region and a total decrease in the resistance of these two areas compared to a one-way supply. The use of a new value of the coefficient of resistance leads to the fact that the velocity of the liquid in the far gate is higher than in the other gates, including the penultimate gate, which corresponds to the experimental data.

Keywords: pouring basin, sprue, runner, gate, head, resistance coefficient, flow coefficient, flow velocity, liquid flow rate.

Introduction

The articles [1–3] present calculations, research techniques and results of determining of the local resistance coefficient ζ_g on rotation of 90 ° from the runner to the gate for different areas of their cross sections. However, these results were obtained with the liquid supply from one side of the runner to the gate. In the studies of single- and double-ring-shaped gating systems, P-shaped gating system, gating system with two sprues [4–9], it was found that this coefficient is less when liquid is supplied to the gate from both sides, than from one side. This article is devoted to the research of this phenomenon.

Research technique

For research purposes, we used the gating system, shown in (figure 1). The system consists of a pouring basin, a sprue, a runner and a gate. The diameter of the basin is 272 mm, the height of the water in the basin is 103.5 mm. The internal diameters of the sprue, runner and gate were determined using development drawing. Diameters of the sprue and runner (mm): $d_{sp} = 24.08$, $d_r = 16.03$. Diameter of the gate d_g was changed from 2.53 to 16.03 mm. Water height H – the vertical distance from section *1–1* of the basin to the longitudinal axes of the runner and gate – was maintained by a constant continuous flow of water into the basin and draining its

excess through a special slot in the basin: $H = 0.3630$ m. A piezometer (a glass tube with a length of 370 mm and an internal diameter of 4.5 mm) was installed in section *6–6*. Liquid outflows from the gate in 30–380 s, and the volume of water poured from the gate was about 8 liters. These weight and time constraints allowed the speed deviation from the mean value of ± 0.005 m/s. Determination of the coefficient of local resistance at the supply of liquid to the gate from two sides was made using a ring-shaped gating system with 3 (Figure 2), 7 (Figure 3), and 19 (Figure 4) gates.

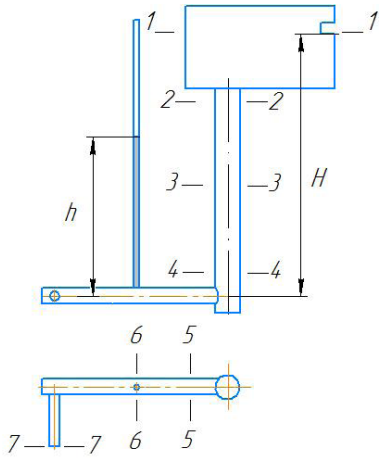

Figure 1. Gating system with one gate

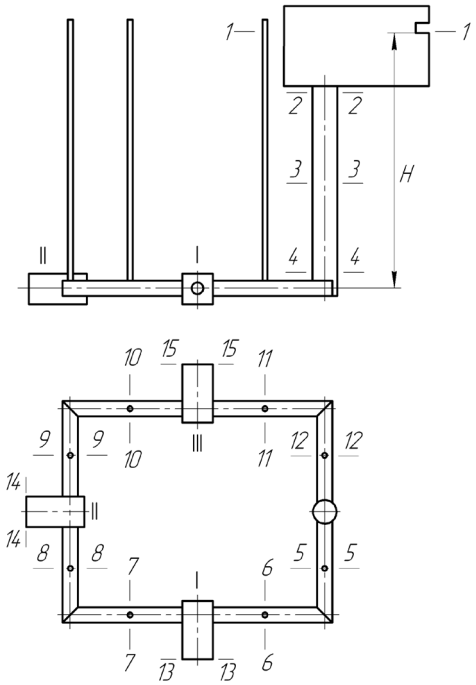

Figure 2. Gating system with three gates

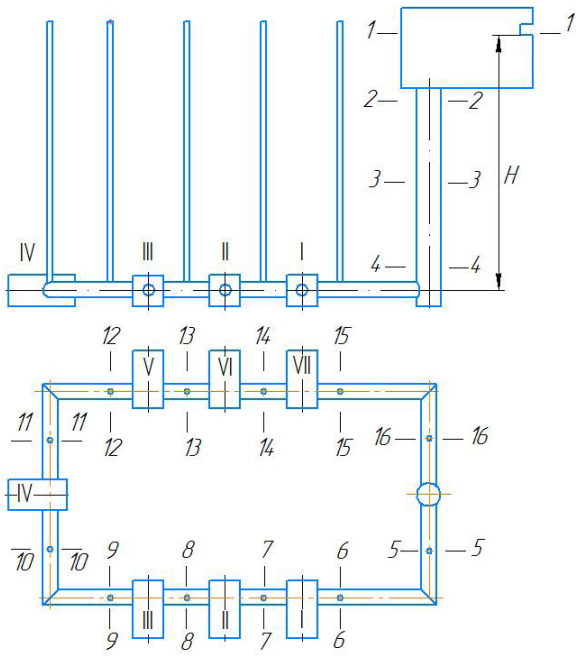

Figure 3. Gating system with seven gates

Main body

When supplying liquid to the gate from one side (Fig. 1), a following dependence of the coefficient ζ_g on the ratio of the areas of the gate S_g and the runner S_r [1]:

$$\zeta_g = \frac{2gh}{\alpha v_g^2} + \left(1 - \lambda \frac{l_{6-g}}{d_r}\right)\left(\frac{S_g}{S_r}\right)^2 - \lambda \frac{l_g}{d_g} - 1, \quad (1)$$

where: g – freefall acceleration, m/s^2; h – head in the flow of liquid in section *6–6*, m; α – coefficient of uneven distribution of velocity along the flow section (Coriolis coefficient); assuming $\alpha = 1.1$ [10, p. 108]; v_g – head in the flow of liquid in section *7–7* of the gate, m/s; λ – scrubbing loss coefficient; assuming $\lambda = 0.03$ [11, 12]; l_{6-g} – length of the runner from section *6–6* to the longitudinal axis of the gate, m; $l_{6-g} = 0.0595$ m; l_g – gate length, m; $l_g = 0.0495$ м. It is evident, that $v_g S_g = v_r S_r$, где v_r – liquid velocity in the runner, m/s. In experiments with different gate diameters, h and v_g, ζ_g value was calculated from formula (1). The processing of the experimental data on ζ_g value by the method of least squares gave the following dependence [3]: $\zeta_g = 0.557\left(S_g / S_r\right)^2 + 0.066 S_g / S_r + 0.257$. This expression is valid when the ratio S_g/S_r varies from

0.250 to 1. For interval $S_g/S_r = 0.025...0.250$ the following equation was obtained:

$$\zeta_g = 0.280 + 0.115 S_g / S_r .$$

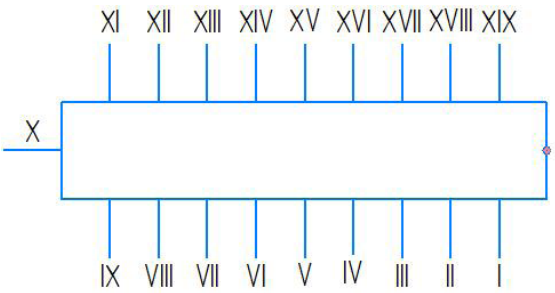

Figure 4. Gating system with nineteen gates

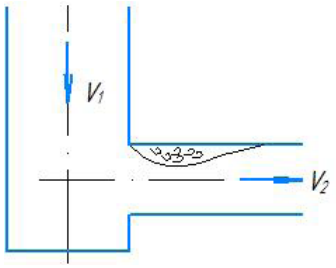

Figure 5. Rotation from runner to gate with liquid supply from one side

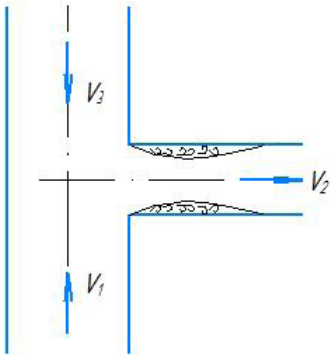

Figure 6. Rotation from runner to gate with liquid supply from two sides

For a gate with a diameter of 9.03 mm and a runner with a diameter of 16.03 mm ζ_g coefficient obtained was 0.334. This value was used in calculations of L-shaped, branched, combined, cross, floored gating system, L-shaped system with a manifold of variable cross-section. The difference between the experimental and calculated data was several percent. This ζ_g value was also used in calculations of P-shaped, ring-shaped gating systems and gating systems with two sprues. The difference between the theoretical and experimental results was still a few percent. However, in non-ring-shaped gating systems, the speed in the penultimate gate is always less than the speed in the last gate (most far from the sprue), both in calculation and in experiment [13, 14]. In ring-shaped gating systems, the speed in the penultimate gate is lower, and in the experiment it is greater than the liquid velocity in the last gate. It is unclear, since after the penultimate gate there is an energy-consuming turn by 90° – from section 7–7 to section 8–8 as shown in (Figure 2).

Experiments were carried out as of (Fig. 1) on the gating system of (Fig. 2). Heads h_8 and h_9 and velocities v_8 and v_9 in the runner sections 8–8 and 9–9, velocity v_{14} in gate II. In the ring-shaped gating system $v_g S_g = 2 v_r S_r$, and equation is as follows (1):

$$\zeta_g = \frac{2gh}{\alpha v_g^2} + \left(1 - \lambda \frac{l_{8-g}}{d_r}\right)\left(\frac{S_g}{2S_r}\right)^2 - \lambda \frac{l_g}{d_g} - 1, \quad (2)$$

Where: h – head in the flow of liquid in section 8–8, m; v_n – liquid velocity in section 14–14 of gate II, m/s; l_{8-g} – length of the runner from section 8–8 to the longitudinal axis of the gate II, m; $l_{8-g} = 0.0595$ m.

When the hydraulic system in (Fig. 2) is open in section 9–9 and the liquid flows to gate II from one side – from section 8–8, the process has the following characteristics: $v_{14} = 1.89$ m/s, $v_8 = 0.60$ m/s, $v_9 = 0$, $h_8 = 0.299$ m, $\zeta_g = 0.334$ – according to the equation (1). In the ring-shaped gating system the characteristics are the following: $v_{14} = 2.07$ м/с, $v_8 = v_9 = 0.33$ м/с, $h_8 = h_9 = 0.331$ м, $\zeta_{gc} = 0.218$ – according to equation (2). In ζ_{gc}, index "c" means that the coefficient was determined by the supply of liquid to the gate from two sides, that is, when the confluence of two streams occurs.

As is evident, when the liquid is supplied to the gate from both sides in comparison with the one-way supply, the resistance coefficient is lowered by 53.2%. Apparently, this drop in resistance to flow upon rotation can be explained as follows: with a one-way supply, a vortex area is formed on one side of the gate (Figure 5), with a two-way supply from both sides (Figure 6). Moreover, the velocity in the

runner with a two-way supply compared with a one-way supply is almost 2 times lower, and the vortex regions are smaller than the simple division of the swirl region from (Fig. 5) into two parts.

Using coefficient ζ_{gc} instead of ζ_g coefficient of resistance coefficient leads to the fact that in the far gate the velocity is higher than in the other gates, including the penultimate one. This is established in the study of gate system with a different number of gates (Figures 2–4).

Conclusion

As can be seen from the above, a drop of 1.5 times the coefficient of resistance to the rotation of the flow of liquid into the gate was detected when the liquid was supplied to the gate from both sides as compared to the one-way supply. This can be explained by the appearance of a second swirl region and a total decrease in the resistance of these two areas compared to a one-way supply. The use of a new value of the coefficient of resistance leads to the fact that the velocity of the liquid in the far gate is higher than in the other gates, including the penultimate gate, which corresponds to the experimental data. The liquid velocities in the gates and the liquid flow rate throughout the system also change.

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Tretiak Oleksii,
Candidate of Technical Sciences (Ph. D.),
SE "Plant "Electrotyazhmash",
Deputy Head of Department on Mechanical Calculations,
Senior Lecturer of Aerospace Thermal Engineering Department,
National Aerospace University named after N. Ye. Zhukovsky "KHAI"
E-mail: alex3tretjak@ukr.net

Kobzar Kostyantyn,
Candidate of Technical Sciences (Ph. D.),
SE "Plant" Electrotyazhmash",
Cheef Designer on Turbogenerators,
E-mail: kk7@ukr.net

Shut' Oleksandr,
SE "Plant "Electrotyazhmash",
Deputy Head of Department on Hydrogenerators and LDCM
E-mail: alekspetm@gmail.com

Poliienko Vladyslav,
Design Engineer, SE "Plant "Electrotyazhmash",
Master Student, National Aerospace University
named after N. Ye. Zhukovsky "KHAI"
E-mail: vlad_polienko@outlook.com.

Gakal Pavlo,
Doctor of Technical Sciences,
Docent, National Aerospace University,
Associate Professor at the Department
of Thermal Engineering Aerospace,
E-mail: pavlo.gakal@gmail.com

PECULIARITIES OF THREE-DIMENSIONAL CALCULATION OF LARGE UNITS OF GENERATORS BY FINITE ELEMENT METHODS

Abstract: The scientific work presents the basic designing principles of large units of Turbogenerators using the example of pressing down flanges. Peculiarities of mechanical calculations of welds are considered.

Keywords: Turbogenerator, stresses, finite element method, pressing down flange.

Introduction

In the present time in generators-building, there are two types of units and parts regarding the norms of mechanical strength: resource units and non-resource units.

Obviously, the approach to calculations and designing for all the above mentioned details can only be determined in its group.

Consequently, assumptions that we could consider inside from a non-resource group cannot be transferred to resource and vice versa.

According to generally accepted standards for designing, for all types of units, stresses shall not exceed the yield strength limit, and the limiting factor shall be the fatigue limit, which shall be determining for the parts that shall work for more than 30 years, with possibility of further extension of the resource.

However before the calculation designing it is necessary to consider in details the design of existing generators.

Design Peculiarities of the Stator of Turbogenerators Manufactured at SE "Plant "electrotyazhmash"

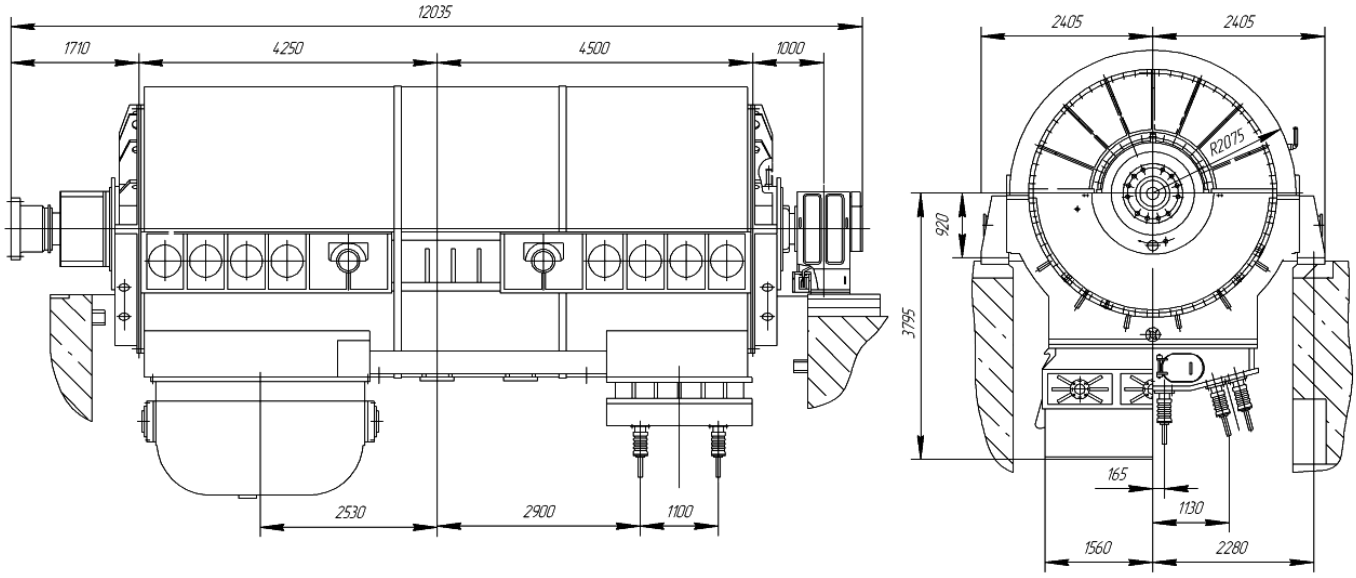


Figure 1. Turbogenerator

The general view of Turbogenerator is submitted in (Figure 1) [1]. The stator casing is double: namely external and internal. The external casing is welded, combined of three parts, provided with jointing rings and fasteners set. Welding, annealing, machining and hydro-tightness tests shall be carried out separately for each part. Assembly of the casing parts between each other shall be carried out on to the guiding fingers. The parts shall be fastened with bolts with consequent welding from outside with gas-tight weld. The casing shall be carried out of cylindrical shape. From the turbine end in the bottom part of the stator casing the gas coolers duct is arranged in which along the longitudinal axis of Turbogenerator three gas coolers are arranged. The stator casing is light-weighted due to thickness decreasing of the shielding, ribs, beams and other parts. Inside the stator casing at the flat spring suspension the internal casing is suspended. In the internal casing there is the stacked up core. The internal casing (namely the stator core frame) is welded, cylindrical, consisting of the forcing rings, longitudinal beams, tightening ribs, prisms, shielding, face end and intermediate ring frames. One side of springs of suspension is fixed to the thrust rings of the internal casing with the help of cylindrical eye-bolts and fasteners. The second side is fastened to the annular ribs with the help of T-shaped straps and pair rings. The stator core consists of the died and insulated with high-quality varnish of hot drying laminated segments manufactured of cold rolled electrical sheet steel with decreased specific losses. The core has the axial cooling system of the back and teeth for which purpose the core segments are

provided with holes. The packages are pressed in axial direction with the help of the pressing down flanges from the both ends of the stator. The installation of power accumulators, five rows of springs of the suspension and manufacturing of prisms of steel with improved characteristics provides effective suppression of vibration of the stator core and maintains a stable force of the core pressing in operation. The stator core is cooled with hydrogen which under gauge pressure the stator casing is filled with. The stator casing from the face ends is tightly closed with the external shields. The modernized design of the external shields, thrust bearings, seals provides easiness of assembly and maintenance of these units.

Let us consider the mechanical calculation of non-resource unit at the e.g. of the pressing down flange of Turbogenerator manufactured by SE "Plant "electrotyazhmash". In (Figure 2) the overhang part of the stator casing is submitted [2]. The pressing down device of the stator core in the submitted model of the casing is power accumulator. In figure 2 the stator casing overhang is shown with section in situ of power accumulator installation where indicated: the utmost frame of the casing 1, flange 2, tightening ribs 3, pressing down flange 4, tightening prism 5, power accumulator 6, bracket 7, overhang part of the winding 8. Dimensions A and B were indicated by Mr. Minko A. [2] for research of the most optimum design.

As it can be seen the pressing down flange is a part which during the whole operation term of Turbogenerator shall create the load with the value of 2 MPa for provision of the stator normal pressing.

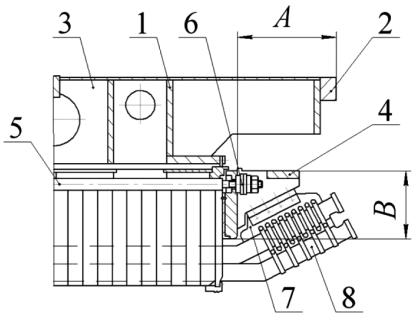


Figure 2. The Stator Overhang

The causes and consequences of reducing of pressing are given in the scientific work of Shtogrin, A. V. [3]. In connection with the above mentioned, it becomes necessary to revise the existing methods for calculating the pressure flange assembly by the finite elements method.

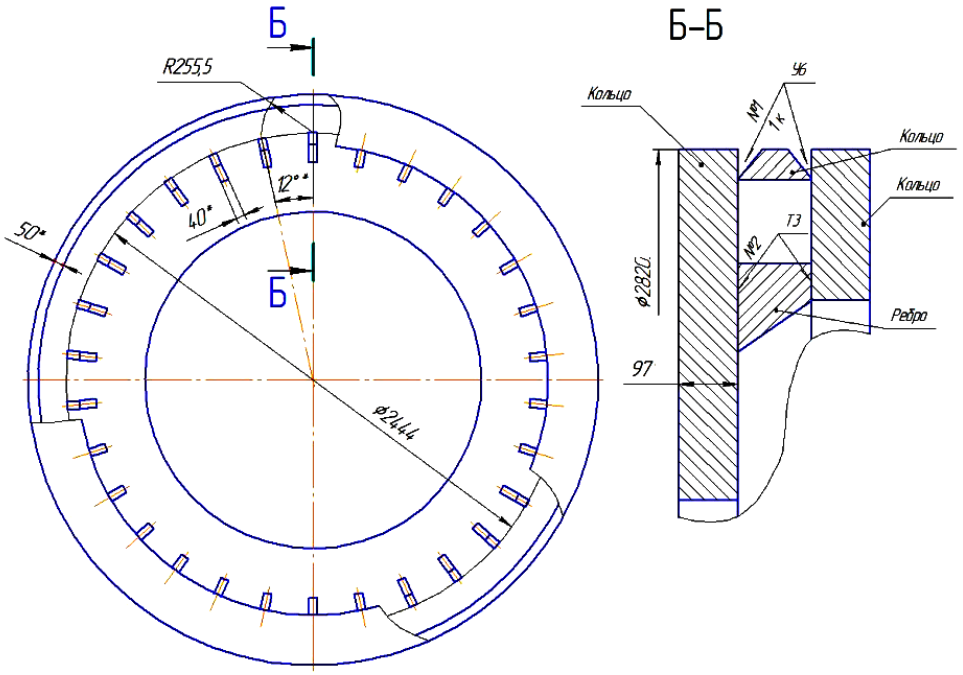


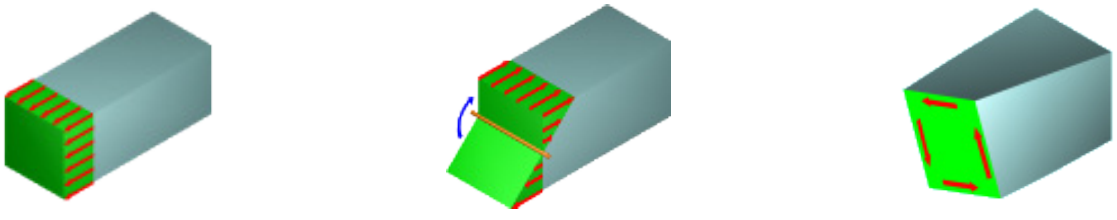
Figure 3. Design of Pressing down Flange

Determining of the Stressed State of the Pressing down Flange

At the present time the classical pressing down flange is manufactured of hot rolled plate by application of welds. See (Figure 2). The material of pressing down flange is high-strength stainless steel.

The existing types of stresses are indicated in (Figure 4). Where: a) are normal stresses (tension – compression), b) are bending ones and c) twisting.

As per the norms of mechanical researches for a pressing down flange in a two-dimensional setting only normal stresses are taken into account, however, as experience shows, there are all three groups hence their total action can be taken into account only in a three-dimensional setting.



$$\sigma_N = \frac{F_N}{A} \qquad \sigma_b = \frac{M_b}{W_b} \qquad \tau_t = \frac{M_t}{W_t}$$

a) normal, b) bending, c) twisting

Figure 4. The Existing Types of Stresses

At the present time SE "PLANT "ELECTROTYAZHMASH" in the part of carrying out of the mechanical calculations transferred to three-dimensional modeling in the medium of SolidWorks Simulation. For non-resource parts the issue of long term strength is very important when the design element cannot be replaced during operation process. In the scientific work [4] the cases when it is necessary to carry out the mesh refinement.

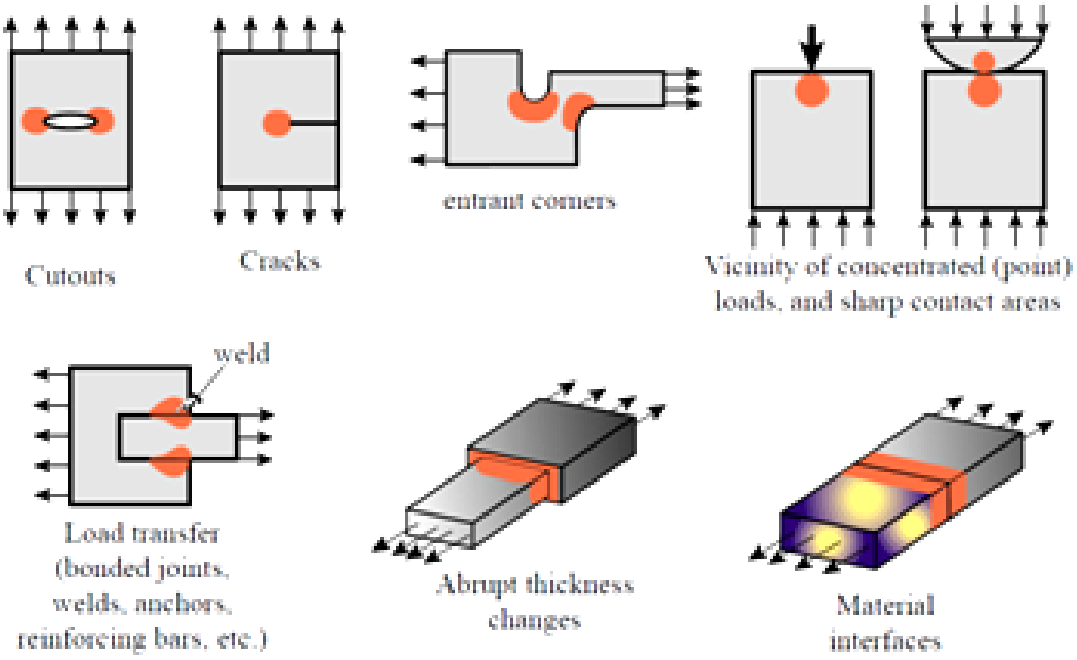


Figure 5. Typical areas in a model where locally refined mesh is required

As applied to the pressing down flange, it is necessary to add peculiarity of the design indicated by welds.

The results of mechanical calculations in SolidWorks Simulation are submitted in (Figure 6).

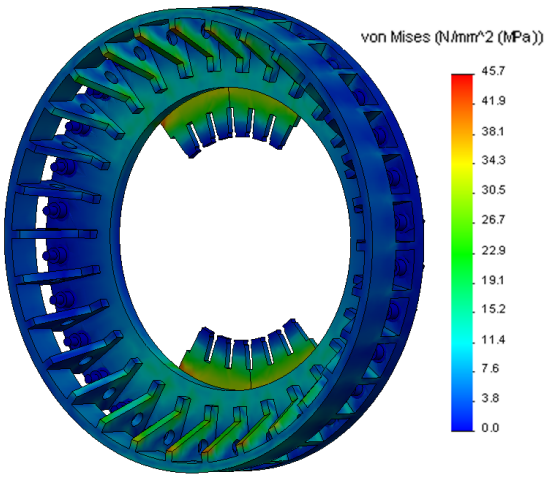


Figure 6. Mechanical Stresses

As per GOST5264–80 for our item the welds were carried out. As per the results of experimental operation for the welds submitted in Figure 7 the rule of admissibility of strength margins can be applied both for the basic elements provided that the welds are completely welded.

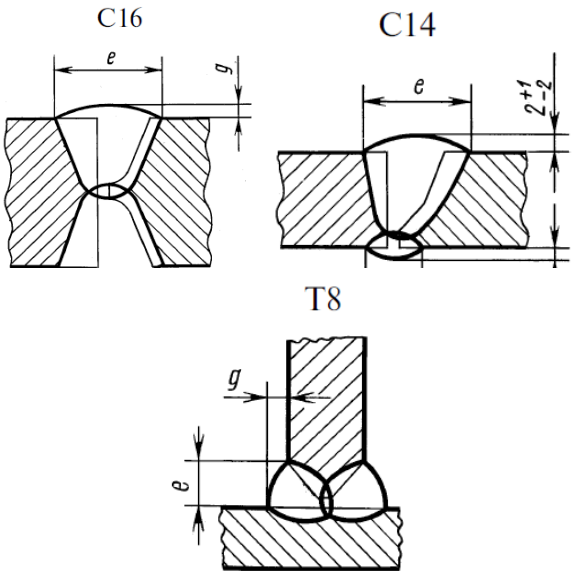


Figure 7. Types of Welds

In Table 1 the strength margins for the pressing down flanges of Turbogenerators TGV series manufactured by SE "PLANT "ELECTROTYAZHMASH" of various power range are indicated.

Table 1. – Mechanical stresses

№	Part	Mechanical stresses, (MPa)		
		TGV-200	TGV-300	TGV –500
1.	Pressing down Flange	135	157	133
2.	Pressing down Finger	274	344	268

Conclusion

In the present scientific work the main peculiarities of design of the Turbogenerators rated 325 MW manufactured by SE "PLANT "ELECTROTYAZHMASH" are submitted. The main features of mechanical calculation carrying out for non-resource units are indicated. The allowable stresses for the welds are shown. The transition from two-dimensional to three-dimensional modeling of parts and units by the finite element method in SolidWorks Simulation is substantiated.

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Section 4. Technical science

Baltabayev Ulugbek,
doctor of philosophy (PhD)
Miralimova Aziza, assistent
Boymuxammedov Muxamadali,
researcher, Tashkent Chemical – Technological Institute,
Tashkent, Republic of Uzbekistan,
E-mail: Ulug85bek77@mail.ru

CATTLE FEED ON THE BASIS OF NON-TRADITIONAL RAW MATERIALS

Abstract: Researched and developed a cattle feed on the basis of non-traditional raw materials. Scientifically justified recipe and received positive qualitative characteristics.

Keywords: Food, cattle, recipe, quality characteristics, nutritional value, non-traditional raw materials, production.

Introduction

Great importance takes the extension of production and full involvement of available raw materials for animal feeds, extension of production and exchange of grain and other raw materials for production of animal feeds, full use in production of animal feeds and expansion of production, using of new feed resources, development of production of feed ingredients from food industry wastes and vegetable wastes [1], and also using of mineral raw materials [2].

Increasing of feed unit and exchange energy of compound feeds, saving of grain resources, increasing of microbiological quality of food are pressing problems.

For feed unit adopted the general nutritional value of 1 kg of good quality oats, in kind 450 … 480 g/l and moisture content about 13% [3]. Known feeds containing, in particular, wheat bran to 32%, barley to 72.5% and dry brewer's grain – 2.5% [4].

It is known the feed, which describes the technology of feed concentrate production by using yeast strains, cultivated on the basis of cheap plant wastes [5].

It is known the method of preparing a feed and/or feed additive for livestock, poultry and fish, wherein using wastes of flour and/or grain production in an amount of less than 1% [6].

It is known the feed additive, the main compound of which is bentonite clay (61–69%) [7]

It is known the feed containing oats, barley, wheat, corn, wheat bran, soybean meal, sunflower basket, monocalcium phosphate, salt and premix [8].

More nearest to present invention is a feed for cattle containing oats, barley, wheat, wheat bran, monocalcium phosphate, salt, premix, corn, soybean meal, potato, Jerusalem artichoke, pumpkin and sunflower basket [9].

The object of present invention is reducing the cost of feed, with norm preservation of fodder and mineral values, saving of barley grain resources, increasing microbiological quality of feed, improvement of environment through using of secondary

resources and also improving the quality and safety of livestock products.

Main aim is achieved by preparing of feed for cattle.

Essence of present invention is in reducing the cost of feed through using of non-traditional secondary raw materials, reduction of valuable grain raw materials content in feed with norm preservation of nutritional value, increasing microbiological quality of feed, improving environment and, consequently creation of non-waste technology, improving the quality and safety of livestock products.

Results and their discussions

Prepared feed is intended for feeding of cattle aged near 18–24 months.

Table 1.– recipes of proposed feed and feed composition according to MNA (more nearest analog)

Compounds	Recipes of proposed feed		MNA
	Sample no 1	Sample no 2	
Barley	5,0	2,0	12
Grain mixes	10,0	2,0	–
By-product of flour-grinding production containing up to 70% of wheat grain	5	4	–
Grain wastes containing up to 50% of wheat grain	3	3	–
Wheat bran	57	60	39
Feed limestone	2	2	–
Bentonies' flour	1	1	–
Rice flour	2	2	–
Brewer's grain flour	5	8	–
Grape pomace flour	5	8	–
Sunflower baskets flour	3.75	6	2
Oats	–	–	10
Wheat	–	–	22
Corn	–	–	2
Soy meal	–	–	5
Potatoes	–	–	2
Jerusalem artichoke	–	–	1
Pumpkin	–	–	1
Monocalcium phosphate	–	–	2
Salt	–	–	1
Premix	–	–	1

As can be seen from Table 1, reducing the cost of product in comparison with MNA is achieved by reducing the amount of valuable expensive raw materials – barley, wheat and vegetable crops, and by introduction of secondary cheap raw materials – feed by-product of flour-grinding industry (waste product) and wastes of food production – grape pomace, brewer's grain, baskets and stalks of sunflower, which are typically utilized. All this greatly reduces the cost of finished product with compliance with feed and mineral values in accordance with approved standards.

Table 2. – Chemical composition of received feed mix,%

Indicators	Sample No. 1	Sample No. 2	MNA
K\E on 100kg	75	71	95
Moisture content, %	11.0	9.8	11.0
Crude protein, %	14.5	13.0	15.0
Crude cellular tissue, %	13.5	14	14.1
Ash insoluble in HCl, %	3.65	3.7	3.4
Solids, %	89.0	90.2	89.0
Fats, %	3.1	3.5	3.6
Calcium (Ca), %	0.81	0.84	1.1
Phosphorus (P), %	0.78	0.77	0.84
Sodium (Na), %	0.09	0.08	0.12
Metallomagnetic impurities, kg/mg	0.28	0.28	0.3

As can be seen from (Table 2), in terms of nutrients, our offering formulation of feed is not inferior to the control. With adding a 5% non-traditional materials and non-peeled barley (Sample number 2, recipe number CS-1 for cattle), determined the best nutritional indicator of feed for cattle, and in control recipe respectively below.

Thus, the study of chemical composition of feed mixture obtained from primary and alternative raw materials with addition of non-peeled barley, gave the highest rates. Table 3 shows quality indicators of proposed feed and feed by MNA.

Table 3. – Quality indicators of proposed feed and feed by MNA

Indicators	Sample No. 1	MNA
K\E on 100kg	75	95
Moisture content,%	11.0	11.0
Crude protein,%	14.5	15.0
Crude cellular tissue,%	13.5	14.1
Ash insoluble in HCl,%	3.65	3.4
Solids,%	89.0	89.0
Fats,%	3.1	3.6
Calcium (Ca),%	0.81	1.1
Phosphorus (P),%	0.78	0.84
Sodium (Na),%	0.09	0.12
Metallomagnetic impurities, kg/mg	0.28	0.3

Table 4. – Comparison of microbiological indicators of proposed feed and feed by MNA

Object of research	Quantity of microorganisms, CFU/g	
	Moulds, 10^3	Bacteria, 10^5
Beginning of storage		
Sample No. 1	3	8
MNA	6	11
After 30 days of storage		
Sample No. 1	1	7
MNA	8	12

As can be seen from Table 4, in the MNA feed, within 1 month of storage was increased total number of microorganisms. During study the effect of meal fodder on microbiological activity has been found, that addition of it in composition reduces intensity of mold and bacterial microflora development compared to MNA, which improves the environment through using of secondary resources and, therefore, creation of non-waste technology, improving the quality and safety of animal products.

Conclusions:

Thus, proposed feed can reduce content of toxic elements in final product and thereby improve the safety of meat and meat-dairy products [10].

Using the proposed composition reduces the input of grain into a feed composition. Entering meal fodder from non-traditional raw materials instead of grain and mineral compounds allows significantly reduce the cost of feed while maintaining the norms of nutritional value. Feed enriched with complete proteins, fats, micro-elements, pectin, vitamins, amino acids, which increases its feed and microbiological value, also have positive effect on animal body, and clears the body of toxic elements, pesticides and residues of harmful elements, thereby improving the quality and safety of meat – dairy products. Using of recycled resources improves the environment and brings economic benefit as it increases the production of finished products and reduces the cost of feed.

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Imomov Sh. B.,
Kodirov I. N.,
Mamatova M. Sh.,
Panjiev J. E.,
Karshi Engineering and Economic Institute
Uzbekistan
E-mail: imomov-shuhrat@rambler.ru

THERMAL EFFICIENCY OF THE SOLAR HEATING SYSTEM BASED ON FLAT REFLECTORS INSTALLED FROM THE NORTHERN SIDE OF THE BUILDING

Abstract: The Considered system three flat reflectors, set up with north sides of the building, in passive system of the solar heating. They Are Determined радиационный mode and heat efficiency flat reflector, providing arrival to solar radiation in heated premises through lightopenings with north sides of the building.

Keywords: solar radiation, the heating season, the northern light aperture, heat balance, flat reflector.

Traditionally, heat collectors (solar collectors, air heaters) in solar heating systems have a strictly directed southern orientation. Since heat receivers are integral architectural and constructive parts of the building, in many cases urban planning, architectural, relief, and other reasons, the southern orientation of the building or the actual heat receiver is not always possible.

The application of a system of flat reflectors, installed on the north side of the building, allows to expand the possibilities and options for using solar energy, to increase the density of solar radiation in the plane of the heat receiver [1].

To determine the thermal balance and temperature of the system, the building + reflectors were previously installed:

1) the radiation and shadow modes of a system of plane reflectors [2];

2) thermal and exergetic efficiency of the system of flat reflectors [1, 3];

3) the model of the heat balance of the building + reflectors system is compiled.

When preparing the heat balance, the following conditions are accepted:

– interacting elements: internal and external air environment, enclosing structures, a system of flat reflectors;

– the influence of interior items on the heat balance of the premises is not taken into account;

– walls, ceiling ceiling, floor spaces are considered as multi-layer, windows and doors – as single-layer fences;

– the walls, combined with the control and tambour rooms, are considered as multi-layered fences with air interlayer;

– with respect to the environment, the building is treated as a stand-alone facility.

In general, the heat balance of a room is determined by the equation:

$$Q_{ab} = Q_{mn;} \quad (1)$$

where Q_{ab} – is the total absorbed heat of the solar radiation, in the room, *W*;

Q_{hl} – total heat loss in the room, *W*.

The total solar radiation that has passed into the room:

$$Q_p = Q_{p4} + Q_{p5}. \quad (2)$$

The total solar radiation entering through the Q_{p5} window and the light-hole Q_{p3}, is determined by the formulas:

$$Q_{p5} = (S_{p5} + D_{p5})\, F_{5;}\ Q_{p3} = (S_{p3} + D_{p3})\, F_{3;} \quad (3)$$

Where S_{p5} and D_p are the density of the transmitted direct and scattered solar radiation, W/m^2; F_5 and F_3 are the area of the glazed window surface and light, m^2.

Direct solar radiation in the lightguard comes from the reflectors:

$$S_{p3} = S_{p0} + 2\, S_{p1}\, sin\gamma; \quad (4)$$

Where S_{p0}, S_{p1} is the direct solar radiation coming from the mean and right + left reflectors, W/m^2; γ – angle of incidence of rays on the plane of the heat receiver, deg.

Solar radiation entering the room is absorbed, internal surfaces and heat sink:

$$Q_{ab5} = A_c\, Q_{p5};\ Q_{ab4} = A_m\, Q_{p3}; \quad (5)$$

Where A_c – is the reduced absorption coefficient of solar radiation internal surfaces of the room; A_m – is the absorption coefficient solar radiation heat receiver.

Total heat loss in the room:

$$Q_{hl} = Q_{hf} + Q_a; \quad (6)$$

Where Q_{hf} – heat loss through fences, W; Q_a – heat loss infiltration of air, W.

The use of a system of reflectors installed on the north side of the building provides an increase in the density of solar radiation intake in the plane of the heat receiver by a factor of 1.7–2.

The temperature regime of the room is considered in the period of the least arrival of solar radiation (the average values for 19–22 December 2006) and the period of the lowest outdoor temperatures (January 20–23, 2007) in the city of Karshi. In the period from 10–11 hours and up to 15 hours the temperature of the air in the room exceeds the normative value t_a = 20 °C. During this period, it becomes necessary to accumulate excess heat from solar radiation. The study of the room temperature in the building + reflectors system allows us to predict the effectiveness of the system of reflectors installed on the north side of the building during the heating season.

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Masimova Lale,
Ph.D., Azerbaijan State Oil and Industry University
E-mail: rahimova_mahluqa@mail.ru

WORDS OF NATIVE ORIGIN IN ENGLISH. THE ORIGIN OF ENGLISH WORDS. COMMON INDO-EUROPEAN AND GERMANIC WORD-STOCK. CHARACTERISTIC FEATURES OF NATIVE WORDS

Abstract: As English appertains to the Indo-European family of languages, it is interrelation to most other languages spoken in Europe and western countries is ubiquitous. This current article sheds lights on the matter of origin of English word stock and their fundamental peculiarities as well as by taking into consideration idiosyncrasies vis-à-vis Common Indo European and Germanic word storage. English is one of the world's most outstanding languages. Its history is interesting for couple of reasons, its flexibility in borrowing from other languages inclusive, a flexibility that has enriched its vocabulary over the centuries. The native language, called Proto-Indo-European, was spoken roughly 5,000 years ago by nomads believed to have roamed in the southeast European territories. Despite its close relation to English, German remains far more conservative than English in its retention of a fairly elaborate system of inflections. Due to etymology, the vocabulary of the English language is far from being homogeneous. Whereas, clarifying the original word stock more precisely, it becomes apparent that the word-stock of English composed of two main sets – native and borrowed which may also be called as loanwords. Native words constitute high percentage of the most frequent words in English. They may be characterized by a high lexical and grammatical valiancy, high frequency and developed polysemy. They are often monosyllabic, have great word building power and enter a number of set expressions. The words of roots which belong to Indo-European elements common to all or most languages of the Indo-European group. English words peculiar to this group denote elementary concepts under circumstances which no human communication would be possible and express the most vital, important and frequently used concepts.

Keywords: Indo-European family of languages, the borrowed and native word stock, words of Common Germanic origin, source of borrowing, international words, eponymy, flexibility of function.

The origin of English words: Due to its versatile word-stock the English language has demonstrated a long way by having close contact with several other languages. Those languages are specifically Latin, French and Old Norse or Scandinavian. A number of Investigations that have been carried out have indicated that the flow of borrowings has been steady and uninterrupted. The greatest number has come from French origin (e.g. ice cream, sunray, jellyfish, killjoy, lifeguard, and passageway). They are applicable to various fields of social-political, scientific and cultural life. A large portion of borrowings is affiliated with mainly scientific and technical terms. The number and character of borrowings do not only depend on the historical conditions, on the nature and length of the contacts, but also on the degree of the genetic and structural proximity of languages concerned. The closer the languages, the deeper and

more versatile is the influence. This largely accounts for the well-marked contrast between the French and the Scandinavian influence on the English language. Therefore, under the influence of the Scandinavian languages, which were closely related to Old English, some classes of words were borrowed that could not have been adopted from non-related or distantly related languages (the pronouns they, their, them, for instance); a number of Scandinavian borrowings were felt as derived from native words.

The borrowed and native word stock of English language

Etymology is a neither rhetorical nor literary device. Etymology is a science whose major aim to investigate word histories as well as dealing with the origin of words.As aforementioned the word-stock of English is represented by native words (25% of the whole vocabulary) and borrowed words (75% of the whole vocabulary).

The most striking feature of English is usually observed in its mixed character. Many linguists consider foreign influence, especially that of French, to be the most important factor in the history of English. This wide-spread viewpoint is supported only by the evidence of the English word-stock, as its grammar and phonetic systems are very stable and not easily influenced by other languages.

For the purpose of comprehending complicated nature of the English vocabulary and its historical development it is essentially considerable to examine the following four notions:

1) etymology of different layers

2) the historical causes of their appearance

3) their volume and role

4) the comparative importance of native and borrowed elements

Above accentuated factors play an utmost role in enriching English vocabulary.

According to their origin words can be native and borrowed. A native word is a word which belongs to the original English stock as known from the earliest available manuscripts of the Old English period.

A native word is a word which belongs to the original English word stock, as known from the earliest available manuscripts of the Old English period. In linguistic literature the term 'native' is conventionally used to denote words of Anglo-Saxon origin brought to the British Isles from the continent in the 5th century by the Germanic tribes–the Angles, the Saxons and the Jutes. Practically, however, the term is often applied to words whose origin cannot be traced to any other language. Therefore. interpretation may have somewhat more reliable criteria behind it, but it seems to have the same drawback–both viewpoints present the native element in English as static.

Up to the point native words are subdivided into two principial groups:

1) words of the Common Indo-European word stock;

2) words of the Common Germanic origin.

Words of the Indo-European stock have cognates (parallels) in different Indo-European languages: Greek, Latin, French, Italian, Polish, Russian and others. The words those which having cognates in the vocabularies of different Indo-European languages form the oldest layer. It has been supervised that they readily fall into definite semantic groups. Among them we find terms of kinship (mother, father, son, daughter), names of animals and birds (cat, wolf, goose), parts of human body (arm, eye). Some of the most frequent verbs belong to this word stock: come, sit, stand. Most numerals are also of the Indo-European origin.

Subsequently, a bigger part of the native vocabulary consists of the words of the Common Germanic word stock. Such nouns as summer, winter, rain, ice, hat; the verbs to bake, to buy, to make, to meet; the adjectives deaf, dead, deep are of the Common Germanic origin. Most adverbs and pronouns also belong here.

Together with the words of the Common Indo-European stock the Common Germanic words form the bulk of the most frequent elements used in any style of speech.

Majority of the native words have experienced great changes in their semantic structure, and in a consequence are nowadays polysemantic. They may be characterized by the following features:

1) a high lexical and grammatical valency (ability to combine with other words)

2) high frequency and developed polysemy.

They are often monosyllabic, have great word building power and enter a number of set expressions.

Diachronically native words are subdivided into three main groups:

1. Words of the Indo-European origin. Indo-European elements are meant words of roots common to all or most languages of the Indo-European group. English words of this group denote elemantary concepts without which no human communication would be possible and express the most vital, important and frequently used concepts.

The following semantic groups can be identified:

– family relations -kinship terms,

– words naming the most important objects and phenomena of nature,

– names of animals and plants, e.g. goose, wolf, cow,

– words denoting parts of the human body, e.g. *ear, tooth, eye,*

– words naming concrete physical properties and qualities (including some adjectives denoting colour), e.g. hard, quick, slow, red, white, new;

– numerals from one to a hundred,

– pronouns' (personal, demonstrative, interrogative)

– some of the most frequent verbs, e.g. *hear, do, be, sit, eat, know, stand* and others.

Words of Common Germanic origin

The Common Germanic stock includes words having parallels in German, Norwegian, Dutch, Icelandic.

It contains a great number of semantic groups some of which are the same as in the Indo-European group of native words:

– nouns denoting parts of the human body, e.g. *head, hand, arm, bone, finger;*

– nouns denoting periods of time *(seasons of the year)*, e.g. *summer, winter, spring, time, week; (autumn is a French borrowing).*

– words naming natural phenomena, e.g. *storm, rain, flood, ice, ground, sea, frost, earth;*

The term borrowing is used in linguistics to denote the process of adopting words from other languages and also the result of this process in the language material itself.

A borrowed word or a borrowings is a word taken over from another language and modified in phonemic shape, spelling, paradigm or meaning according to the standards of the English language.

English history is very rich in different types of contacts with other countries, that is why it is very rich in borrowings. The Roman invasion, the adoption of Cristianity, Scandinavian and Norman conquests of the British Isles, the development of British colonialism and trade and cultural relations served to increase immensely the English vocabulary. The majorities of these borrowings are fully assimilated in English in their pronunciation, grammar, spelling and can be hardly distinguished from native words.

English continues to take in foreign words, but now the quantity of borrowings is not as plethora as it was before. Even more so, English now has become a «giving» language.

Borrowings can be classified according to different criteria:

a) according to the aspect which is borrowed,

b)according to the degree of assimilation (partial or total conformation to the phonetically, graphical and morphological standards of the English language and its semantic system),

c) according to the language from which the word was borrowed. (In this classification, only the main languages from which words were borrowed into English are described, such as Latin, French, Italian, Spanish, German and Russian).

Borrowings enter the language in two ways: through oral speech (by immediate contact between people) and through written speech (through books, newspapers, etc.). Oral borrowings took place in the early periods of history, whereas in recent times written borrowings have gained importance. Words borrowed orally are usually short and they undergo considerable changes during the act of adoption.

Written borrowings preserve their spelling and peculiarities of their sound form, their assimilation is a long process.

Borrowings may be direct or indirect, i.e. through another language. Such languages-intermediaries were, for example, Latin through which many Greek words came into the English language and French by means of which many Latin words were borrowed.

Thus, there should be a noticeable differentiation made between the term 'source of borrowing' and the term 'origin of borrowing'. The first should be applied to the language from which the loan word was taken into English. The second refers to the language to which the word may be traced.

Borrowings enter the language in two ways: through oral and written speech. Oral borrowing took place chiefly in the early periods of history, whereas in recent times written borrowing gained importance. Words borrowed orally are usually short and they undergo more changes in the act of adoption. Written borrowings preserve their spelling.

Borrowings can be borrowed in two ways:

1) through transcription (football, trailer, jeans)

2) transliteration (cruise, motel, club).

Besides there can be loan words (blue stocking, collective farm).

International words

There exist overwhelming number of words that are multilingual which have been borrowed from several languages. Such words basically refer to Latin and Greek origin and convey notions which are unequivocally significant in the field of communication in different countries. This list comprises:

1) the names of sciences *philosophy, physics, chemistry, linguistics,*

2) terms of art, *e.g., music, theatre, drama, artist, comedy,*

The English language became a source for international sports terms, *e.g., football, hockey, cricket, rugby, tennis.*

Eponymy

Every language has words that have not been borrowed from other languages but that have developed with the language over time. These are called native words. Words are arbitrary, but we know that is not strictly true. The form of the word must fit the phonology of the language. Companies spend a lot of money trying to find exactly the right sound and letter combination for their product. Kodak is an example of a brand name that has became a general synonym for camera. List as many other brand names which have become general terms as you can. Why have they been incorporated into the general lexicon in this way? Can you think of other examples of individuals who have coined words for the language?

The word *boycott* is also based on the name of a real person, Captain Boycott, a retired British army captain who oversaw estates in Ireland and refused to give humanitarian concessions to his Irish tenants. They hated him so much that they ostracized him and boycott became a synonym for rejection and isolation.

Place names can become common words. *Camembert* (cheese) and *limousine* are named after places in France. *Charleston,* the dance, is also the name of an American city. In science eponyms abound, and a definite etiquette governs how eponyms are used from field to field. In astronomy, comets are named for the first person who observes them.

An *eponym* is a word derived from the name of a real, fictional, mythical or spurious character, person or place. Most eponyms originate from a person's surname.

Flexibility of function:

To make a further addition the simplicity of inflections, English has got two other basic characteristics:

- flexibility of function;
- openness of vocabulary.

Flexibility of function has grown over the last five centuries as a consequence of the loss of inflections. Words formerly distinguished as nouns or verbs by differences in their forms are now often used as both nouns and verbs. One can speak, for example, of *planning a table* or *tabling a plan, booking a place* or *placing a book, lifting a thumb* or *thumbing a lift*. In the other Indo-European languages, apart from rare exceptions in Scandinavian languages, nouns and verbs are never identical because of the necessity of separate noun and verb endings. In English, forms for traditional pronouns, adjectives, and adverbs can also function as nouns; adjectives and adverbs as verbs; and nouns, pronouns, and adverbs as adjectives. One speaks in English of the *Frankfurt Book Fair*, but in German one must add the suffix *-er* to the place-name and put attributive and noun together as a compound. In French one has no choice except constructing a phrase involving the use of two prepositions: *Foire du Livre de Frankfort*. In English it is now possible to deploy a plural noun as adjunct (modifier), as in *wages board* and *sports editor*; or even a conjunctional group, as in *prices and incomes policy* and *parks and gardens.*

Conclusion:

Language is a living thing as it grows and is exposed to alternations made by human negotiations through which obtained by interactions via contact with several languages by borrowing a number of words from one another's lexicon, and meanwhile, it can also go extinct. A language becomes moribund when people relinquish to learn it. After that, it can go extinct in a matter of decades. A language doesn't become extinct until the last person to speak it dies. It is undeniable fact that English vocabulary, which is one of the most extensive amongst the world's languages contains an immense number of words of foreign origin. It goes without saying that the English proper element also contains all the later formations, that is, words which were made after the 5th century according to English word-building patterns both from native and borrowed morphemes. The native element in English comprises a large number of high-frequency words like the articles, prepositions, pronouns, conjunctions, auxiliaries and, also, words denoting everyday objects and ideas. Following this further, the grammatical structure is essentially Germanic having remained unaffected by foreign influence.

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Section 5. Transport

Menshchikov Alexander,
Center for Computational and Data-Intensive Science and Engineering (CDISE) Skolkovo Institute of Science and Technology (Skoltech)
Skolkovo, Moscow Region, Russian Federation
E-mail: aleksandr.menshchikov@skolkovotech.ru

DEVELOPMENT OF ADAPTIVE WING WITH ADAPTIVE FLAP AND SLAT FOR UNMANNED AERIAL VEHICLES

Abstract: Aircrafts perform flight in multiple regimes with different speeds, Angles of Attack (AoA), sideslip angles and different altitudes. Designers usually choose the airfoil with the best performance for the cruise mode only or which stays suboptimal for all the flight regimes. It leads to reduction of maximum lift-to-drag ratio for certain regime as well as reduction of the overall performance. That is why adaptive wing, which can stay optimal for any flight regime is promising technology, which could significantly improve the performance and maneuverability of the aircraft during the flight. This work demonstrates performance of the wing with traditional and adaptive mechanization of the flap and slat in computer simulation and in the wind tunnel testing. It also provides the design of the adaptive wing with adaptive flap and slat. All the investigations were performed for 2D airfoil under different Reynolds numbers and Ao A. This paper proves, that adaptive wing improves lift-to-drag ratio and maneuverability of the aircraft for different flight regimes. Improved lift-to-drag ratio increases the range and the mission time.

Keywords: Intelligent Structures, adaptive wing, aircraft mechanization.

1. Introduction

Adaptive wing is kind of so-called Intelligent Structures. Intelligent structures are kind of structures, which have close integration of the actuation, sensing, controlling systems and computer architecture. That kind of structures has ability to sense and perform actions according to the outer conditions, based on non-trivial controlling and computing algorithms. Highly cognitive properties of those structures make them kind of bio-inspired embedded neuro systems for engineering applications.

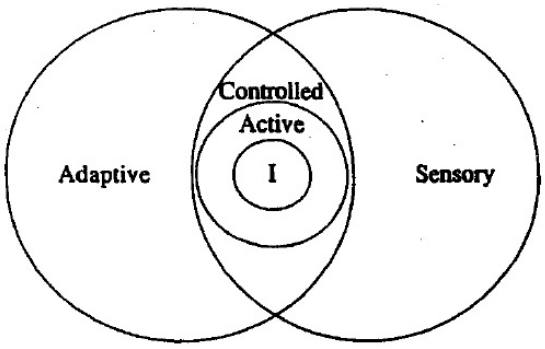


Figure 1. Classification of Intelligent Structures as a subset of adaptive, sensory and controlled structures [1]

For better understanding of the Intelligent Structures concept it is better to refer to the article [1], where they are described as the subset of complex intersection of adaptive, sensory and controlled structures.

Intelligent structures are a subset of a much larger field of research. It incorporates Adaptive, Sensory, Controlled, Active structures and includes high authority control system [2].

Adaptive structures are defined as those, which possess actuators that allow the alteration of system states and characteristics in a controlled manner [1]. Another definition of Adaptive Structures are structures, that "can purposefully vary its geometric configuration as well as its physical properties" [3]. Adaptive structures have the system of distributed actuators. All the wings of conventional aircrafts have multiple actuators for flaps, slats, ailerons, etc. That is why wings of conventional aircrafts are adaptive structures.

Sensory structures have the system of distributed sensors. These sensors return the information about the state of the structures, or about outer conditions (temperature, flow velocity, pressure, current, etc.).

Controlled structures are inside overlap of adaptive and sensory structures. The state of these structures could be influenced by information from sensors in a simple close-loop or any more advanced control system architecture.

Active structures are inside the subset of controlled structures. Their actuators also have load-bearing functionality.

Intelligent structures are a subset of active structures. They have everything, mentioned above: highly distributed sensors and actuators system. These systems are united by control system. Actuators also have structural functionality. In addition to that intelligent structures have distributed control functions and advanced computing architecture.

Currently there are many examples of applications of intelligent structures for modern UAVs. These examples include: aeroelastic control and maneuver enhancement of helicopter [4], high performance aircraft-like wing, made from carbon laminate [5], active structure damping, wave propagation control, active stabilization (aircraft flutter), vibration and shape control. The first adaptive wing was created in 1986 as embedded part of F-111 jet fighter [6]. However, those time it was inefficient and impractical. A few years later, methods of incorporating actuators into wing substructure or skin, hence developing true adaptive aeroelastic structure, have been investigated with promising results [7]. However, 20 years later "FlexSys inc." proved, that adaptive wing with smooth variable flap for business jets could become effective and commercially attractive [8].

Currently "FlexSys inc." has the most advanced technology. However, it was created for business jets – fast passenger airplane, which flies in conditions with high Reynolds numbers, low AoA and performs gentle maneuvers with low g-loads. In contrast, UAV fly in low Reynolds numbers, low to medium AoA and could perform abrupt maneuvers with high g-loads. Furthermore, that concept has adaptive flap, but has not adaptive slat.

That is why the investigation of adaptive wing with adaptive flap and slat for UAV should be investigated.

2. Methodology

A. Computational Fluid Dynamics Analysis of Adaptive Flaps

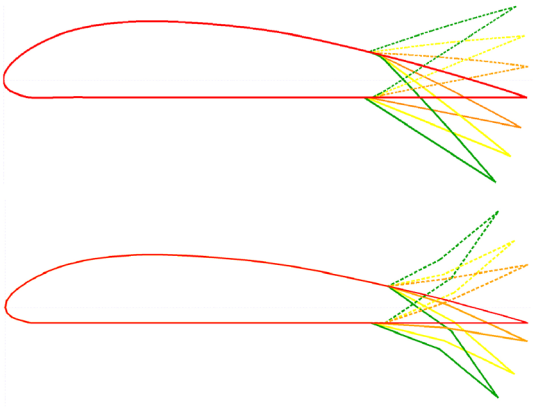
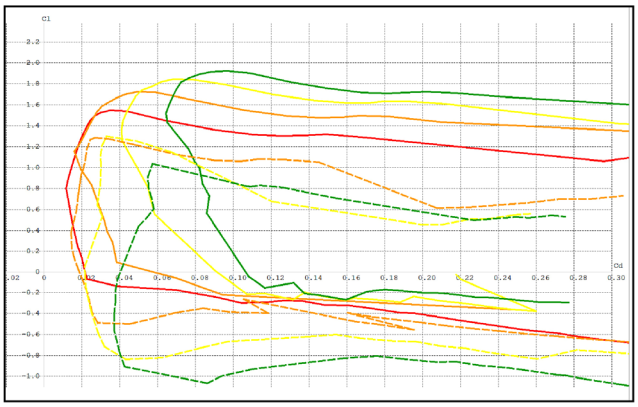
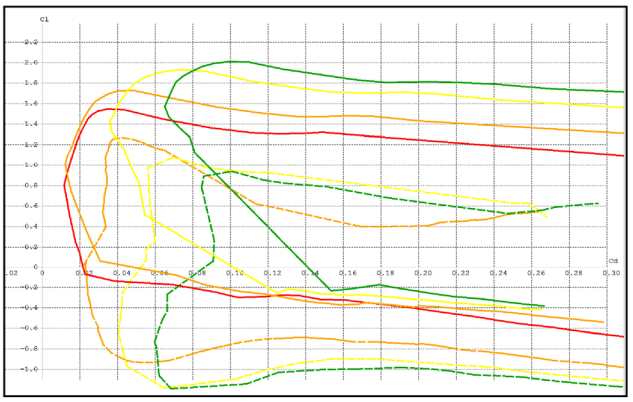


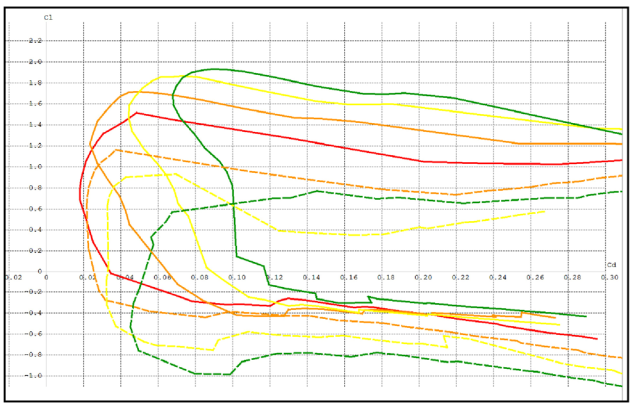
Figure 2. The airfoil Clark YH with traditional (top) and adaptive (bottom) mechanization. The color depicts angle of deflection: 0°–red; 10°–orange; 20°–yellow; 30°-green. Solid line is for negative angles, dotted line is for positive angles



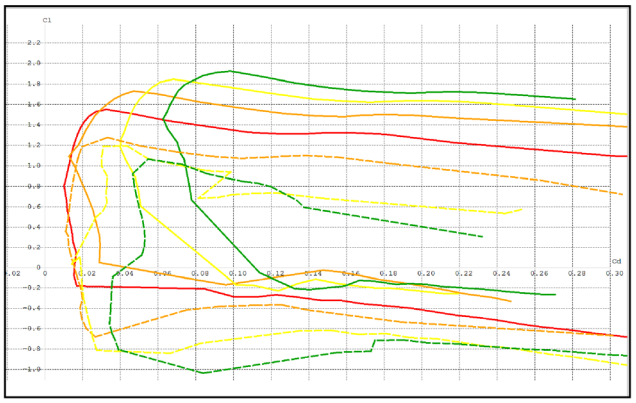
Re = 100 000; Configuration – traditional;



Re = 200 000; Configuration – adaptive;



Re = 100 000; Configuration – adaptive;



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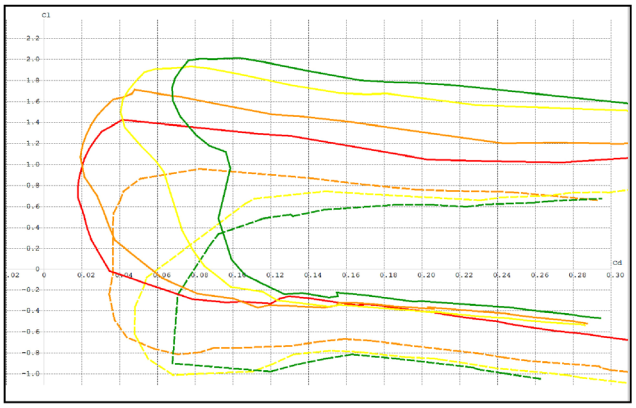

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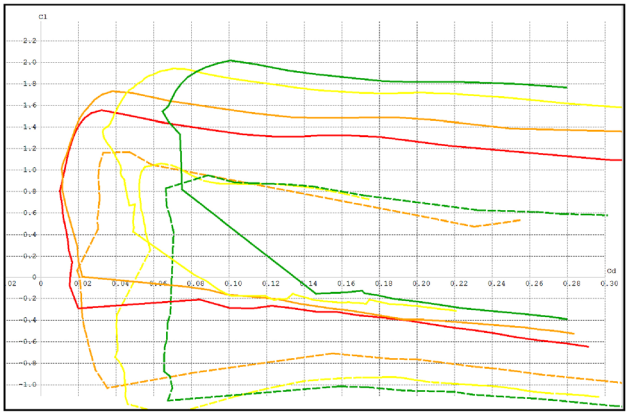
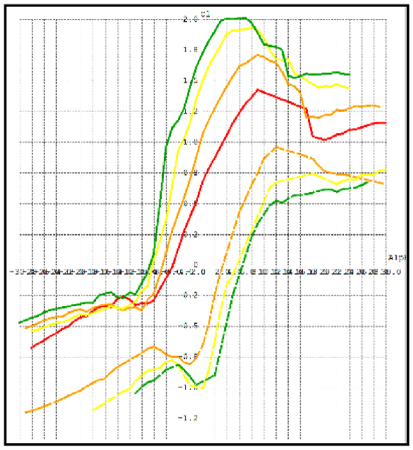


Re = 300 000; Configuration – adaptive;

Figure 3. C_L vs C_D characteristics for different Reynolds numbers and configurations of the wing. The color depicts angle of deflection: 0°–red; 10°–orange; 20°–yellow; 30°–green. Solid line is for negative angles, dotted line is for positive angles.

In the current work all experimentation is divided into two parts: 2D airfoil computational analysis and wind tunnel testing. Both methods applied to the wing with traditional mechanization as well as to the wing with adaptive mechanization. The model of investigation is Clark YH airfoil. In all the experiments the flap is deflected from +30° to –30° with 10° increment.



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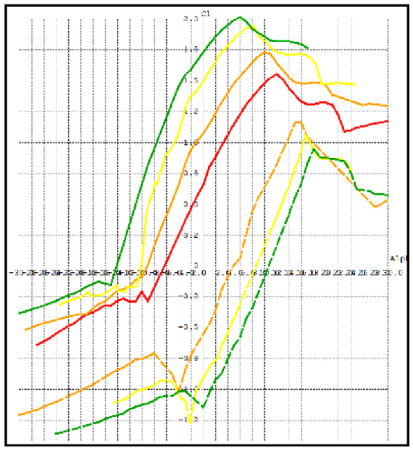

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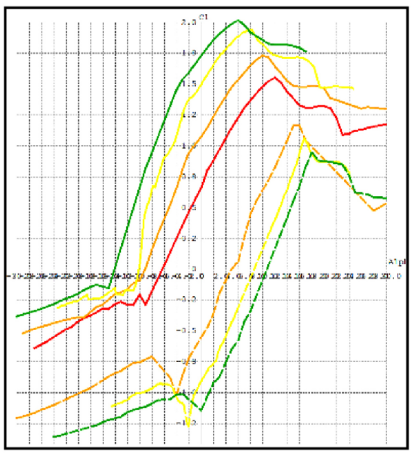

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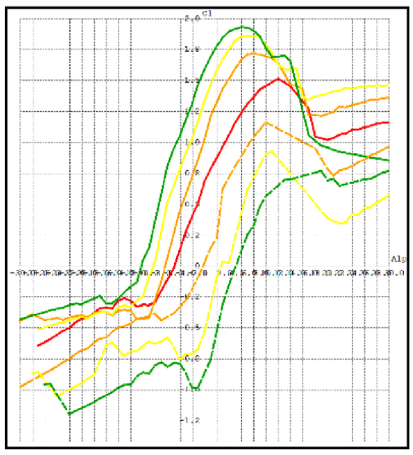

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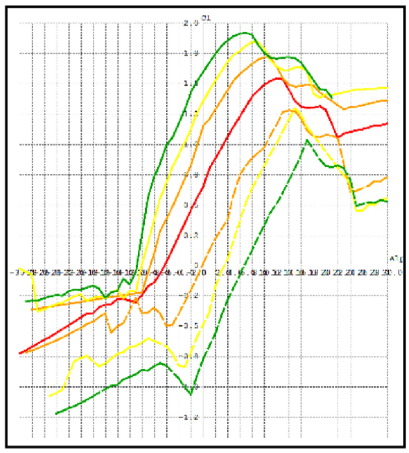

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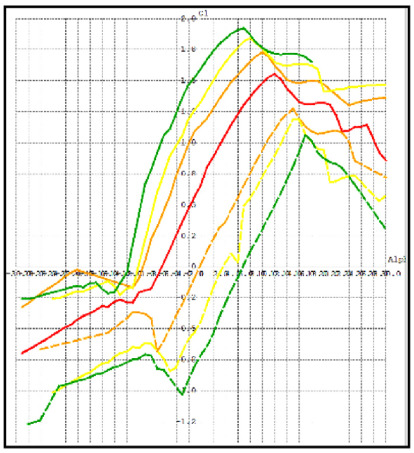

Re = 300 000; Configuration – adaptive;

Figure 4. Lift coefficient vs Angle of Attack characteristics for different Reynolds numbers and configurations of the wing. The color depicts angle of deflection: 0°–red; 10°–orange; 20°–yellow; 30°–green. Solid line is for negative angles, dotted line is for positive angles

The investigation was performed for all the geometrical models of adaptive and traditional mechanization configurations for different conditions:

- Reynolds number varies from 100000 to 300000 with 100000 increment;
- AoA varies from –5° to 35° with 0.5° increment.

For Computational Fluid Dynamics (CFD) study XFLR5 software was used. It is open-source software for low Reynolds numbers investigations [9]. Every single configuration of the wing under certain conditions (Reynolds number and AoA) was calculated in 100 steps.

CFD study of adaptive wing with adaptive flap showed the improvement of aerodynamic characteristics. It is depicted in polar curve – dependency of lift coefficient (C_L) from drag coefficient (C_D)C_L vs C_D (Fig. 3) and C_L vs *AoA* (Fig. 4) characteristics.

C_L vs C_D characteristics shows, that in the same conditions adaptive wing has slightly lower C_L, than traditional wing. However, C_D for adaptive wing is significantly lower, than for traditional wing under the similar condition and configuration. That is why lift-to-drag ratio of the adaptive wing significantly increases. It leads to lower power consumption of the aircraft.

C_L vs C_D characteristic is in polar reference frame. That is why the modulus of the radius-vector and its inclination represent physical characteristics. The modulus of radius-vector shows total aerodynamic force and the inclination angle shows lift-to-drag ratio for the certain conditions. If radius vector is tangential line, which origins in the reference point, its inclination angle will represent maximum lift-to-drag ratio possible in such configuration:

Kmax = tan θ; θ – inclination of the tangential.

It is also seen from the graphs (Fig. 4), that they are slightly higher for adaptive wing, than for traditional wing, hence the maximum achievable lift-to-drag ratio is also increased.

All the C_L vs AoA (Fig. 4) graphs slightly moved in the positive direction of AoA (horizontal) axis. Hence, the stalling angle increased for ~4° for all the configurations. It means improvement of stability and maneuverability.

Critical values of C_L (for stalling angle) are also increased in every case. It means higher values of the lifting force before stalling. Hence, better controllability for near-critical regimes.

All the C_L vs *AoA* characteristics in the stalling angle region are low-sloped. It means, that aircraft doesn't lose controllability under stalling conditions.

3. Experimental Results

B. Experimental setup and measurements

All the experiments were conducted in the wind tunnel (Fig. 5). That wind tunnel is specialized for low-Reynolds number investigations. The characteristics of the wind tunnel are the following:

- Maximum airflow velocity: 30 m/s
- Test chamber width x length: 0.8m x 1.0m
- Mean turbulence level: 7%

Figure 5. The Wind Tunnel

That wind tunnel is equipped with particle generator and high FPS optical system. That methodology is widely known as Particle Image Velocimetry (PIV). In our case particles are produced by the fume generator, then they go to the inlet of the wind tunnel. Special mirror transforms the laser beam into light sheet. Than it illuminates particles inside the test chamber. Reflected light goes to the high-speed cameras, which capture the picture from different angles. That video becomes an input file for advanced videogrammetry software, which calculates position and velocity of

every particle in the flow for every frame. Kinematic characteristics of these particles over time allow to calculate pressure distribution over the object of investigation (e.g. airfoil), (Fig.6).

The advantage of such a methodology is no touch measurements, which do not produce any disturbance of flow. Advanced software allows to calculate characteristics of the flow in every point with high accuracy. The disadvantage is that setup returns only 2D pictures of the flow. Furthermore, it doesn't work for the whole object simultaneously, but for the top or bottom surface at a time.

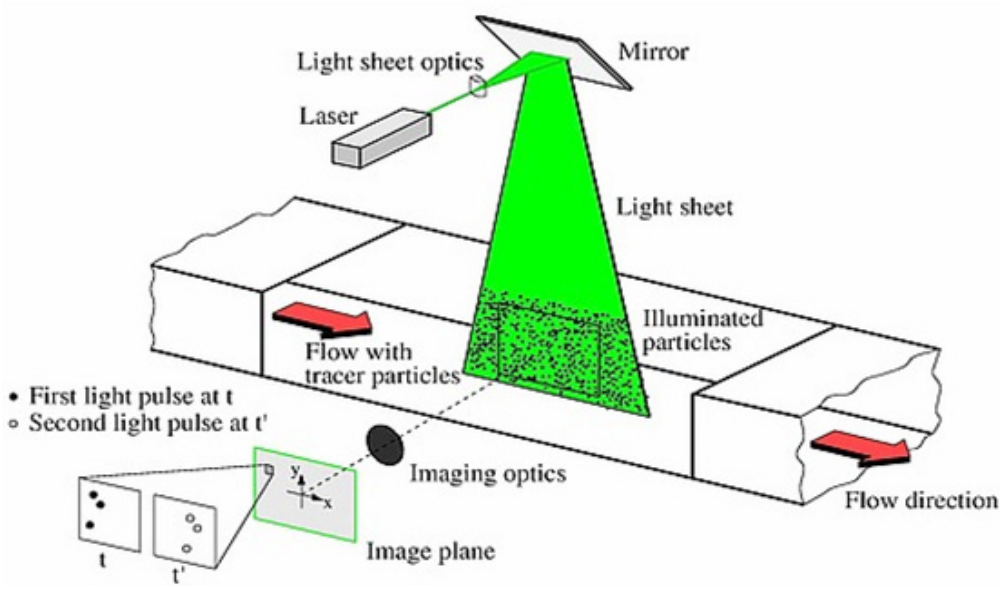

Figure 6. Particle Image Velocimetry methodology [10]

C. Adaptive wing design

The adaptive wing was designed and tested in SolidWorks 2016 software (Fig. 7). The wing consists of 40 parts. The mechanization has the following characteristics:

- Slat can deflect up to 30°;
- Flap can deflect from –30° to +30°;
- The thickness varies from 11.9% to 22%.

The section of adaptive wing has 11.2 cm chord and 40 cm wingspan. All the control surfaces are deflected by means of 6 servos, which are situated inside the wing. They are controlled by Arduino Uno microcontroller. All the parts of the wing were made from ABS plastic, using additive manufacturing technologies. The skin of the wing was made from silicon.

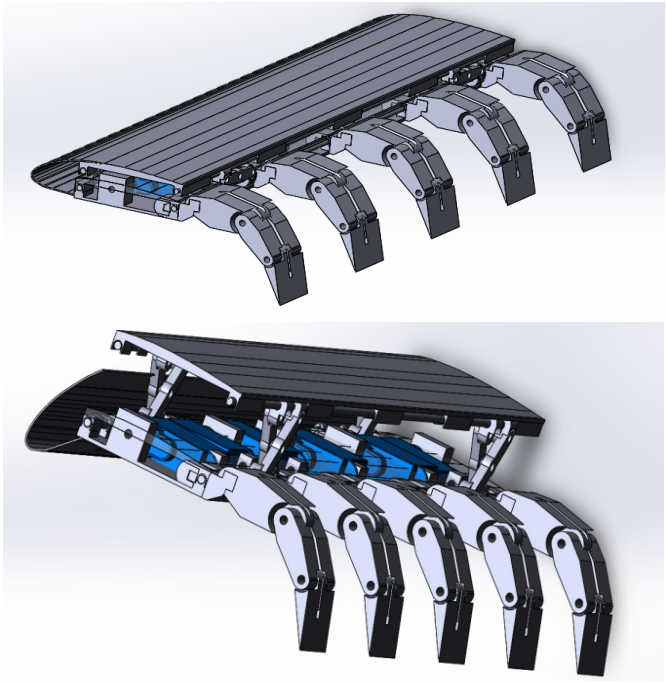

Figure 7. The design of the adaptive wing segment in the Solid Works 2016 software

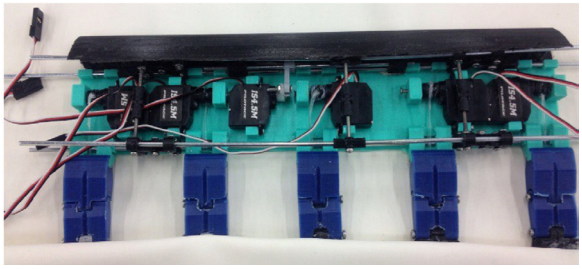

Figure 8. The manufacturing of the section of the adaptive wing

D. Experiment

The experiment was performed for every deflection angle of the flap and for AoA from –5° to +35° with 5° step. The velocity of the flow had the following values: 10 m/s, 20 m/s, 30 m/s to achieve 100000, 200000 and 300000 Reynolds numbers.

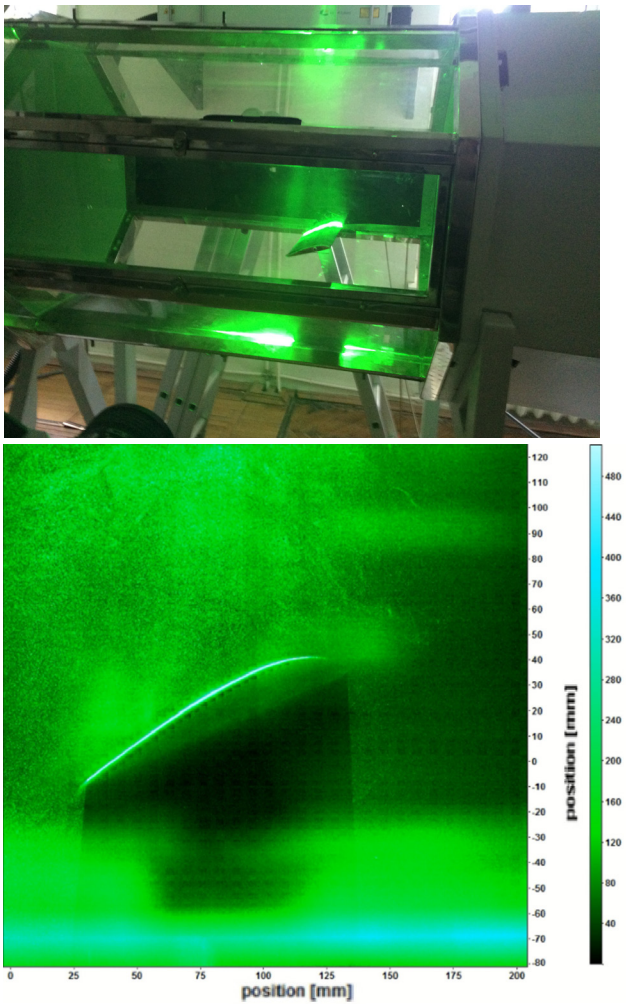

Figure 9. The test chamber of the wind tunnel with the laser, turned on (top); the data, received during the experiment by the cameras (bottom)

During the experiment, the pictures of illuminated airflow over the wing was received (Fig. 9).

These pictures and videos were input data for the OpenPIV software. As the result, all the important aerodynamic characteristics were calculated: lift, drag, pressure and velocity distribution (Fig. 10).

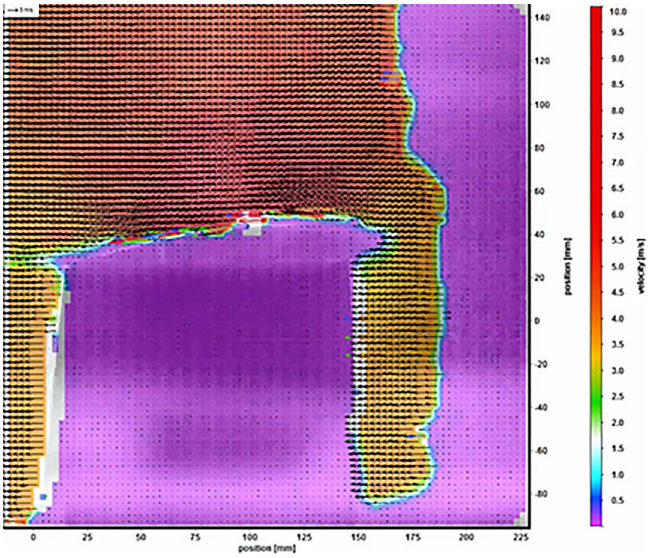

Figure 10. Visualization of the pressure distribution of the airflow over the segment of the adaptive wing

The analysis of the experimental results proved the initial hypothesis. Furthermore, the experiment proves, that flap deflection leads to increase of lifting force as well as lift-to-drag ratio. It also increases the torque, that means improvement of controllability and maneuverability of the aircraft. The deflection of the adaptive flap also leads to decrease of the drag force, hence, it lowers the power consumption of the aircraft.

The experiment also showed significant decreasing of the pressure over the upper surface of the wing. It increases lifting force.

4. Conclusions

1. Verification of the XFLR5 software showed, that the error for low Reynolds number is ~1%.

2. The advantage of adaptive mechanization was showed:

a. The lift-to-drag ratio of the adaptive wing significantly increases. It leads to lower power consumption of the aircraft. The maximum lift-to-drag

ratio is also increased up to 5% for all the configurations and regimes.

b. The stalling angle increased for ~4° for all the configurations. It means improvement of stability and maneuverability.

c. Critical values of C_L increased in every case. It means higher values of the lifting force and better controllability for near-critical regimes.

d. Improvement of controllability under stalling conditions.

3. During the investigation the segment of the adaptive wing was successfully designed and manufactured. It reliably worked during the experiment in the wind tunnel.

4. As a result of the experiment, the initial hypothesis, that adaptive flap would significantly improve aerodynamic characteristics of the wing, was successfully proved.

5. Future Work

In the current work numerical investigation and the wind tunnel experiment of the adaptive flap was represented. However, the prototype of the adaptive wing segment also has adaptive slat and variable thickness mechanization. Investigation of their influence on aerodynamic characteristics should become the objectives of the future work.

Acknowledgment

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Section 6. Chemistry

Garaybayli Samira Aslan,
Azerbaijan State Oil and Industry University
Engineer, the Faculty of Chemical Engineering
E-mail: syamakerim@gmail.com

Gambarov Mirsalam Beyukaga,
Ministry of environment and natural resources of Azerbaijan Engineer
E-mail: bvl_ok@rambler.ru

Atayev Matlab Shixbala,
Azerbaijan State Oil and Industry University
Lecturer, the Faculty of Chemical Engineering
E-mail: bvl_ok@rambler.ru

Alosmanov Mirali Seyfaddin,
Azerbaijan National Academy of Science
Professor, Institute of Geology and Geophysics
E-mail: alosmanov1143@scientifictext.ru

DEVELOPMENT OF ECOTECHNOLOGY OF A SLAG PRODUCED FROM MUNICIPAL SOLID WASTES (MSW) INCINERATION BY ADDING MODIFIERS (PHOSPHORITE AND PHOSPHOGYPSUM)

Abstract: In the article of "Working out of ecotechnology of the slag, received by burning of solid municipal wastes by addition of modifications". It has been determined that by addition of phosphorites and phosphogypsum into the slag, the organic complex fertilizer will be received by the following composition: P_2O_5 assimilated; K_2O – 6.4%; CaO – 20.4%; yield of aim product – 94.6%; grains hardness – 1.7 MPa.

Keywords: slag, phosphogypsum, phosphorite, fertilizer.

Introduction. Development of utilization technology of treated macro-, microelement wastes (slag, sludge), and multicomponent modifiers from sorting and incineration of organic mineral complex wastes; different production processes, extraction, transportation, processing, application of minerals is one of the most important problems. Growth of non-oil sector and improvement of ecological situation for solution of these problems are the main factors. Environmental improvement is closely connected with the use of cheap wastes and non-ore natural mineral compounds. In the entire world, including our country a great amount of slag is formed in metallurgy fields of many industries [1–3].

Our republic is rich with the reserves of cheap macro- and microelement modifying compounds.

Unfortunately, they have not been found their application fields up to now. Development of utilization technology of treated wastes by adding cheap and local natural compounds is the basis for all these. For example, 1500–1800 tons of organic complex mineral wastes (MSW) are formed per day in Baku and its regions. These wastes are incinerated in a plant of Balakhany district in Baku and the resulted bottom ash and flue dust are not used and remain unused around the plant.

Presently, the amount of such wastes in every country is million tons and they accumulate and pollute atmosphere, hydrosphere and lithosphere.

If we consider that despite sufficient reserves of low-quality phosphorite there is no information on the use of it for preparation of phosphoric fertilizer or phosphate in technical literature. But phosphorite has been used as a neutralizer up to now. This is not economically useful for protection of soil reserve. In this study, we have developed ecotechnology of slag waste using previously unused in this field phosphorite as a modifier with rich reserves in the Republic of Turkey and Nakhichevan AR. According to our goal, we have also used phosphogypsum. Phosphogypsum is prepared by the following reaction with the mixture of sulfate and phosphate acids [4].

$$Ca_5F(PO_4)_3 + 5H_2SO_4 + nH_3PO_4 = (n+3)\,H_3PO_4 + 5CaSO_4 \cdot mH_2O + HF$$

Phosphogypsum, produced in the reaction, always draws attention. When the soil is enriched with phosphogypsum, it actively effects on the formation of soil and improves its chemical composition. It contains calcium (30%), sulphur 23–25%, SiO_2 0.3% and microelements. Furthermore, phosphogypsum contains many compounds that are necessary for plants and soil. Considering this, we used phosphogypsum with a certain compound or as a modifier in one of our works [6–8].

It is known that our republic needs 450–550 thousand tons of fertilizer and it is dearly bought from abroad. However, using local reserves we may produce nearly 45–55% of it in our republic.

Our aim is the treatment by using a slag and the following local modifiers formed during incineration of MSW and development of utilization technology. Phosphogypsum and phosphorite were used as a modifier. To achieve our goal we used a slag from the incineration of MSW and modifiers. Presently, only the wastes formed in Baku are burned in Balakhany district. The amount of this waste is averagely 1600–1700 tons per day. 250–350 kg slag is produced during the incineration of this waste. Table 1 shows chemical composition of this waste.

Table 1. – Composition of 250–300kg of slag formed averagely during incineration of 1 ton of MSW

Results of analyses of burned waste,%													
Name	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**P_2O_5**	**SO_3**	**K_2O**	**CaO**	**TiO_2**	**MnO**	**Fe_2O_3**	**Cl**	**YTI**
Waste burned № 1 (bottom)	5.82	2.42	4.12	14.86	2.12	2.56	2.27	32.47	0.83	0.21	10.31	2.07	19.48
Waste burned № 1 (flue)	2.92	1.26	1.52	6.53	0.94	3.80	7.14	34.62	0.98	0.24	3.90	14.62	21.12

Chemical composition of phosphogypsum used in this research work is given in (table 2).

Table 2. – Chemical composition of phosphogypsum

CaO	**SO_3**	**P_2O_5 gen.**	**P_2O_5 in water**	**R_2O_3**	**Fe_2O_3**	**Al_2O_3**	**MgO**	**F**	**CO_2**	**dissolution**	**R_2O_3**
33.5	47.1	1.1	0.7	0.5	0.2	0.1	0.3	0.3	0.1	16.5	0.1

Low-quality Nakhichevan phosphorite was also used in this work. Its composition is given in table 3 (%).

Table 3. – Composition of Nakhchivan phosphorite

CaO	P_2O_5	SO_3	F	CO_2	Na_2O, K_2O	MgO	Mn Fe_2O_3	Al_2O_3	TiO_2	Organic comp.	HgO	Other mixture
39.5	14.4	0.15	2.1	2.2	1.5	3.8	1.6	2.5	1.01	1.41	1.7	2.71

In laboratorial condition 100 ml of processed H_2SO_4 is poured into 0.5 l of cylindrical reactor and heated at 35–40°C and 50g of slag (slag is produced from MSW incineration) is added and mixed. After 10–15 minutes 50g of phosphorite is delivered into reactor. The sample is taken from the reactor. If necessary elements in slag and phosphorite pass to the solution 50g of phosphogypsum is added into the reactor. Cylindrical reactor is placed in a drier and kept 60–90 minutes at 100–105°C. Then reactor is removed from drier and fertilizer is taken from reactor and neutralized, granulated and dried. The composition of granule complex fertilizer is given below (mass%): P_2O_5 – adopted 13.5%; K_2O – 6.4%; CaO – 20.3%; P_2O_5 – free 2.4; MgO – 2.5; MnO – 1.3; H_2O – 2.2; solidity of a granule 1.6–1.7 mPa, yield of the main product is 94.6%.

Scheme of technological installation of the research work has been developed.

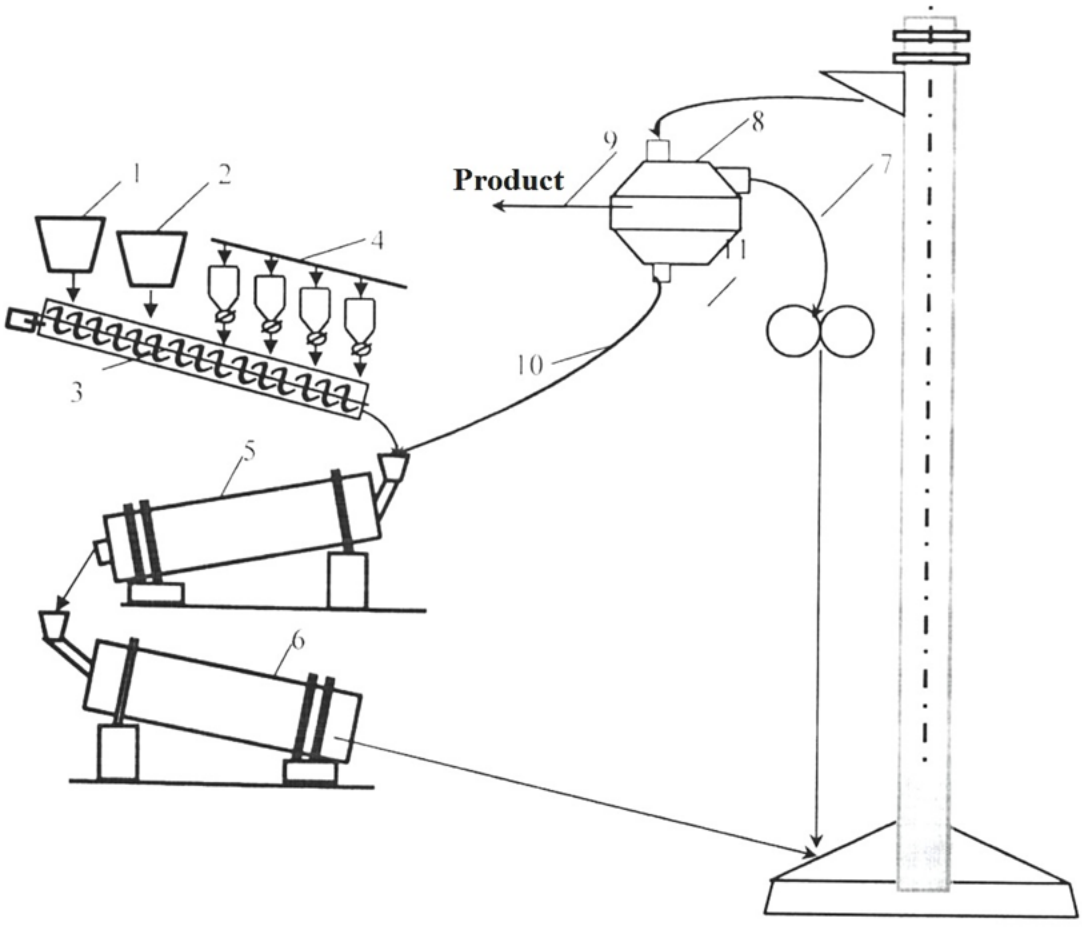

Figure 1. Technological scheme: 1 – tank for H_2SO_4; 2 – hopper for MSW; 3 – screw; 4 – hopper for modifiers; 5 – granulator; 6 – drier; 7 – elevator; 8 – sieve; 9 – final product line; 10 – recycle line; 11 – grinder

Description of the technological scheme**.** Processed sulfuric acid is delivered to a tank (1), crumbled slag is delivered to hopper (2). Screw (3) is put into operation firstly. Then slag is delivered to screw from acid tank (1) and slag hopper. Modifiers are delivered onto the compounds in screw. The mixture produced in screw is delivered to granulator (5); then is passed into recycle separated from sieve (8).

Granule mass in granulator (5) is delivered to drier (6). Dried material is passed to elevator (7). Dried product is delivered to sieve (8) via elevator (7). It is divided into three parts there. 0.5–1.0 mm product is delivered to recycle granulator, 1–5 mm final product is delivered to 5 mm grinder (11), and then sent to elevator and process. 10 g of slag contains FeO, Fe_2O_3 compounds. The amount of phosphorite in 1 g phosphorite is 0.89 g, when both of them are decomposed in sulphuric acid iron is converted into $FeSO_4$ and H_3PO_4. Free H_3PO_4 is decomposed and P_2O_5 is produced. As a result the following compound which is used in agriculture is produced. $FeSO_4$–11–17%; P_2O_5 (free) – 8.5–11.3%.

Conclusion

In the work on the development of utilization technology of slag formed during incineration of municipal solid waste with local modifiers it was determined that complex fertilizer can be produced by adding low-quality phosphorite and phosphogypsum into a slag with rich reserves which disrupts ecological balance. Amount of P_2O_5 adopted in granule complex fertilizer is 13.5%; K_2O – 6.4%; CaO – 20.3%. The yield of the main product is 94.6%. Solidity of granule is 1.6–1.7 mPa.

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Mukhtarov Nuriddin Shamsiddinovich,
Institute of general and inorganic chemistry
Academy of Sciences of Uzbekistan,
doctor of philosophy
E-mail: muknur@list.ru

DEVELOPMENT OF INNOVATIVE TECHNOLOGIES FOR THE PRODUCTION OF FUELS AND OILS WITH IMPROVED PERFORMANCE PROPERTIES

Abstract: According to existing ideas, depressant ability of the polymer depends on its compositional heterogeneity. The depressors polymethacrylate type of compositional heterogeneity is largely determined by the molecular weight distribution of alkyl groups in macromolecules of polymers or copolymers, and not for the macromolecules.

Keywords: polyalkylmethacrylate, polyalkylacrylate, polyvinylalkyl esters, pour point depressant properties, diesel fuel, lubricant, additive, axial oil, dispersion systems, disperser.

Currently in the global economic crisis, rational use of secondary resources and the new synthesized materials with the purpose of producing petroleum - diesel fuels and lubricants with improved performance and solving problems of import substitution determines the effectiveness of the developed new innovative technologies. Of particular importance is played by the implementation of target projects of modernization and technical updating of basic branches of economy, introduction of modern innovative technologies designed to give powerful impetus for the exit of Uzbekistan to a new level that ensures the competitiveness of our country on the world market [1].

The production of winter diesel fuel and lubricating oils implies the conformity of fuels and oils the requirements of the relevant standards for such low-temperature properties and as cloud point, pour point, cold filter plugging and sedimentation stability in storage conditions at temperatures below the cloud point. The best means of improving low-temperature properties of diesel fuels and oils, is the use of depressant-dispersant additives, and in the preparation of lubricating oils with a special role is played by the compositions of base oils.

Among the many depressants widespread copolymers of ethylene with vinyl acetate, obtained at high pressures (up to 100 MPa and higher) and temperatures (100-150°C). Alkylmethacrylate copolymers of polar monomers are of interest due to a softer process conditions (the atmospheric pressure). But they do not show effectiveness in the primary low temperature indicator the temperature limit of filterability.

It should be particularly noted that depressants only inhibit the adhesion of paraffin crystals with the formation of sedentary patterns and may not prevent onset of crystallization. Therefore, the fuel with these additives during long-term storage is divided into two layers: the lower one enriched with paraffin crystals, and the upper light. Both layers retain mobility, but differ in the composition, and therefore the thermophysical characteristics. This disadvantage is eliminated by introducing into the fuel along with the depressor of another additive, called a dispersant paraffin's [2].

The most effective interaction between the depressor and n-alkane occurs when the depressor is released from the solution simultaneously with n-alkanol in the range of temperatures between the cloud point and

pour point, i.e. after the appearance of crystals of n-alkane, but before the formation of their spatial frame. Then closer together the temperatures of the separation of crystals of n-alkane and the depressor, the more effectively the depressor lowers the temperature limit of filterability, because it limits the size of crystals in the initial stage of their growth. Therefore, the copolymer released from solution in the fuel simultaneously with the crystals of n-alkanes gives a good depression of the freezing temperature, and the temperature limit of filterability. If the polymer is released from diesel fuel much higher temperature cloud point, it does not interact with the paraffin crystals formed and therefore has little effect on the pour point [3].

Maximum efficiency is achieved when the maximum depressor under the molecular weight distribution of the alkyl groups of the molecular weight distribution of n-alkanes of diesel fuel [4].

The presence of these two trends defines the character of the dependence of temperatures of glass transition and crystallization of comb-like polymers, the length of the side chain. This dependence is shown in figure, where the left branches of the curves indicate changes of the temperature of glass transition, and right – of melting. With increasing number of carbon atoms in the side branches increases the free volume of the system (increasing the porosity of the packing), and thus, decreases the glass transition temperature. In the field of values of *n* from 3 to 4 up to 9–10 amorphous polymers. Starting from *n* 9 to 12 a phase transition occurs from amorphous to crystalline polymers, and as *n* increases the melting point increases. Hypothetical limit of the melting point as ***n*** tends to infinity must be the melting point of polymethylene (polyethylene), exceeding 100 °C.

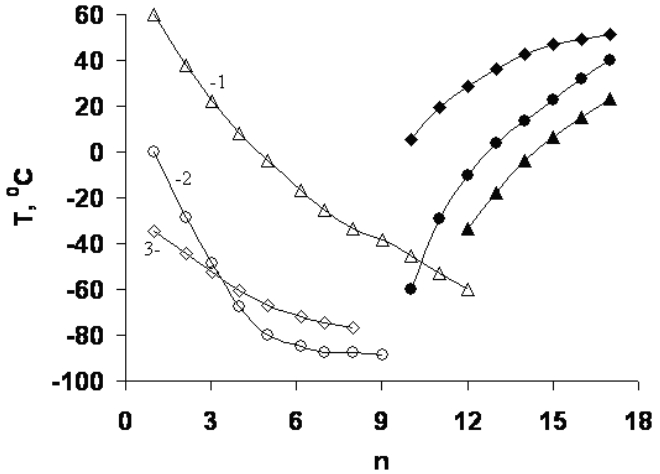

Figure. The dependence of the glass transition temperatures (light dots) and melting point (dark dots) of the length of the side chains in a series of comb-like polymers: 1 – polyalkylmethacrylate; 2 – polyalkylacrylate; 3 – simple polyvinylalkyl esters

Thus, the maximum solubility in hydrocarbons have polymethacrylates with long alkyl radicals from 8 to 12, because they, first, have a high affinity to hydrocarbons, and, secondly, have a minimum value of temperatures of glass transition and crystallization, which lies far below the working diapasons work depressants for diesel fuels. In order to reduce the solubility of polymethacrylate in hydrocarbons and increase the temperature of its crystallization, to a temperature range of operation of the depressor can be used two ways. On the one hand, this can be achieved by reducing the thermodynamic affinity of the polymer to hydrocarbon, namely, the introduction into the copolymer of (meth)acrylates with shorter radicals, from 1 to 4 or more of other polar monomers, for example vinyl acetate, male inmate with substituents from 1 to 4, nitrogen-containing monomers or their derivatives quaternion, styrene,

methacrylate's of glycols and other. On the other hand, to increase the temperature of crystallization can be due to the weighting of the fractional composition of the basic monomers of methacrylate used in the synthesis of the copolymer. To do this, as the basic monomers can be used methacrylate's with long alkyl radicals from 16 to 24. At the same time using both, you can ensure that the composition of the alkyl radicals of polymethacrylate match the composition of the normal paraffin's of the fuel, and the temperature of its crystallization from the fuel corresponded to the temperature of crystallization of paraffin's.

As noted above, the base monomers in the synthesis of polymethacrylate depressants for oils and fuels are alkylmethacrylamide obtained on the basis of higher fatty alcohols, typically from C12 to C24. These monomers provide the basic characteristics of the depressor: solubility in hydrocarbons, and affinity for paraffins. To enhance the individual properties of depressants or giving them additional features (upon receipt of polyfunctional additives) in the composition of the injected polymer different comonomer usually functional. In organic synthesis industry fatty alcohols are produced, usually in the form of individual compounds and of fractions of definite composition. Used a number of fractions of fatty alcohols company SASOL brands NAFOL based on them were obtained three basic alkylmethacrylamide: **MA NAFOL 1218K, MA NAFOL 1618S, MA NAFOL 2022.** Investigated the effect of composition of copolymers on the basis of alkylmethacrylamide their depressant properties enabled us to carry out a scientific and methodical approach to solving problems of synthesis of alkylmethacrylamide, synthesis of dialkylitaconate alcohol **NAFOL 1618S** the synthesis of polyalkylmethacrylates based on the **MA NAFOL 1218K** and analysis of the comparative characteristics of the obtained samples depressants which implies the following: polimethacrylates, obtained on the basis of **MA NAFOL 1218K** has a high pour point depressant properties by lowering the pour point when used in lubricating oils, especially when you get a new grease composition for lubrication of axle boxes of wheel pairs of locomotives, where it was possible to reduce pour points from –27 to –41°C with the development of technology for obtaining axle oil OM-Uz both summer and winter version. The introduction it in diesel fuel in amounts of 01 wt. % practically did not affect the cloud point. Depression of pour point at minus 13 °C.

When developing a dispersant for paraffin were used available raw materials, the use of which it is possible to conduct the synthesis in the soft mode, on an industrial scale. Compounds used in the quality of paraffin dispersants, exhibit surface activity in the system n-alkane-diesel fuel and help to stabilize the dispersion of n-alkanes in diesel fuel. These compounds should have a way to the surface of the *n*-alkanes, easily adsorbed on the surface of crystals of *n*-alkane depressor (or crystallization with them) and contain a polar or easily polarizable functional group capable of forming an electric double layer at the interfacial surface, thus leading to further stabilization of the dispersed system.

On the basis of the conducted production tests of the implementation, the use of a new dispersant paraffin's allowed to reduce the content of the pour point depressant additives in the package to 25 % compared with the additive package, consisting of a depressor Keroflux 6180 and dispersant paraffin's Keroflux 3614, currently used on Bukhara refinery.

When using 0.7% of the synthesized copolymers based alkylmethacrylates with other monomers in a mixture of dewaxed oil of the second fraction with dewaxed residual oil in the ratio of 2.8 has allowed to reduce the freezing point of the axial oil OM-Uz to – 27°C sample and when using as base oil a mixture of dewaxed oil selective and hydro treating with dewaxed residual oil in a ratio equal to 3 was able to reduce the freezing point to –41°C at 0.5% depressant in the total mixture.

As evidenced by the comparative physical and chemical properties, obtained lubricant comply with

the GOST 610-72 by the pour point to summer (sample No. 1) and winter options with improved performance characteristics according to the diameter of the spot of wear. Filed Patent application of the Republic of Uzbekistan № IAP 20140336, №. IAP 20160022 and developed innovative technologies of their production.

The new composition of the axial oil OM-Uz with depressant additive based on copolymers of alkylmethacrylate successfully passed bench tests and operational tests at the consumer of JSC "Uzbekiston Temir Yollari". The pilot batch in the amount of 58 tons is obtained. After a large-scale trials in the depot "Tinchlik" It will decide on the implementation and replication.

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Rakhmatov Khudoyor Boboniyozovich,
Associate professor of the chemistry faculty
of Karshi engineering-economics institute
The Republic of Uzbekistan,
Qashqadaryo Region, Qarshi city
E-mail: zavod.lab@mail.ru

Kholliev Shamsiddin Khudoyberdievich,
Assistant professor of the chemistry faculty
of Karshi engineering-economics institute
The Republic of Uzbekistan,
Qashqadaryo Region, Qarshi city
E-mail: shamsiddin1985@mail.ru

Yuldashev Tashmirza,
Head of the technological machines
and equipment faculty of Karshi engineering-economics institute
The Republic of Uzbekistan, Qashqadaryo Region, Qarshi city,

Farmonov Humoyun,
Student of Karshi engineering-economics institute
The Republic of Uzbekistan, Qashqadaryo Region, Qarshi city,

DETERMINATION OF THE NATURE OF ANODIC CURRENTS OF VINYLMORPHOLINE ANODIC OXIDATION IN NON-AQUEOUS MEDIUM

Abstract: the article demonstrates a possibility of determining the nature of anodic currents of vinylmorpholine electrolytic oxidation in non-aqueous medium. The nature of the current-potential curves of vinylmorpholine anodic oxidation taken at different temperatures of sample solution and microanode platinum disc rotation speed in all tested background electrolytes as well as solvents, was established as diffusion and by the method of log analysis its irreversible nature was established.

Keywords: palladium, vinylmorpholine, acetic acid, n-propanol, titer.

For optimization of the amperometric titration conditions of metal ions, including the other factors that affect the shapes of the curves and the results of the determination, it is also necessary to establish the nature of the anodic currents of the anodic oxidation of vinylmorpholine (from here on called VM) in mixed and non-aqueous solutions used.

It is established that the nature of inherently mixed and kinetic currents requires strict thermostatic control of the analyzed VM solution and compliances with some formalities. Therefore, a log analysis was conducted for the purpose of determination and identification of the reversibility and irreversibility of the processes occurring in the solution and to establish the nature of the influence of the microelectrode disc rotational speed and the temperature of the investigated VM solution on the maximal current and other parameters of the anodic oxidation of VM.

Log analysis of VM anodic voltameprograms

With the purpose of determining of the kinetics of the electrode processes of oxidation of VM on a microanode platinum disc in non-aqueous and mixed media, a log analysis of VM voltamperograms obtained in a series of experiments was conducted. For each curve obtained, the value $Y = \lg I/I_d - I$ was calculated for 10–15 equally spaced potential values in the area of VM wave. Then, according to the obtained values, a graph was plotted in the coordinates $Y = X$, where X is the value of the potential. In general, the graphs in all cases were almost rectilinear, but the tendency to tilt to the potential axis were always smaller than could be expected for a reversible process with the number of electrons participating in it, which indicates the irreversibility of the corresponding electrode process. "a" and "b" parameters were calculated on based on the experimental values of y_i and x_i by using the least squares method according to the formulas:

$$a = \Sigma x_i^2 \Sigma y_i^2 - \Sigma x_i y_i / P\Sigma x_i^2 - (\Sigma x_i)^2;$$
$$b = P\Sigma x_i y_i - \Sigma x_i \Sigma y_i / P\Sigma x_i^2 - (\Sigma x_i)^2$$

where P stands for the number of used values of x_i and y_i

The half-wave potentials ($E_{1/2}$) and the product αn were calculated, using the found values of the parameters "a" and "b", where α stands for the transfer coefficient, and n is the number of electrons participating in the process. Calculations were carried out according to the formulas:

$$E_{1/2} = -a/b;\ an = 0.0584$$

The number of electrons participating in the electrode reaction, determined from the slope of the straight line, is significantly lesser than the truth number-2, which was found by the coulometric method, it also indicates that the process is irreversible. On the other hand, in accordance with the logarithmic analysis of the voltammograms of the oxidation of VM on a microanode platinum disc in non-aqueous media and backgrounds, it can be concluded that in all background electrolytes (0.25M CH_3COOK, 20M $LiCLO_4$, 0.15M $LiNO_3$) and the investigated protolytic solutions (acetic acid and propanol) VM is completely irreversible.

VM electrolytic oxidation at different rotation speed of microanode platinum disc and temperatures of investigated solution

Electrode processes of VM oxidation in non-aqueous protolytic media, which are not followed with the formation of new phase, are extremely poorly researched. The study of those processes would make possible the fuller understanding of the laws of electrochemical kinetics. To determine the nature of anodic current of VM oxidation it was necessary to study the dependence of the maximal current on the number of rotations of the microanode disc. The research that was conducted at 25°C and various rotation speeds of the electrode (380, 725, 1085 and 1400 rpm) showed that the magnitude of the maximal current of VM oxidation is proportional to the number of rotations of the microelectrode disc. As the condition of anodic currents of the depolarizer in all the background electrolytes of the protolytic solvents is the same, the table gives the results of the effect of temperature on the magnitude of the maximal current of VM oxidation only for acetic acid media on various backgrounds. The experiments showed that when researching the dependence on the root of the square of the speed of rotation of the microanode disc of the maximal current of VM oxidation in protolytic media, all four experimental points corresponding to different electrode velocities fit very well on the line passing through the origin, which again confirms the diffusion nature of maximal current of VM oxidation on a microanode platinum disc. The detected limitation of the maximal current of the electro oxidation of the reagent by the mass transfer rate was observed for all background electrolytes studied and protolytic solvents.

The fact that was discovered by the aforementioned research makes it possible to consider that diffusion-convection equation for rotating electrode disc is usable for VM anodic oxidation speed [1–3]. The data obtained during experiment allows for the

conclusion that the rate of anodic oxidation of the researched depolarizer in non-aqueous protolytic media at different background electrolytes distinct in acid-base properties is limited by diffusion to the electrode.

Table 1.– Dependence of the maximal current of VM oxidation on microanode platinum disc in acetic acid media and various background electrolytes on the temperature of the researched solution

Solvent type	Type and amount of background, mol/l	Temperature coefficient of maximal current	Temperature of researched solution, °C	Maximal current value, μA	
				$2\cdot10^{-4}$M	$4\cdot10^{-4}$M
Acetic acid	0.25 KCH_3COO	3.32	24.0	4.05	8.07
	0.25 KCH_3COO	3.43	30.0	4.85	9.71
	0.25 KCH_3COO		40.0	6.55	13.12
	0.20 $LiClO_4$	4.15	24.0	7.80	15.58
	0.20 $LiClO_4$	3.66	30.0	9.77	19.52
	0.20 $LiClO_4$		40.0	13.41	26.82
	0.15 $LiNO_3$	4.18	24.0	4.27	8.56
	0.15 $LiNO_3$	3.24	30.0	5.45	10.78
	0.15 $LiNO_3$		40.0	7.15	14.34

Established linear relationship between the concentration of the reagent in the researched solution and the limiting current in the range of its oxidation potentials allows us to recommend the use of VM as analytical titrants for ions of various metals in non-aqueous amperometric titrations.

The confirmation of diffusive nature of anodic currents of VM oxidation was likewise given by the determined average value of the temperature coefficient of the maximal current of oxidation at rotation speed of microelectrode disc equal to 1085 rpm in the temperature range 24–40 °C, which equals 3.0–5.6% per degree.

The temperature coefficient values of maximal anodic current of VM were calculated by using the following equations and technique [4–6]:

$$K = \left[\left(I_d\right)_{t_2} - \left(I_d\right)_{t_1}\right] \cdot 100 / \left(t_2 - t_1\right) \cdot \left(I_d\right)_{t_1}, \%$$

Where $\left(I_d\right)_{t_2}$ – maximal current at t_2; $\left(I_d\right)_{t_1}$ – maximal current at t_1.

Experiments were not carried out in a wider temperature range, since below 24 °C the background electrolytes that were used in research were partly deposited due to their limited solubility in the non-aqueous protolytic media used, and above 40 °C the agar-agar gel of the connecting bridge was dissolved.

By applying our research, we can conclude that the proportional relationship between the magnitude of the maximal current and the concentration of the researched VM-reagent for all the studied non-aqueous protolytic solvents and their mixtures with some inert solvents, as well as background electrolytes, is well fulfilled in the concentration range $2\cdot10^{-3} - 4\cdot10^{-5}$ mol/l.

It has been discovered that the polarization curves of VM oxidation, taken at different temperatures of the solution and number of turns of microanode platinum disc in all the studied background electrolytes and solvents, has diffusive nature, and its irreversible character is revealed by the method of logarithmic analysis. On the basis of polarization curves, it was established that if the process of electric oxidation of the researched depolarizer on the microanode platinum disc in the non-aqueous media is non-reversible, the electrode process is accompanied by the recoil of two electrons, followed by the transformation into simpler substances, the nature of which has not yet been identified.

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Rakhmatov Khudoyor Boboniyozovich,
Associate professor of the of the technological machines and equipment faculty of the Karshi Engineering-Economics Institute
Republic of Uzbekistan, Karshi
E-mail: zavod.lab@mail.ru

Djurayeva Shokhista Dilmurodovna,
Senior lecturer of the Chemistry Faculty of the Karshi Engineering-Economics Institute,
Republic of Uzbekistan, Karshi

Ubaydullaeva Ismoilovna Dilfuza,
Associate professor of the of the Chemistry Faculty of the Karshi Engineering-Economics Institute,
Republic of Uzbekistan, Karshi,

Khidirova Zulkhumor Uralovna,
Senior lecturer of the Chemistry Faculty of the Karshi Engineering-Economics Institute,
Republic of Uzbekistan, Karshi

Bobilova Chinnigul Khayitovna,
Assistant professor of the Chemistry Faculty of the Karshi Engineering-Economics Institute,
Republic of Uzbekistan, Karshi

AMPEROMETRIC TITRATION OF NOBLE METALS BY ORGANIC REAGENTS SOLUTIONS IN NON-AQUEOUS MEDIA

Abstract: The article describes conditions and possibility of amperometric titration of palladium (II) and platinum (IV), silver (I) and gold (III) ions with solutions of 4-methoxyphenyl-carboxymethyl-diethyldithiocarbamate (MPCMDETC) and 4-methoxyphenyl-carboxymethyl-diphenylthiocarbazone (MPCMDPTC) in non-aqueous media (acetic acid, *n*-propanol, DMF, DMSO) with background electrolytes having various acid-base properties. Techniques of the amperometric titration of micrograms of the quantities of palladium (II), platinum (IV), silver (I) and gold (III) ions in the presence of foreign ions are shown

Keywords: palladium, platinum, silver, gold, electrooxidation, anodic wave, acetic acid, n-propanol, background electrolytes, equivalence point.

Amperometric titration of metal ions in non-aqueous and mixed media by various complexants makes it possible to expand their analytical capabilities and simplify the solution of many complex analytical problems. First and foremost, this is related to the fact that the nature of the solvent strongly affects the strength of the complex formed, and it is dissimilar for different cations, which makes the tecnique selective and rapid. Aside from that, the tecnique of non-aqueous complexiметry successfully solve the

problem of precise and selective determination of metals in organic objects, as well as directly in extracts obtained by concentration.

The article presents experimental data on the selection of optimal amperometric titration conditions for a number of noble metals by solutions of derivatives of organic reagents such as diethyl-dithiocarbamate and diphenylthiocarbazone: 4-methoxyphenyl-carboxymethyl-diethyldithiocarbamate (MPCMDETC) and (4-methoxyphenyl-carboxymethyl)-diphenylthiocarbazone (MPCMDPTC) in non-aqueous protolytic media, acid-base properties of background electrolytes. There are no data on the use of both analytical titrants in the amperometric titration of ions of various metals by the solutions of the above reagents, since they were synthesized relatively recently [1] and only their biological activity have been studied [2].

Reagents and apparatus. Base 0.002 M solutions of Na_2PdCl_4, K_2PtCl_6, $AuCl_3$ and $AgNO_3$, as well as 0.01 M solutions of MPCMDETC and MPCMDPTC were blended by dissolving the corresponding weighed portions of these reagents in acetic acid (n-propanol, DMF and DMSO). The noble metal concentration was determined amperimetrically by 0.01 M potassium iodide solution [3]. Amperometric titration was carried out on two rotating (1000 rpm) platinum wire electrodes on a common axis configuration. The configuration of electrodes, as well as piston automatic microburette and apparatus are described in detail in [4].

Amperometric titration was carried out on aon two rotating (1000 rpm) platinum wire electrodes on a common axis configuration. The configuration of electrodes, as well as piston automatic microburette and apparatus are described in detail in [5].

In accordance with the voltammetric behavior of MPCMDETC, MPCMDPTC and other products participating in electrochemical media of amperometric titration of noble metal ions, it should be carried out at polarization voltage of 0.75–1.15 V depending on the nature and concentration of the background electrolyte (acetates, nitrates, chlorides, perchlorates of alkali metals and ammonium) [6, 7]. The indicator current must appear behind the point of equivalence (PE) due to the oxidation of the free reagent and the dissolved oxygen recovering.

The data acquired showed that in the media and backgrounds studied of 0.15–0.40 M solutions of noble metal ions with solutions of MPCMDETC and MPCMDPTC are titrated quite well and rapidly, and the shape of the curve coincides with the expected shape with some constant current at the beginning of the titration followed by a sharp transition (kink) at the end point of titration (EPT).

Analysis of noble metal ions in individual solutions. It was found that when the ions of the following noble metals are titrated with the corresponding molar ratio Me: reagent is: Pd: 1:2 reagent and Pt: 1:4 reagent, the titrated solution acquires a reddish-brown color. In the transition from acetate background to perchlorate containing some amount of perchloric acid, the shape of the titration curve of noble metal ions deteriorates significantly, which ultimately leads to a decrease in the reproducibility and correctness of the results. This is due to the increased acidity of the analyzed medium when changing from acetates to perchlorates [8, 9]. The results of the analysis of different concentrations of noble metal ions by MPCMDETC solution of 10.0 ml of the analyzed solution under optimal conditions shows good accuracy of the developed procedure. Influence of additives to acetic acid, n-propanol, DMF, DMSO of frequently used as extragents of inert solvent, such as chloroform, tetrachloromethane, benzene, toluene, hexane, methyl ethyl ketone, dioxane, etc., on correctness and reproducibility of titration of noble metal ions. The conditions are the same as for the titration of noble metal ions in their individual solutions, but with the content of the protolytic solvent in the analyzing range. As a consequence of lower solubility of the background electrolyte under these conditions to values less than 0.2 M under the influence of large additions of an inert solvent, the background concentration (with

40–50% volume of the inert solvent) must be continuously reduced up to values of the order of 0.05 M. The addition of any of the mentioned solvents in the amount of 10–20% volume (depending on the nature of the solvent) leads to the fact that the shape of the titration curve becomes less steeply inclined to the axis of the volumes, and at solvent contents higher than 50–60% volume reproducibility and accuracy of noble metal ions deteriorate.

The revealed effect of inert solvents on the form of the titration curve is explained by a sharp decrease in the electrical conductivity of the titrated solution at a high content of an inert solvent in the protolytic medium, leading to a significant and continuously increasing ohmic voltage drop in the analyzed solution with an increase in the indicator current.

Analysis of silver (I) and gold (III) ions in model mixtures. The possibility of amperometric titration of silver (I) and gold (III) with a solution of MPCMDPTC was tested on various artificial mixtures of salts (simulating natural and industrial materials) containing large quantities of other metals, often and widely found with these metals in nature. Analysis of silver (I) and gold (III) ions can be done in two ways: 1) directly in an aliquot of the analyzed sample [10, 11.] with strict observance of all optimization conditions when assessing the degree of influence of various extraneous cations; 2) the combination of the preliminary extraction [12, 13] separation of silver (I) and gold (III) ions from other elements, followed by their titration with a standard solution of MPCMDPTC in an aliquot of the extract obtained after destruction of the extraction reagent and complex, and adding the required amount of protolytic solvent and background. The obtained results confirm that the developed amperometric methods for the determination of silver (I) and gold (III) ions by the solution of MPCMDPTC differ by high selectivity and reproducibility with a relative standard deviation not exceeding 0.133.

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Section 7. Ecology

Mammadova Fafida,
Azerbaijan State University of Oil and Industry
E-mail: farida.mamedova@yahoo.com

INVESTIGATION OF THE MINERALIZED WATER CORROSIVE AGGRESSIVENESS

Abstract: In given work the results research by corrosive aggressiveness of mineralized waters are given. To corrosion three kinds of metals were subjected^ steel 3, steel 20 and steel 40. As corrosive medium the different types of mineralized waters have been used. In results of investigations it have been determined that after 240 hours of tests the corrosion rapidity becomes stability. Also in results of conducted research it have been determined that the corrosion rapidity in the seawater softened by Na-ion-exchange is high than in the seawater. Metal corrosion rapidity in the vaporizer concentrate is lower, than in the wet and softened seawater. Deceleration of corrosion rapidity is explained by biocarbonate decay on high temperature and formation of hydrates and carbonates in the vaporizer concentrate.

Keywords: mineralized water, corrosive aggressiveness, corrosive medium corrosion rapidity, static conditions, electrochemical method, Na-zeolite softening.

One of the criterions for normal work of the new manufactures is to choice and substantiates the materials using for equipment production.

Today to improve technical-economical indicator of desaltng the ion-exchange way of waters demineralization, which are investigated weakly, is used widely. The aim of the present work is to estimate the metals corrosion stability and to give recommendations over choice or production of equipment working on mineralized waters.

The corrosion investigations were carried out by gravimetrical means. 3 sorts of metals were investigated for corrosion stability: St 3, St 20 and St. 40 working on mineralized waters. As corrosive medium the different types of mineralized waters: were used seawater (Caspian), softened seawater and its concentrates. The investigations results of St 3 are shown in Table 1. ($n > Jr8$)

Table 1. – Dependence of corrosion rapidity of St 3 on exposition time in 20° temperature

Exploitation term τ, h	**Corrosion rapidity g/m'. h**		
	Seawater	**Softened sewater**	**Vaporizer concentrate**
1	***2***	***3***	***4***
40	0.25	0.32	0.085
80	0.36	0.23	0.87
120	0.32	0.18	0.83

1	*2*	*3*	*4*
160	0.29	0.15	0.090
200	0.27	0.13	0.086
240	0.26	0.12	0.088
280	0.25	0.11	0.085

As shown in the present table in first 72–80 hours of tests the corrosion rapidity in the seawater is comparatively high, and then it decays. After 240 hours of tests the corrosion rapidity practically becomes stabilize on the level 0.11–0.12 g/m^2. h. Corrosion of the examples surface has a point character. The corrosion products are placed in two layers. The first layer is red, friable, passes easily into solution. The second layer is the black deposit. The color of solution after tests became red with existence of sediment as flocks of $Fe(OH)_3$.

Irregularity in the time of the steel corrosion rapidity in the seawater is explained by, that the corrosion produst layer is packing and raises its thickness and it results in deceleration of cathode process. Chlorine ions having mobility and a small radius influences on the anodic process more intense at the beginning of the exposition time, than at the finish, and it is explained by the absorption forcing of oxygen and formation of soluble metal flocks Rising of the sediments thickness also results in reduction of oxygen diffusion to the metal surface, and thereby decelerates the corrosion rapidity.

In accordance with the table data in the same tests period the corrosion rapidity in the seawater softened by means of Na-eationization is greatly high, than in the seawater end is equal to 0.27–0.3 g/m^2.h This circumstance can be connected only with two factors; the first: oxygen solubility in the softened seawater is higher, than in the seawater, the second. existence of the inflexibility minerals in the seawater obviously favors to formation of the protective film on the metal surface. Given corrosion character in the softened seawater is shown with the areas of separate points and spots, at the same time the metal surface is dull.

Metal corrosion rapidity in the vaporizer concentrate is lower, than in the wet and softened seawater and is equal to 0.08 g/m^2.h. Deceleration of corrosion rapidity is obviously explained by bio carbonate decay on high temperature and formation hydrates and carbonates in the vaporizer concentrate increasing pH of the solution to 9.5–10. At the same time owing to of increasing solution saline the oxygen solubility increases.

Estimation of corrosion rapidity of investigated exemplars by the ten-point scale of metal corrosion stability (State Standard) shows, that in the seawater and softened seawater the abyssal index of the corrosion rapidity is within 0.1–0.3 mm/year, i.e. belongs to the 6 point (low stability), and for vaporizer concentrate this index is equal to 0.07 mm/year, i.e. belongs to the 5 point (stable).

Experimental tests of St. 20 corrosion stability in the softened seawater in the range of temperature 40–800C was carried out by means of electrochemical method and are shown in (table 2).

Table 2. – Galvanostatic characteristics for St.20 in the softened water in static conditions

Current density J, MA/sm-	**Potential displacement *E, mV***							
	***t* = 20 °C**		***t* = 40 °C**		***t* = 60 °C**		***t* = 80 °C**	
	Potential mV							
	Anode	**Cathode**	**Anode**	**Cathode**	**Anode**	**Cathode**	**Anode**	**Cathode**
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
	450	440	380	385	430	430	440	440

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
	480	430	400	380	440	425	440	440
	700	425	420	375	445	420	445	435
	750	420	440	370	450	400	450	435
	770	410	460	365	460	365	460	435
	790	400	480	365	470	380	460	430
	800	490	550	360	550	375	460	430

The St. 20 corrosion rapidity on the temperatures 40, 60, and 800 C determined by the data of this table shows they are 0.5, 0.68, and 0.87 g/m^2.h. relatively.

From the technological point of view in some cases to hold the previous softening of mineralized water by the Mg-Ne-cathode scheme is more preferable. In this cases a mostly all magnesium ions stay in the softened water. The results of galvanostatic characteristics of ST. 20 in Mg-Na-cathode water are given in (table 30).

Table 3. – Gatvanostatic characteristics for St 20 in concentrate of vaporizer in static conditions

Current. density J. mkA/snv	**Potential displacement E.mV**					
	T = 40 °C		**T=60 °C**		**T = 50 °C**	
	Potential, mV					
	Anod	**Cathode**	**Anod**	**Cathode**	**Anod**	**Cathode**
0	355	340	395	380	370	310
20	390	330	450	350	400	315
40	440	325	525	340	495	285
60	580	350	630	337	590	300
80	620	353	650	330	660	330 ‘
100	775	355	675	327	750	340
120	695	353	700	325	770	337

Analyze of this table data shows that the temperature increasing of limit diffusion current in the dynamic conditions is higher, than in static conditions. Corrosion rapidity is: in static conditions 0.12, in dynamic conditions on the temperature 40, 60 and 800 C and 800 C – 0.62 and 0.83 g/m^2.h. relatively.

Comparison of obtained results of ST. 20 corrosion rapidity determination on two types of softened waters shows, that the corrosion rapidity in Mg-Na-cathode water is lower, than in Na-cathode water. In this connection can be supposed the probability of diffusion barrier preventing forward contact with trivalent metal oxide, and it serves depolarizer of cathode process.

So displayed, that in case of thermo-softened water using in spite of hagher corrosive aggressiveness of seawater softened by Na-and Mg-Na-cathode it is not necessary to take measures for metals corrosion protection – it can be limited by known metods. More corrosion stability has the steel of St. 20 sort.

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