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Hydrotechnical Properties of Mastics on the Basis of Petroleum Bitumen Rocks (PBR)

Uliya Abdikerova, Zhangyl Abilbek, Asylkhan Shomantayev, Kamalbek Baitasov,
Panabek Tanzharikov and Nauryzbay Alibekov
Korkyt Ata Kyzylorda State University, Kyzylorda, Kazakhstan

Abstract: Currently for many construction industries promising becomes the creation of waterproofing materials on the basis of integrated management natural oily raw material, as well as improvement of traditional bituminous materials with polymeric and Surface-Active Additives (SAA). Choice of material depends on the working conditions of a hydraulic installation, categories of reliability construction its structures, the availability of local building materials, method of work and technical and economic indices of construction. The study presents the results of studies of hydrotechnical properties of mastics. The analysis of the results of laboratory tests allowed for the optimization of its content in bitumen. It has been demonstrated that the properties of mastics based on petroleum bitumen rocks studied by the authors of the study has a significant impact on physical characteristics of bitumen.

Key words: Mastic, hydrotechnical construction, waterproofing and bitumen, rocks, concrete slabs

INTRODUCTION

One of the major tasks of designing, construction and reconstruction of irrigation systems is to increase their coefficient of land use and efficiency, rational distribution and economical use of water resources in the conditions of increasing scarcity of fresh water which is the main consumer of irrigated agriculture. For purposes of more economical water consumption and cost reduction must be resolutely pass to the water supply for lined canals and closed systems.

There are a lot of technical potential ways of dealing with filtering from the channels. However, practical applications can only get those that will meet the basic requirements imposed on them at the moment that is the reduction of the loss of water in the channels is not <2-3 times the high use of local building materials and the complete mechanization of the entire construction process. From the practice of irrigation construction it is well-known that due to the loss of water through seepage, evaporation and idle discharge to the consumer sometimes reaches no >50% of abstracted from the head of water channel. This significantly increases the cost of the channel, requires an increase in its capacity, the design section at the front section which leads to additional volumes of excavation area, increases disposed lands besides saturation of the soil in the vicinity of the channel can lead to buckling exterior slopes dams and with the planting soil-sediment to water engineering and their destruction.

Significant damage to the national economy is caused by the flooding areas sited adjacent to the channels. In the absence of membrane, significant leakage leads to a rapid rise in the groundwater level. If level rises there is the evaporation of water and soil salinization. Flushing land requires a lot of water flow. The main control measure with this phenomenon-the device of impervious coatings.

Evaporation losses, depending on climatic conditions and the surface area of the channel is not large (0.3-0.8 m per year). Furthermore, they do not have such an impact on the territory adjacent to the channel as filtration losses. Hard types of membrane allow to narrow the channel cross-section by reducing the slope ratio, compared to the channel in earthen channel and thereby reduce evaporation losses. The use of hard surfaces does not eliminate the problem of overgrowth of small and medium-sized channels but nevertheless they allow to transport the flow at high speeds, thereby reducing siltation and hinders the germination of plants. Thus, in the engineering of channels the impervious event provide for the reduction of losses on filtration and increasing the KPD (efficiency) of the channel, preventing waterlogging and salinization of adjacent channel areas (Bishimbayevv *et al*., 2004).

Widely available and relatively cheap materials to reduce the water filtration are current practically absent. Concrete and reinforced concrete linings that has high impervious performance are still very expensive. One of

Corresponding Author: Uliya Abdikerova, Korkyt Ata Kyzylorda State University, Kyzylorda, Kazakhstan

Table 1: Technical characteristics of mixer CO-8

Variables	Values
Hopper capacity (l)	55
Rotation frequency (revs min^{-1})	
First mixing shaft	125
Second mixing shaft	60
The material required for one kneading, kg	40
Performance when cooking (kg h^{-1})	
Sealing compound	120
Putty	140
Colorful pastes	150
Electric motor	
Power (kWT)	2.8
Voltage (V)	220/330
Overall dimensions: mm	
Length	900
Width	600
Height	950
Weight (kg)	210

the most promising of waterproofing materials in the hydraulic engineering is hydraulic engineering asphalt (GTA) which has a number of advantages compared to concrete can significantly reduce the cost of construction.

The existing asphalt concrete (AB) coatings are prepared as a rule, on the basis of bitumen, the lack of which is felt all the more acute with each passing year. This in turn is one of the major reasons hindering widespread adoption of water-proof materials in the practice of water management construction. Therefore, one of the most relevant tasks is to find new organic binders that can be used to produce a variety of waterproofing materials. From this point of view, one of the most promising sources of organic binders are oil bituminous rocks (NBP) an organic part of which is close to the properties of oil bitumen.

Currently, within the West Kazakhstan during the production of geological survey there were revealed more than 100 displays of the NBP. The content of natural bitumen in the rock varies from 5-25% by weight. Oil bituminous rocks are cheap natural raw materials and their use as an organic binder for hydraulic asphalt concrete and use them to reduce the filtration of water for water facilities is a very promising and actual direction.

The aim is to study the hydraulic properties and determination of rheological characteristics for engineering calculations cover the dislodging and crack; substantiation of efficiency of application GTA obtained on the basis of the NBP by modified bitumen rocks and atactic polypropylene to reduce the filtration of water irrigation channels (Vatin *et al*., 2014a, b).

New technological developments on the application of Petroleum Bitumen Species (PBR) in formulations of waterproofing materials noted in scientific writings of academics Nadirov, Bishimbaev, Narmanova, Shomantaev, researchers Zharasova, Hodzhanazarova and other (Vatin *et al*., 2014a, b; Bishimbayev and Narmanova, 2002; Bishimbayevv *et al*., 2004).

The main reserves of Petroleum Bitumen Species (PBR) in Kazakhstan concentrated in Aktyubinsk, Mangistau and Atyrau regions.The greatest practical interest for the production of cold mastics are Petroleum Bitumen Rocks (PBR) deposits of Iman-Kara and Martuk with bitumen content in 18-21% of the breed. Technology of preparation of cold mastic on the basis of Petroleum Bitumen Species (PBR) is very simple and does not require special equipment you can use a mixer or mortar mixer CO-8 (Bishimbayevv *et al*., 2004) (Table 1).

MATERIALS AND METHODS

One of the most important properties of hydraulic asphalt concrete is watertight. From the ability of asphalt pavement to filter the water to a greater extent depend on the working conditions of the coating itself and the underlying layers. The purpose of this study-to give not only the quality but also a quantitative assessment of permeability of asphalt concrete to determine the influence of some structural-forming components in the water permeability and find ways to control the filtering capacity of the material. The solution of these tasks will allow:

- To ensure the water resistance of asphalt concrete coatings on solid grounds, the porosity is lower than the porosity of asphalt concrete
- To determine the amount of moisture coming through the asphalt surface in the porous base
- To consider the filtration capacity of asphalt concrete in the construction of an anti-wear

It is known that in considering of an anti-moisture in porous bodies, Darcy's law is valid only for the laminar regime in strict abidance to the linear law of filtration so it was necessary to find out what is the movement of water through the asphalt mode and whether the linear law is maintained. To this end, work was determined the relationship between the consumption of water, filtered through asphalt pressure gradient (Fig. 1):

$$R_e = \frac{10\rho V_f \sqrt{K}}{m^{2,3}\mu} \quad (1)$$

Where:

ρ = The density of the liquid
V_f = Filtration rate
K = Permeability
m = Void ratio
μ = Viscosity of the fluid

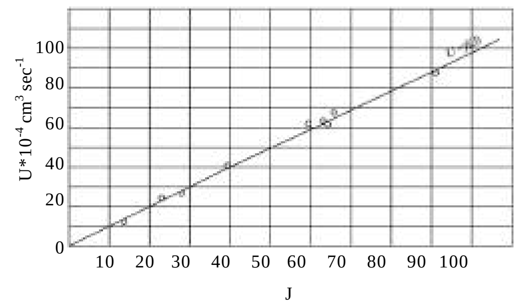

Fig. 1: Relation of the filtration rate from the pressure gradient

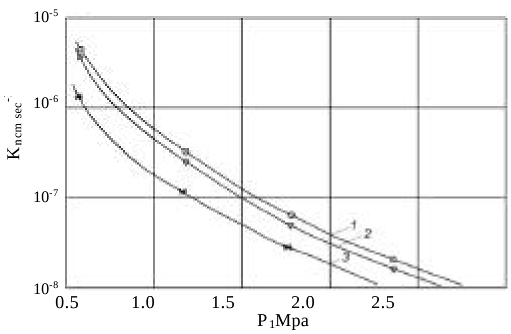

Fig. 2: Dependence of the filtration coefficient of the samples forming the specific pressure 1 and 2 without additives and with mineral powder, respectively and 3 grained sand GTA

Table 2.Determination of water viscosity

Temperatute (°C)	Coefficient taking into account water (η)
5	1.51
15	1.30
10	1.13
20	1.00
25	0.89
30	0.80

Depending on the composition and porosity of residual species, asphalt Reynolds number is varied in the range (0.0005 ... 0.08) for interrupting a critical range equal to the formula 1 ... 12. As seen in Fig. 1 the relationship between the O_f flow rate and pressure gradient I is linear. Under this law, the water permeability of porous bodies is characterized by the coefficient of filtration K_f.

Filtration coefficient is the most appropriate criterion for assessing the quality of asphalt concrete substantiating its impervious ability. To speed of laminar filtration through the soil Darcy equation is as follows:

$$V_f = K_f I \quad (2)$$

Where:
V_f = Filtration speed
K_f = Filtration rate

The I = H/l-hydraulic slope; H = P/γ-pressure loss in the thickness of the layer; P-pressure fall; γ-liquid density. Substituting these values into the Darcy formula and determining K_f, we get:

$$K_f = \frac{V_f \gamma l}{P} \quad (3)$$

Evaluation of permeability above these (three) equations were given on the total flow for 12 h. The formula for calculating the filtration coefficient for the specific conditions of the data has the form (Bishimbayevv *et al*., 2004):

$$K_f = \eta \frac{W\delta}{S\tau\,\Delta P} \quad (4)$$

Where:
η = Coefficient taking into account the viscosity of water
W = The volume of filtered water (cm^3)
δ = The thickness of asphalt concrete (sm)
S = The area of sample (sm^2)
τ = Test sample time (sec)
Δp = Water pressure difference between inlet and outlet of the sample (sm)

The value of P_1 is taken equal to the excess pressure in the installation; value P_2 in the filtrate after the free surface of the sample which is zero. Depending on the temperature of the water ç coefficient taking into account the viscosity, adopted in accordance with the values specified in Table 2.

To determine the value of filtration coefficient series of samples, the filter coefficients calculated for individual samples in this series are arranged in order of increasing or decreasing their value and then taken the arithmetic mean of hydraulic conductivity. It was determined the relationship between the filtration coefficient K_f and specific pressure molding samples GTA (Bishimbayevv *et al*., 2004).

As shown in Fig. 2 with an increase in the specific load of the filtration coefficient is reduced. Filtering coefficient according to the degree of compaction varies: for the composition of no.1 from 6.04×10^{-5} cm sec^{-1} to 3.2×10^{-7} cm sec^{-1}; for the composition of No. 2 from 5.85×10^{-5} cm sec^{-1} to 1.48×10^{-7} cm sec^{-1}; for the composition of No.3 from 1.2×10^{-5} cm sec^{-1} to 2.2×10^{-8} cm sec^{-1}.

As it is known, any conglomerate material permeability largely depends on its porosity, therefore we carried out research and fine sand permeability of asphalt concrete according to the residual porosity. These tests as a function of changes in porosity and specific pressure

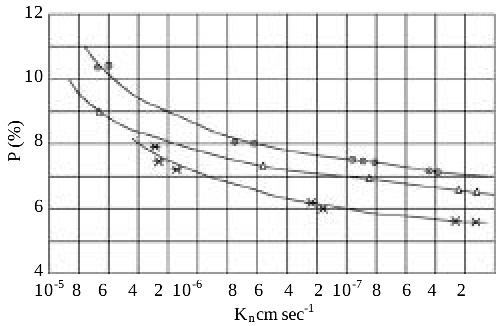

Fig. 3: Dependence of the filtration of residual porosity GTA 1-grained; 2 with the addition of 10% mineral powder; 3-gritty GTA

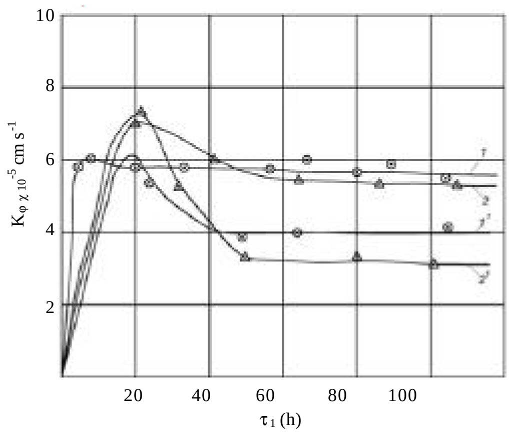

Fig. 4: Changing the filter coefficient fine GTA time 1,2 and '1, 2'-without additives and with mineral powder, respectively, at a pressure of formation of 0.594 (1.2) and 1.185 (1", 2") MPa

filtration coefficient on the value of the residual porosity of asphalt concrete are shown in Fig. 3 and 4. The porosity of the test specimens was within 6.5-10.5% and its value is regulated by varying the surface pressure in the formation of asphalt samples.

Figure 4 researched and fine-grained sand asphalt found adequate permeability to water but at the same value of the residual porosity of asphalt concrete sand filtration coefficient is lower than fine asphalt. These data suggest that in addition to the absolute value of the residual porosity of asphalt concrete on the water permeability is greatly influenced by the nature pores, their dimensions and relative positions of which along with other factors caused by the geometrical dimensions of the mineral material. Mutually communicating pore space portion (effective porosity) exerts a decisive influence both on the water saturation of asphalt concrete and its permeability.

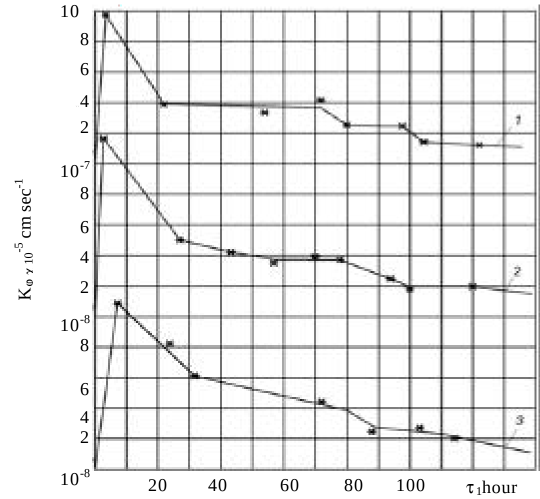

Fig. 5: Changes filtration coefficient sandy GTA time 1, 2, 3-specific pressure of samples, respectively, 1.195, 1.79, 2.39 Mpa

The water permeability of the asphalt concrete as well as other artificial conglomerate materials is closely linked to its structure. On this basis it considers the influence on permeability of asphalt concrete structure-forming components such as a mineral powder. As research samples with the introduction of a 10% mineral powder (composition No. 2) significantly affects the improvement of properties of hydraulic asphalt concrete. Examination of the samples with the mineral powder in the same degree of compaction has shown that the porosity of asphalt mixtures with lower porosity mineral powder blend without mineral powder of 0.5%. This shows the effect of mineral powder on the structure of asphalt concrete which affects its permeability.

As it is seen in Fig. 4 all other things being equal, the use of mineral powder considerably reduces the filtering ability of the GTA i.e., contributes to changing the nature of the porosity and pore size reduction. To investigate the mechanism of water movement through the asphalt it was important to determine how the filter coefficient depends on the duration of the test. For this purpose, multi day trials were conducted, the results of which changes as a function of time during the filtration rate and are shown in Fig. 4 and 5. Tests were carried out with a gradient of pressure I = 20.0. Taking into consideration that the asphalt has almost no initial pressure gradient and that with a linear filtration law is independent of the pressure, the test can be carried out at any pressure, allowing to determine the filter coefficient is not destroyed structure of the material.

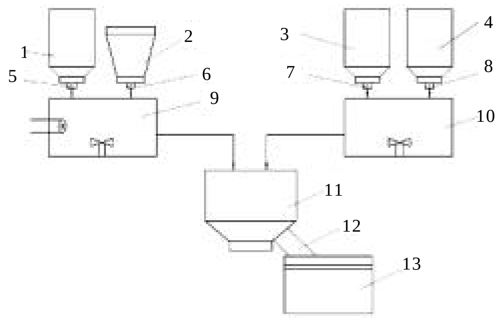

Fig. 6: Schematic diagram of the production of cold mastic based on PBR 1-receivinghopper for PBR; 2-receiving hopper for bitumen; 3-capacity for MPR; 4-receiving hopper for APP; 5, 6, 7, 8-dispensers for PBR, bitumen, MPR, APP; 9-container with stirrer and heating for PBR and bitumen; 10-container with stirrer for MPR and APP; 11-mixer; 12-tray for unloading finished mastic; 13- reception capacity for finished mastic

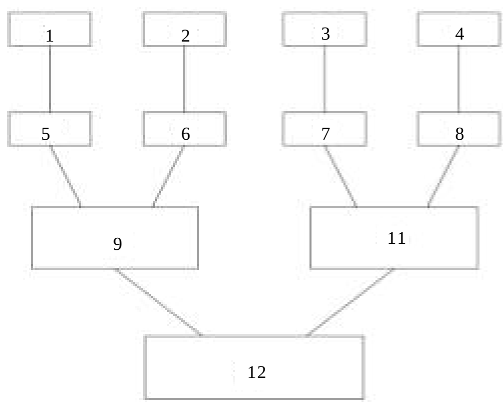

Fig. 7: The technological scheme of production of cold mastic based on PBR 1-container for PBR; 2-bitumen tank; 3-solvent tank; 4-atactic polypropylene; 5-dispenser PBR; 6-dispenser of bitumen; 7-solvent dispenser; 8-pipette atacticpolypropylene; 9-mixer for bitumen and PBR; 10-mixer for solvent and atactic polypropylene; 11-mixer for mixing all the components

Group of curves shown in Fig. 4 and 5 can be divided into two areas. 1st area is not steady (unstable) movement of water through the pores of the asphalt concrete. The growth rate of filtration in this area for 20-25h (Fig. 4) shows that all the pores are able to pass through the water itself actively involved in. The reduction of filtration because the pores formed from shrinkage cracks during cooling of the molding material temperature occurs, decreases the size of mutually interconnected pores. P-zone is a zone of stable filtration and practically constant. This value is the filtration coefficient for the GTA can be taken as true. Duration of stable filtration time was observed for an average of 80-100 h. The changing nature of filtration, i.e., the complete cessation of its time due to the apparently mudding its structure and mechanical suspensions air bubbles through the filter with water.

Group curves in Fig. 4 and 5 it is possible to introduce a shortened time model of asphalt pavement in the real conditions. Thus GTA three formulations of the filtration properties meet the requirements of P 20-85 and is acceptable as an impervious coating to reduce the water filtration in irrigation canals. The concept and the technological scheme of preparation of mastics on the basis of Petroleum Bitumen Species (PBR) is shown in Fig. 1 and 2 and includes the following main operations:

- First check the readiness of the source material: PBR, bitumen, Atactic Poly Propylene (APP) Mild Pyrolysis Resins (MPR) as well as agitators and mixers-mixers
- Delivery of pbr rock hopper 1
- Molten delivery when t 90°C BN 90/10 reception capacity 2
- Batched pbr from the hopper 1 and bitumen from receptacle 2 is served in a bowl with a mixer and heated 9 and mixed to achieve a homogeneous state
- Delivery prepared by APP in receiving hopper 4
- Delivery of MPR in 3 capacity
- Batched APP and MPR are served in a bowl with mixer 10 and mixed until a homogeneous liquid mixture
- Feed mixtures prepared in 11 mixer for mixing within 20 min to obtain a homogeneous mixture
- The finished grout mixers merges using the tray, 12 reception capacity for finished material 13 for collection and further transportation for required objects
- Physical and mechanical properties of mastic shall conform to the requirements of GOST (Table 3 and Fig. 6 and 7).

Solvent and atactic polypropylene mix before reception of homogeneous weight. following this mixed bitumen and PBR as well as the solution of atactic polypropylene serves in the mixer (II) for all components and continue to stir within 15-20 min until smooth black Finished mastic merge in a metal container and determine its quality according to GOST.

Filling expansion joints with mastic between concrete and ferro-concrete plates under the leadership of SUN-S-5-76 (Urbanaviciene *et al*., 2014). Physical and mechanical properties of cold mastic for sealing expansion joints are shown in Table 1.

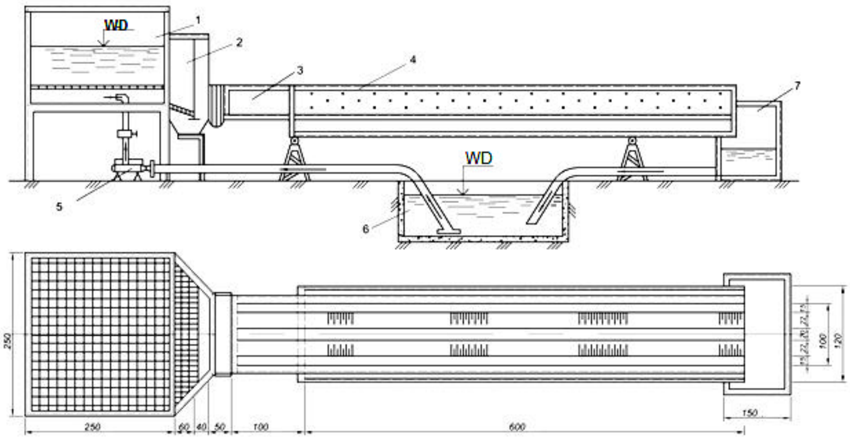

Fig. 8: Filter tray 1-pressure tank; 2-the damper; 3-inner tray;4-outer tray; 5-asoa; 6-water reservoir; 7-spillways maintenance tank;8-concrete slabs;9-expansion joints of the investigated mastic

Table 3: Physical and mechanical properties of cold mastic for sealing expansion joints

	Indicator		
	Cold mastic based on PBR		
Properties	After cooking	Through 3 year	According to GOST 15836-2889,79-80
Heat resistance (°C)	120	117	85-90
Gluing ability (n)	(over 5 days)		
Water saturation (%)	305	300	-
Flexibility to the rod with a diameter of 10 mm	0.2 (via 12:00 am) withstands	0.6 withstands	0.2 withstands
Needle penetration depth at 25°C, 0.1 mm	25	22	not <20
Elongation (sec)	4	3.5	not <3
Softening temperature on Kish (°C)	120	117	11

Laboratory studies were carried out on the filter tray laboratories agricultural water supply Water economy Department KSU Korkyt Ata. A pilot plant consists of a pressure tank capacity-5 m reservoi-9 m^2 pumps of the brand K-45/30 and the box-tray with double bottom (Fig. 3). Length of tray-6 m, width external Tray-1 m a width of inner Tray-1 m with holes for the filtration of water.

The inner tray was stowed loam soil. Soil compaction produced layers every 10 cm, roller weighing 100 kg. After sealing smooth roller, surface of each layer loosened to a depth of 3 cm, for the best coupling with the subsequent layer. In the packed soil was developed by channel of trapezoid section: the width of the top-50 cm, bottom-20 cm and depth-15 cm. Slopes and bottom channel sealed rink. Check flatness of slopes and the bottom of the channel showed that the greatest backlash between batten (lighthouse) and our weak points of the surface was 2-3 mm.

Hydraulic concrete slabs manufactured sizes of 50×20×3 cm. Through 28 day to achieve the desired strength, concrete slabs laid on a slope in the direction of the width of falling of a slope. Next test was conducted of flatness. The greatest backlash between batten and the surface of the concrete slab amounted to 1-2 mm. Expansion joints of concrete slabs have the width of 1-1, 5 cm which filled developed composition of mastic on the basis of PBR (Fig. 8).

Technology device expansion joints was carried out according to Snip 2.06.03-88, Snip 111-20-74, SUN-S-5-76 the following technological sequence: preparation of mastics on the basis of PBR; on the channel filter tray under the joints of concrete slabs stacked pad with anti-adhesive layer (Fig. 9). After cleaning the cavity of the seam from the soil, debris, dust and other foreign matter, seams filled with mastic at air temperature not below +5°C; a total of 69 laid concrete slabs and 196 sealed seams; quality control of works on sealing joints with mastic was implemented as follows-verified quality seam cavity under seal, the presence of anti-adhesive layer, surface finish sides of plates, forming seams; layer thickness and flatness caused by sealant; density of an adjunction of mastic to mating surfaces.

Disjoining mastic determined by spreading its thin layer on the glass plate. If there were no visible by eye highlights in mastic. The thickness of a layer of mastic checked thin metal screw with measuring marks. Adhesion of mastics to concrete slabs measured adhesiometer AD-1. Figure 9 shows a design of deformation seam.

After the full achievement of the impact the ability of mastics fired water on armored channel placed on filter tray. On the filter tray hydraulic mastic properties were investigated on the basis of PBR and their applicability for sealing joints in concrete channels liners and monolithic construction. Quality control of grouting carried out on samples that were extracted from the joints of concrete lining at various intervals of their stay in the water

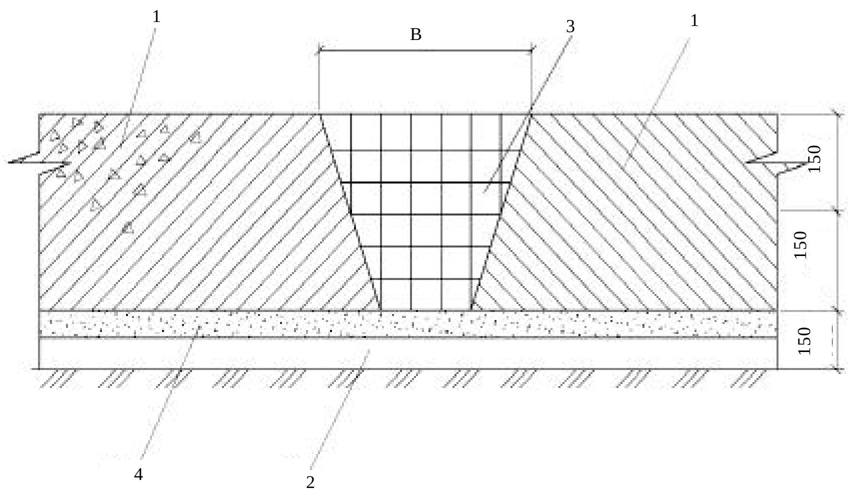

Fig. 9: Construction deformation seam sewn termination with mastic based on PBR 1-concrete slab; 2-seal of the rolled material with anti-adhesive layer; 3-mastic based on PBR; 4-gravel sand preparation

(Bishimbayevv *et al*., 2004). F or long term stays in water physical and mechanical properties of stabilized corresponding regulatory requirements (Table 4). Tests have been carried out at flow velocities in the tray 0.3 . 1 m sec^{-1} at a depth of water 5, 10.2 cm. During observations seams concrete slabs worked tightly, water leakage and the destruction of weld material.

RESULTS AND DISCUSSION

It should be noted that the tested mastic moisture and under the influence of ambient heat reaches maximum gluing strength and ability for 13-18 day. Mastic has a high tensile strength of 12-16 kg cm^{-2} (curve 3 in Fig. 5) and adhesive strength which remains practically not changed (Table 4 and Fig. 10).

Denote the curves: 1-tensile strength of mastic based on PBR; 2-too bituminous mastic; 3-elongation of bitumen mastic; 4-too mastics on the basis of PBR. A very important property of waterproofing materials is their ability to resist moisture for a long time. To determine these properties studied samples of mastic on the change of water absorption by weight which does not exceed 1% (curve of Fig. 11).

Analyzing the results of the foregoing experimental studies, we can draw the following conclusions: hydraulic Engineering asphalt (GTA) prepared on the basis of NBP at field Iman-Kara natural bitumen containing 16% by weight, physico-mechanical properties meet the requirements of P-20-85; GTA folding and sealing must be carried out at the optimal temperature of 70-130°C

Table 4: Hydraulic properties of mastics on the basis of the PBR for prolonged stays in the water

View sealants (months)	Mastic based on PBR	Bitumen mastic
Cohesivestrength (MPa)		
1	13.85	13.02
3	13.8	11.04
6	12.88	9.06
9	2.06	9
12	12	8
Elongation (%)		
1	160.2	170
3	130	140.6
6	80.8	120
9	80	110.4
12	70.6	110
Water absorption (%)		
1	0.68	0.8
3	0.73	1
6	0.78	1.2
9	0.8	1.2
12	0.8	1.2

which provides the desired complex structural and mechanical properties required density, strength and water resistance.

At long stay in the water physico-mechanical properties of the material are stabilized, water seepage losses decrease with time averaging <15, water resistance coefficient is 0.89. In the conditions of a steady flow of water in canals recommended formulations GTA in its resistance to erosion will be a substantial margin.

Filtering mode in the GTA based on the NBP is linear and obeys Darcy's law. filtration coefficient for the fine GTA is 6.04×10^{-5} to 3.2×10^{-7} cm sec^{-1}, fine GTA with 10% mineral powder 5.85×10^{-5} to 1.48×10^{-7}cm $sec^{-1}$and sandy GTA 1.2×10^{-5} to 2.2×10^{-8} cm sec^{-1} (Usanova *et al*., 2014; Vatin, *et al*., 2014a, b).

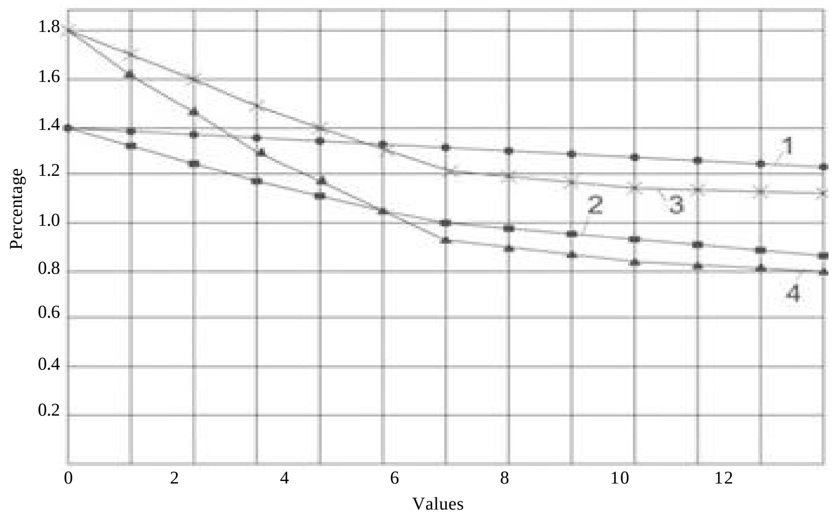

Fig. 10: The dependence of tensile strength and elongation of sealants on the duration of stay in water Denote the curves: 1-tensile strength of mastic based on PBR; 2-too bituminous mastic; 3-elongation of bitumen mastic; 4-too mastics on the basis of PBR

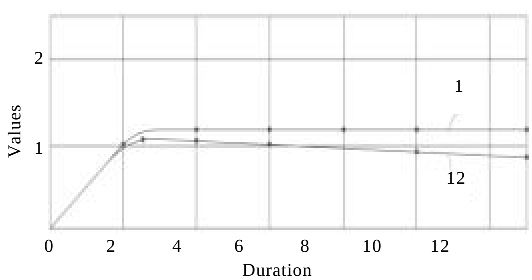

Fig. 11: The dependence of water sealer on the duration of stay in water Designation of curves: 1-water absorption of bitumen mastic; 2-also on the basis of PBR

CONCLUSION

The results of these studies show that the samples have been subjected to the test after 25 cycles of freezing and thawing reduce the compressive strength of the value of not >15% of the original. At external examination, the destruction of the samples or any cracks were not found. Frost factor with up to 1 consistence 0.86, 2 consistence is 0.86, 3 consistence is 0.94 and after 30 cycles, respectively, 0.65; 0.71, 0.91. These data indicate sufficient frost resistance test GTA samples based on the NBP (Vatin *et al.*, 2014a, b; Arseniev *et al.*, 2014; Gamayunova and Vatin, 2015; Kaklauskas *et al.*, 2015).

GTA samples have been subjected to the test after 25 cycles of freezing and thawing reduce the compressive strength of the value of not >15% of the original. Frost coefficient at the same time made for fine compositions is 0.86, for sandy is 0.94. After 30 test cycles accounted for fine compositions without additives and with mineral powder of 0.65 and 0.71, respectively, for the sandy 0.91. This indicates sufficient hardiness of GTA and brand for 3 compositions can take Mrz 25.

Laboratory studies have shown that mastic based on PBR might be applied in the hydraulic and reclamation construction. A distinctive feature of mastic based on PBR is stable adhesion, practically not changeable from the action of water.

Operational reliability of constructions is inextricably linked with the effectiveness of waterproofing and air-tightness butt joints. Practice of the construction and renovation of hydrotechnical and reclamation constructions convinces the need of improving the constructive-technological solutions for waterproofing and sealing of expansion joints.

Reliability and durability of waterproofing and sealing is largely determined by three factors: isolation and structure of a seam, mechanical and technological properties of the coating and sealer (Urbanavieien *et al.*, 2014; Kaklauskas *et al.*, 2013; Keeling, 2006; Ravinet, 2008).

Constructive solution of the seam and the sealing material is assigned depending on the design of the lining of the channel and operating conditions, taking into account the feasibility study. It works by sealing the seams with mastic materials should begin after all the preparatory work. In the production of the work must comply with "Safety in Construction".

Thus, the results of hydraulic properties of studies have confirmed that the cold mastic on the basis of the PBR has: a tensile strength of 12 month 12 MPa; elongation 70 and 0.8% water saturation; heat resistance 1050°C; the ability to self-healing, ie., it can provide reliable isolation of the compounds of structural connections of hydraulic and drainage structures. Depending on the depth of the channel filling over pressure given temperature, shrinkage deformation, creep and shear abutting elements defined design thickness of the veneer.

REFERENCES

Arseniev, D.G., A.V. Rechinskiy, K.V. Shvetsov, N.I. Vatin and O.S. Gamayunova, 2014. Activities of Civil Engineering Institute to attract foreign students for training in civil engineering programs. Appl. Mech. Mater., 2014: 2076-2080.

Bishimbayev, V.K. and R.A. Narmanova, 2002. Use of petroleum bitumen rocks and waste of the chemical industry to obtain hydraulic asphalt concrete. Complex Usage Miner. Raw Mater. Almaty, 2002: 54-57.

Bishimbayevv, V.K., A.A. Shomantaev and R.A. Narmanova, 2004. Defining design characteristics of asphalt concrete based on PBR/Abstracts Rep: Improvement of Construction Materials, Construction and Improvement of the Quality of Agricultural and Water Construction. 1st Edn., Novocherkask Publisher, Novocherkask, Russia, pp: 129-137.

Gamayunova, O. and N. Vatin, 2015. Education in the field of construction of unique, high-rise and long-span buildings and constructions. Adv. Mater. Res., 2015: 2459-2462.

Kaklauskas, A., A. Kuzminske, E.K. Zavadskas, A. Daniunas and G. Kaklauskas *et al*., 2015. Affective tutoring system for built environment management. Comput. Educ., 82: 202-216.

Kaklauskas, A., E.K. Zavadskas, M. Seniut, V. Stankevic and J. Raistenskis *et al*., 2013. Recommender system to analyze student's academic performance. Expert Syst. Appl., 40: 6150-6165.

Keeling, R., 2006. The bologna process and the Lisbon research Agenda: The European commission's expanding role in higher education discourse. Eur. J. Educ., 41: 203-223.

Ravinet, P., 2008. From voluntary participation to monitored coordination: why European countries feel increasingly bound by their commitment to the Bologna Process. Eur. J. Educ., 43: 353-367.

Urbanaviciene, V., A. Kaklauskas, E.K. Zavadskas, J. Sliogeriene and J. Naimaviciene *et al*., 2014. Facilitating the housing bargaining with the help of the bargaining decision support system. Intl. J. Strategic Property Manage., 18: 213-224.

Usanova, K., A. Rechinsky and N. Vatin, 2014. Academy of construction for university applicants as a tool of university online marketing. Appl. Mech. Mater., 2014: 2090-2094.

Vatin, N., D. Nemova, L. Khazieva and D. Chernik, 2014a. Distant learning course energy efficient refurbishment management. Appl. Mech. Mater., 2014: 2057-2062.

Vatin, N., O. Gamayunova and D. Petrosova, 2014b. Relevance of education in construction safety area. Appl. Mech. Mater., 2014: 2085-2089b.