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STUDY ON HYDROTECHNICAL PROPERTIES OF MASTICS ON THE BASIS OF PETROLEUM BITUMEN ROCKS (PBR)

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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 of technical and economic indices of construction.

Keywords: mastic, hydrotechnical construction, waterproofing and bitumen, rocks, concrete slabs.

1. INTRODUCTION

New technological developments on the application of petroleum bitumen species (PBR) in formulations of waterproofing materials noted in scientific writings of academics Nadirov N.K., BishimbaevV.K., Narmanova R.A., professors A.A. Shomantaev, researchers Zharasova A.M.., Hodzhanazarova A.T. and other [1-4].

The main reserves of petroleum bitumen species (PBR) in Kazakhstan concentrated in Aktyubinsk, Mangistau and Atyrauregions. 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 [4].

Technical characteristics of mixer CO-8.

1	Hopper capacity (l)	55
2	Rotation frequency, revs/min: -first mixing shaft -second mixing shaft	 125 60
3	The material required for one kneading, kg	40
4	Performance when cooking, kg/h -sealing compound -Putty -colorful pastes	 120 140 150
5	Electric motor: -power, KWT -voltage, v -overall dimensions: mm -length -width -height -weight, kg	 2.8 220/330 900 600 950 210

2. EXPERIMENTAL PART

The concept and the technological scheme of preparation of mastics on the basis of petroleum bitumen species (PBR) is shown in Figure 1, 2 and includes the following main operations:

a) First check the readiness of the source material: PBR, bitumen, atactic polypropylene (app), mild pyrolysis resins (MPR), as well as agitators and mixers-mixers.

b) Delivery of PBR rock hopper 1.

c) Molten Delivery when t 90^0C BN 90/10 reception capacity 2.

d) BatchedPBR 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.

e) Delivery prepared by APP in receiving hopper 4.

f) Delivery of MPR in 3 capacity.

g) Batched APP and MPR are served in a bowl with mixer 10 and mixed until a homogeneous liquid mixture.

h) Feed mixtures prepared in 11 mixer for mixing within 20 minutes to obtain a homogeneous mixture.

i) The finished grout mixers merges using the tray, 12 reception capacity for finished material 13 for collection and further transportation for required objects.

j) Physical and mechanical properties of mastic shall conform to the requirements of GOST, below table 1.

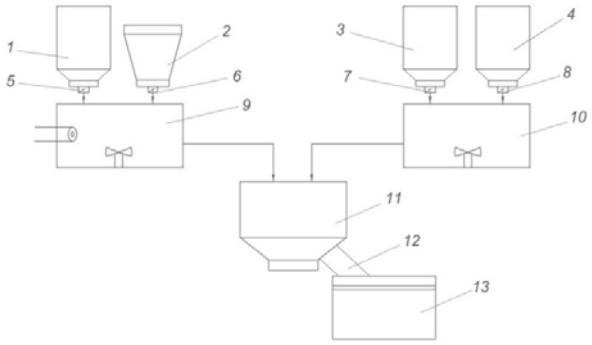

Figure-1. Schematic diagram of the production of cold masticbased on PBR
1-receivinghopper for PBR; 2-receiving hopper for bitumen; 3-capacity for MPR; 4-receiving hopper for APP; 5, 6, 7, 8-dispensers for PBR, bitumen, MPR, APP; 9-container with stirrer and heating for PBR and bitumen; 10-container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

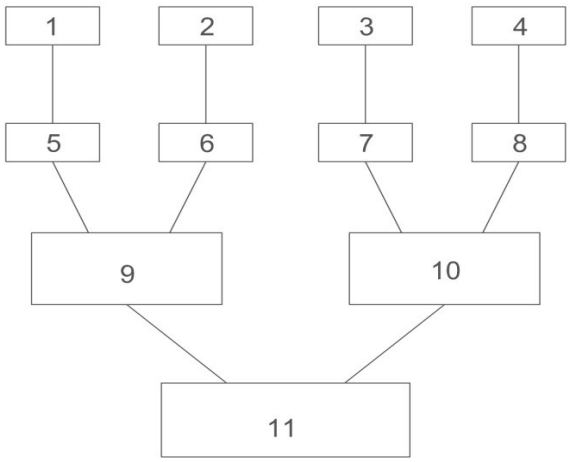

Figure-2. The technological scheme of production of cold mastic based on PBR
1-container for PBR; 2-bitumen tank; 3-solvent tank; 4-atactic polypropylene; 5-dispenser PBR; 6-dispenser of bitumen; 7-solventdispenser; 8-pipette atacticpolypropylene; 9-mixer for bitumen and PBR; 10-mixer for solvent and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

Table-1. Physical and mechanical properties of cold mastic for sealing expansion joints.

No.	Properties	Indicators		
		Cold mastic based on PBR		According to GOST 15836-2889, 79-80
		After cooking	Through 3 years	
1	Heat resistance, ^{0}c	120(over 5 days)	117	85-90
2	Gluing ability, n	305	300	-
3	Water saturation,%	0.2	0.6	0.2
4	Flexibility to the rod with a diameter of 10mm	(via 12:00 am) withstands	withstands	withstands
5	Needle penetration depth at 25 ^{0}c, 0.1 mm	25	22	not less than 20
6	Elongation, see	4	3.5	not less than 3
7	Softening temperature on Kish, ^{0}c	120	117	118

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 minutes 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 [5].Physical and mechanical properties of cold mastic for sealing expansion joints are shown in Table-1.

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 - 5m reservoir - 9m, two pumps of the brand K-45/30 and the box-tray with double bottom (Figure-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 50x20x3 cm. Through 28 days 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.

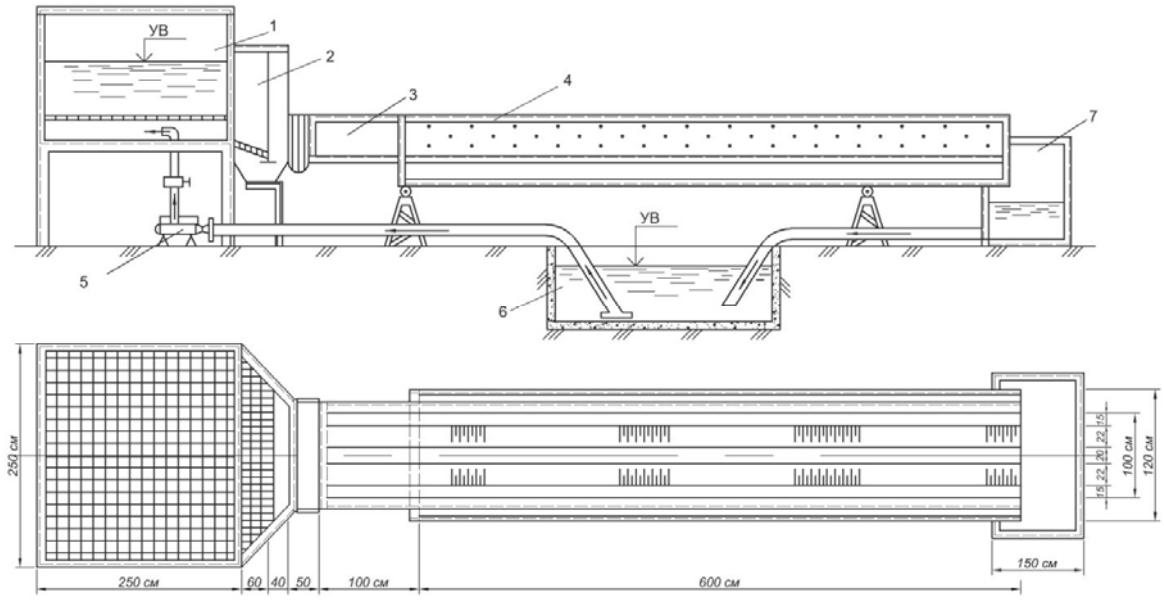

Figure-3. Filter tray.
1-pressure tank; 2-the damper; 3-inner tray; 4-outer tray; 5-asoa; 6-water reservoir; 7-spillways maintenance tank; 8-concrete slabs; 9-expansion joints of the investigated mastic.

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. 4); 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 $+5^0$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-4 shows a design of deformation seam.

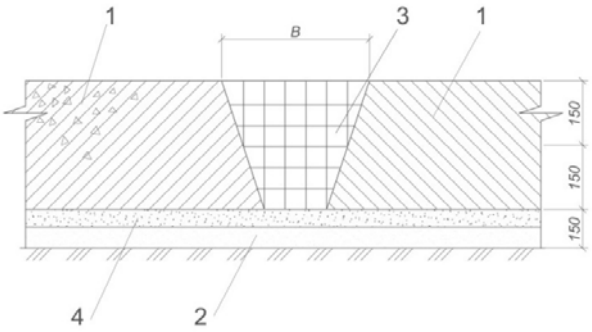

Figure-4. Construction deformation seam sewn termination with mastic based on PBR
1-concrete slab; 2-seal of the rolled material with anti-adhesive layer; 3-mastic based on PBR; 4-gravel sand preparation.

After the full achievement of the impact the ability of mastics fired water on armored channel placed on filter tray (Figure-5).

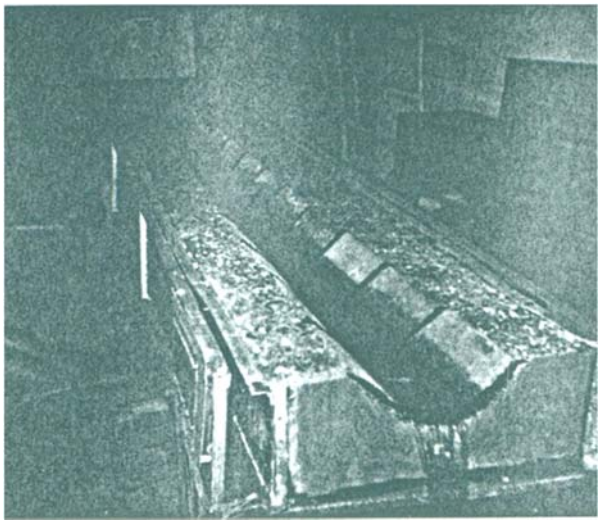

Figure-5. Laboratory filtration tray faced with concrete slabs 50x20x3sm with expansion joint based on PBR.

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.

For long term stays in water physical and mechanical properties of stabilized corresponding regulatory requirements (Table-2).

Tests have been carried out at flow velocities in the tray 0,3 ... 1 m/s 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

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 days. Mastic has a high tensile strength of 12-16 kg/cm^2 (curve 3 in Figure-6) and adhesive strength, which remains practically not changed.

Table-2. Hydraulic properties of mastics on the basis of the PBR for prolonged stays in the water.

Viewsealants	1month	3 month	6 month	9 month	12 month
Cohesive strength, MPa					
Masticbased on PBR	13.85	13.80	12.88	12.06	12.00
Bitumenmastic	13.02	11.04	9.06	9.00	8.00
Elongation,%					
Mastic based on PBR	160.2	130	80.8	80.0	70.6
Bitumenmastic	170	140.6	120	110.4	110.0
Water absorption,%					
Masticbased on PBR	0.68	0.73	0.78	0.80	0.80
Bitumen mastic	0.80	1.0	1.2	1.2	1.2

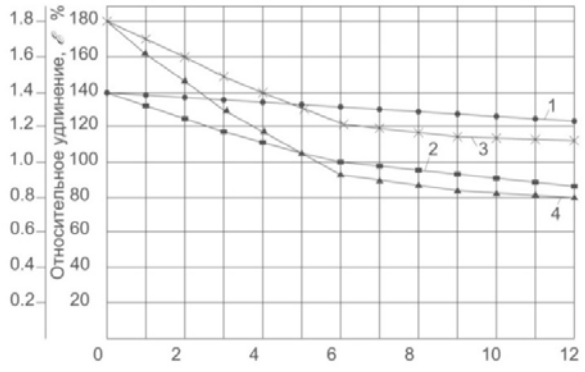

Figure-6. The dependence of tensile strength and elongation of sealants on the duration of stay in water Denote the curves: 1-tensile strength of mastic based on PBR; 2-too bituminous mastic; 3-elongation of bitumen mastic; 4-too mastics on the basis of PBR.

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 Figure-7).

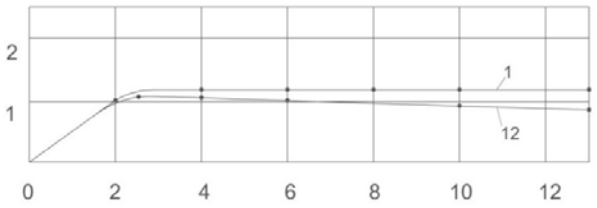

Figure-7. The dependence of water sealer on the duration of stay in water.
Designation of curves: 1-water absorption of bitumen mastic; 2-also on the basis of PBR.

3. DISCUSSIONS

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 [6].

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 months- 12 MPa; elongation - 70%; -0.8% water saturation; heat resistance - 1050C; 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 overpressure given temperature, shrinkage deformation, creep and shear abutting elements defined design thickness of the veneer.

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