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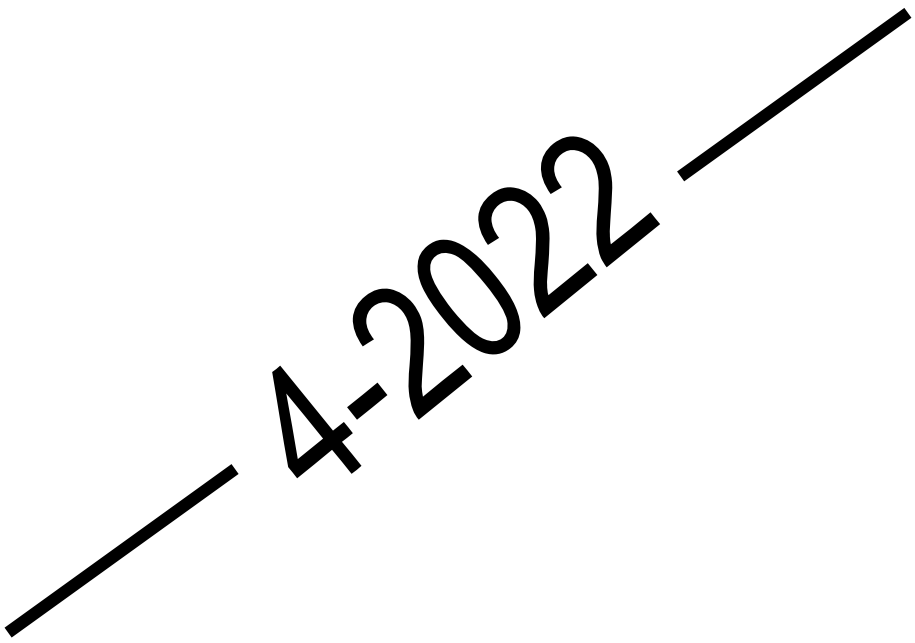

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CONSTRUCTION METHODS OF BASE WITH TREATMENT GRAVEL-SAND MIXTURE WITH CEMENT-BITUMEN EMULSION.

СПОСОБЫ СТРОИТЕЛЬСТВА ОСНОВАНИЙ С ДОБАВЛЕНИЕМ БИТУМНОЙ ЭМУЛЬСИИ В ГРАВИЙНО-ПЕСЧАНУЮ СМЕСЬ, ОБРАБОТАННУЮ ЦЕМЕНТОМ

BITUM EMULSIYASI QO‘SHILGAN SEMENT BILAN ISHLOV BERILGAN SHAG‘AL-QUM QORISHMALARI BILAN ASOSLARNI QURISH USLUBLARI

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Annotatsiya

Maqola avtomobil yo‘llari uchun bitum emulsiyasi qo‘shilgan sement bilan ishlov berilgan shag‘al-qum qorishmalaridan foydalanish haqida. Eksperimental tadqiqotlar (sinovlar) murakkab bog‘lovchilar yordamida asosni mustahkamlash samaradorligini asoslaydigan tadqiqotning bir qismi sifatida amalga oshirildi. Ushbu maqolada qurilish usullari va materiallar fizik-mexanik xususiyatlarini o‘rganib (sement, shag‘al-qum aralashmasi va bitum emulsiya) bir qancha kompozitsiyalarda o‘tkazilgan sinovlar keltirilgan. Sinov natijalari bitum emulsiyasi qo‘shilgan sement bilan ishlov berilgan shag‘al-qum qorishmalaridan foydalanilganda suv shimuvchanlikning kamayishi va bu konstruksiyaning mustahkamligini oshishini ko‘rsatdi.

Аннотация

В статье речь идет об использовании гравийно-песчаных смесей для автомобильных дорог, обработанных цементом с добавлением битумной эмульсии. Экспериментальные исследования (испытания) проводились в рамках исследования, обосновывающего эффективность укрепления основания с помощью сложных вяжущих. В данной статье представлены испытания, проводимые в нескольких составах с изучением методов строительства и физико-механических свойств материалов (цемент, гравийно-песчаная смесь и битумная эмульсия). Результаты испытаний показали снижение водопоглощения при использовании гравийно-песчаных смесей, обработанных цементом с добавлением битумной эмульсии, что повышает прочность конструкции.

Abstract

The article deals with the use of gravel-sand mixtures for highways treated with cement with the addition of bitumen emulsion. Experimental studies (tests) were carried out as part of a study justifying the effectiveness of strengthening the base with the help of complex binders. This article presents tests carried out in several formulations with the study of construction methods and physical and mechanical properties of materials (cement, gravel-sand mixture and bitumen emulsion). The test results showed a decrease in water absorption when using gravel-sand mixtures treated with cement with the addition of bitumen emulsion, which increases the strength of the structure.

Kalit so‘zlar:*Asos, joyida aralashtirish, maksimal quruq zichlik, optimal namlik, shag‘al-qum aralashmasi, sement, bitum emulsiyasi.*

Ключевые слова*: Основание, Перемешивание на месте, Максимальная сухая плотность, Оптимальное содержание влаги, гравийно-песчаная смесь, Цемент, битумная эмульсия.*

Key words: *Base, Mixing in-place, Maximum dray density, Optimum moisture content, gravel-sand mixture, Cement, bitumen emulsion.*

Introduction

One of the criteria for the level of development of the country is the state of the road network. More money is spent on the design, construction, maintenance, and repair of highways than on the rest of the communication routes combined.But at the same time, at present, the transport and operational characteristics of most domestic highways lag behind the world level.The construction of highways is accompanied by the use of a wide range of road construction materials used.This is due to various weather and climatic conditions of construction; geological conditions of occurrence of minerals suitable for the construction of road clothes; transport and operational requirements for the quality of road clothes of the highway [1].

According to the method of preparation, road-building materials are divided:

- materials prepared in the installation;

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- materials obtained by mixing on the road.

According to the composition of road construction materials, they are divided :

- for simple, consisting of one component (soils, sands, crushing screenings, crushed stone and gravel mixtures);

-for complex - composite materials consisting of a filler and a binder.

By the nature of the binder, road-building materials can be divided into: - composite materials prepared using organic binders (bitumen, tar, various mastics and emulsions based on them); - for composite materials prepared using inorganic binders (ash-lime, slag-lime, cement).Composite materials are widely used in the construction of rehabilitation and reconstruction of roads, due to their denser structure, the ability to perceive the required loads from road transport and withstand weather and climatic influences. The most common composite materials in the construction of the base of highways are treated materials with cement (figure no.1).

When gravel sand mixtures using as base course of roads is requires a stabilizing effect in order to provide a longer life to pavements. One of the most popular techniques to achieve this is by treatment by cement. But a number of factors lead to a decrease in the pace of construction, an increase in estimated costs and a discrepancy in strength indicators. Nowadays, to solve above problems and to improve the quality of base layers, in developed countries use gravel-sand mixtures (GSM) treated with cement and addition of bitumen emulsion for road base [3].

In construction of treated base, the objective is to thoroughly mix a material with the correct quantity of cement and enough water/emulsion to permit maximum compaction. The resulting mixture must be adequately cured to provide the necessary moisture needed for cement hydration to fully harden the treated base.

Treatment of gravel-sand mixture with cement-bitumen emulsion is usually carried out by three types of methods, (i) mixed-in-place, (ii) mixed-in-place existing base,(iii) central plant methods.

GSM in required quantity distribute on an accurately graded, well-compacted subgrade in an even layer or in a uniform windrow, depending upon the type of mixing equipment to be used.For maximum efficiency the day's work brokers down into several adjacent sections rather than one or two long sections.Bulk cement is normally hauled to the jobsite in bulk transport trucks. Cement is then transferred to job cement storage trucks, which are usually enclosed or fitted with canvas covers. Cement is transferred into the cement storage trucks pneumatically by a screw or belt conveyor. Prior to cement spreading, truckloads of cement are weighed on portable platform scales or at a nearby scale. A mechanical cement spreader is attached to the dump truck. To obtain a uniform cement spread, the spreader operates at a constant slow speed with a constant level of cement in the hopper. The mechanical cement spreader can also be attached directly behind a bulk cement truck. Cement is moved pneumatically from the truck through an air separator cyclone that dissipates the air pressure. Cement falls into the hopper of the spreader. Skirts are sometimes used to minimize wind blown dusting (Figure 2).Cement is most commonly applied dry, but can also be applied in a slurry form. With a slurry application, it is important that the slurry be dispersed uniformly over the placement area so that it will not pool or run off in any manner. Procedures for applying water and bitumen emulsion and mixing will depend on the type of mixing machine used. A thorough mixture of GSM, cement, emulsion and water must be obtained. Uniformity of the mix is easily checked by digging trenches or series of holes at regular intervals for the full depth of treatment and inspecting the color of the exposed mixture.

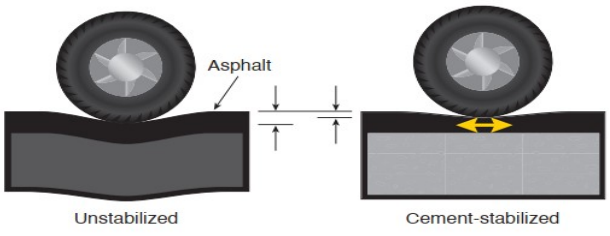
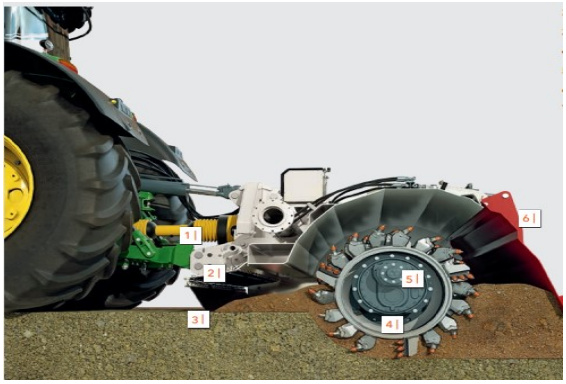


Figure no.1*Unstabilized bases have high deflection due to low stiffness, which results in high surface strains and eventual fatigue cracking. The higher stiffness provided by cement-stabilized bases produces lower deflections, resulting in lower surface strains and longer pavement life [2]*

Figure 2. *In mixed-in-place construction, cement is uniformly distributed over the area to be processed*

Uniform color and texture from top to bottom indicate a satisfactory mix; a streaked appearance indicates insufficient mixing. Treated base construction with single-shaft traveling mixers varies depending on the type equipment used. Some equipment can thoroughly mix the base in a single pass. Other equipment requires more than one mixing pass. However, the basic principles and objectives are the same. One of the most popular types of equipment for treatment of the base is Wirtgen group machines (Figure 3).

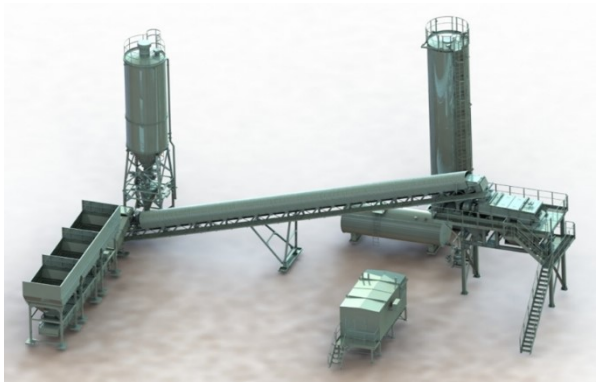
a.



b.

Figure 3. a)*tractor-towed stabilizer, b) working process*

Revolving-blade pug-mills can be used for mixing GSM materials. With batch-type pug mills and rotary-drum mixers, materials are batch weighed, mixed, and placed into haul trucks. With continuous-flow-type pug mills, materials are individually metered by weight or volumetrically prior to entering the pug-mill mixing operation. Each plant calibrates to make sure proper quantity of material is entering the mixer.Cement is usually metered onto the GSM main feeder belt just prior to entering the pug -mill. Water and emulsion is metered and added by means of spray bars mounted above the pug-mill. The mixed material is discharged into a holding hopper and then into haul trucks (Figure 4).



a

b.

Figure 4. *a) Mixing plant b) loading to dump truck*

The mixed material is placed on a moist subgrade without segregation and is spread by an aggregate spreader, or by two spreaders operating side by side, or by an automatic string-line-controlled grader. Compaction starts immediately after the material has been mixed or spread. While vibratory-steel-wheel rollers are most common, many types of compaction equipment may be used to obtain adequate densification.

Methods

The main regulatory standards are SHNK 2.05.02-07, SHNK 3.06.03-08, GOST 23558-94 for design, construction and quality control and technical conditions of treatment the base with cement. Unfortunately, in Uzbekistan and in the countries of Central Asia, the treatment of bases in a combination way with organic and inorganic binders has not been sufficiently studied and practically does not apply. Thus, we focused our research to develop and recommend the technical specification, technologies to constructions and quality control and quality assurance procedures. One of the research aim is to show the efficiency of treatment gravel-sand mixture with cement-bitumen emulsion. To do this, we planned in advance to test samples from several combined mixtures. The test will be carried out in two phases, in the first phase a will be design mix by GSM, cement and water. At the second stage, a will be design mix by GPS, cement, bitumen emulsion and water. Those mixtures samples will be tested maximum-dry density, optimum moisture content, compressive strength and compare the results. Prior to the making samples we must be sure qualities and conforms the standards of selected materials. To check the binder quality sampled the sulphate resisting potland cement “ССПЦ 400 Д0 –GOST 22266-94” manufacturer KIZILKUMCEMENT and tested in accordance with GOST 30515, GOST310.1, GOST 310.2, GOST 310.3 and GOST 310.4

Results and Discussion

Table no. 1 shows the physical and mechanical properties of cement.

Table no.1 test results of cement

Name of the Test	Specification	Test results	Remarks
Setting time - Start - Finish	-not earlier than 45 minutes - no later than the 10 h	2 h. 15 minutes 5 h. 35 minutes	comply
Normal density of cement dough	Not regulated	26,5%	
Uniformity of volume change during boiling in water	Shall be withstand	Withstand	comply
The presence of signs of false grasping	It shouldn't	Absent	comply

Specific surface area	Not less than 250 m2/kg	284 m2/kg	comply
Compressive strength at the age of 28 days	Not less than 39,2 MPa	41,2 MPa	comply
Real density	-	3,10 g/cm3	

GSM were taken three (3) samples from quarry located in "Urta-chirchiq" district, Tashkent region. Gradation results of GSM materials given in table no.2.

Table no.2 Sieve analysis of GSM

Sieve(mm)	Sample no.1	Sample no.2	Sample no.3	Requirements [0-40 мм], (%)	
40	9.8	9.3	9.7	0,0	10,0
20	27.6	36.8	38.9	20,0	40,0
10	57.0	58.6	57.8	35,0	65,0
5	60.0	71.3	72.6	50,0	80,0
2,5	72.1	75.6	75.0	60,0	85,0
1,25	78.9	79.3	79.4	70,0	90,0
0,63	82.1	83.0	83.2	75,0	95,0
0,315	95.3	95.2	95.6	80,0	97,0
0,14	96.2	96.1	96.8	85,0	98,0
0,005	97.3	98.2	98.8	87,0	100,0

Bitumen emulsion sampled from located plant Kibray district, Tashkent region. In accordance with Quality Certificate this emulsion is “Bitumen road emulsion anionic ЭБА-1”. Pursuant to the quality passport of material this sampled bitumen emulsion conforms to the requirements of GOST 18659-2005. After making sure that all materials comply with the requirements of regulatory documents, the maximum dry density (MDD) and optimal moisture content (OMC) of mixtures are determined (see table no.3).

Table no.3 MDD and OMC results

Mixture	Density of wet mixture	MDD	OMC
GSM+ Cement+ Water	2.42	2.27	6.3
GSM+Cement+ Bit.Emulsion+Water	2.45	2.32	5.3

Based on the MDD and OMC results, calculated mix design of mixtures:

Name of Mixture	Base Material	Cement Content	Water Content	Bit. Emulsion
A-1	GSM	3.0%	OMC	3.0%
A-2	GSM	3.5%	OMC	3.0%
A-3	GSM	4.0%	OMC	3.0%
A-4	GSM	4.5%	OMC	3.0%
A-5	GSM	5.0%	OMC	3.0%
B-1	GSM	3.0%	OMC	3.0%
B-2	GSM	3.5%	OMC	3.0%
B-3	GSM	4.0%	OMC	3.0%
B-4	GSM	4.5%	OMC	3.0%
B-5	GSM	5.0%	OMC	3.0%

Using above combinations was prepared samples with size 15x15x15 cm cubic and cured 28-days.

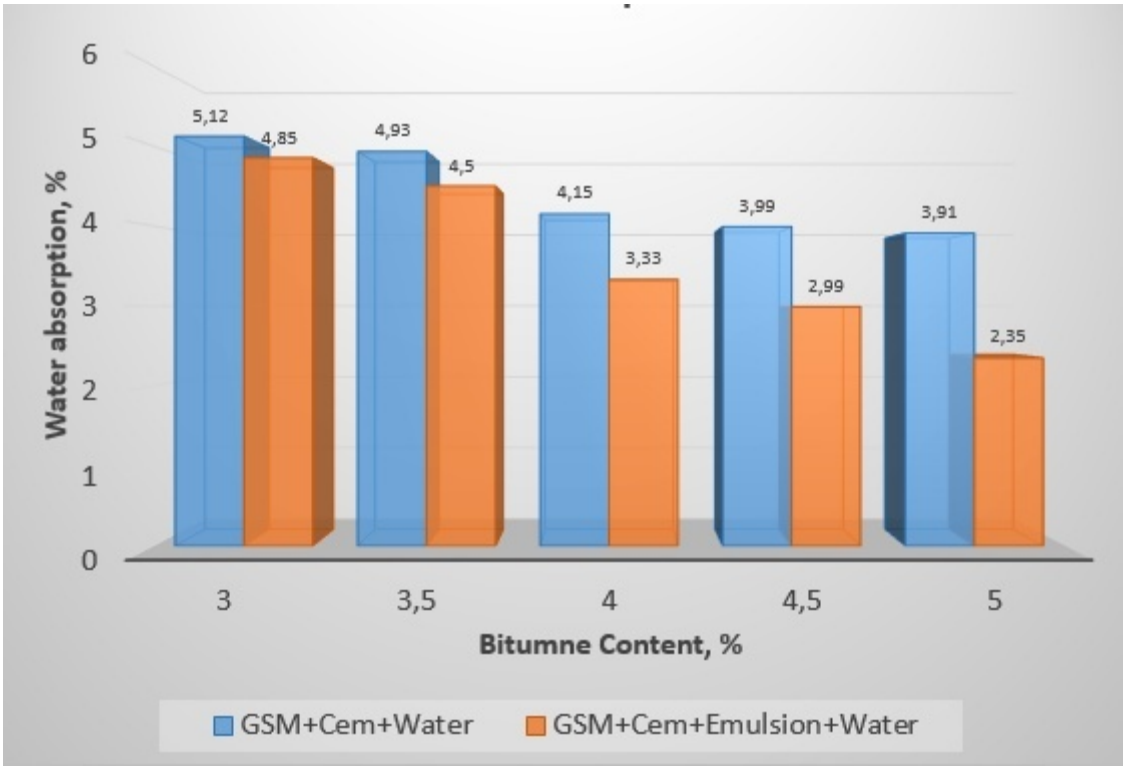


Figure 5. *Effects of Cement - Bitumen Emulsion on water absorption (28 days)*

After that, samples was prepare for testing in accordance with the GOST 12730.0—2020 "C*oncretes. General requirements for methods of determination of density, moisture content, water absorption, porosity and water tightness*". Cubic samples test for the water absorption conducted following the GOST 12730.3—2020 *"Concretes. Method of determination of water absorption"*. The water absorption versus bitumen emulsion for variety of cement percentages are shown in Figure 5. Based on all of the plot curves, the results indicated that the increase in water absorption was in tandem with reduced in value indicated from the cement. The plot curves indicated that the minimum value of WA was reached when the cement content 5% and bitumen emulsion 3%.

Conclusion

The findings revealed that overall; the optimum value of Portland cement and bitumen emulsion utilized in base treatment method is 4%-5% and 3% respectively. With this method, the duration time of the project can be reduced and subsequently the project cost may be also reduced. The findings from the tests WA showed that combination of Portland cement and bitumen emulsion as the base of treatment reduced the water absorption. In results increases frost

resistance and at the same time sharply reduces the temperature dependence of the consistency of the pavement.

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