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CONSTRUCTION METHODS OF ROAD BASE BY GRAVEL – SAND MIXTURE TREATED WITH CEMENT THE ADDITION OF BITUMEN EMULSION

Abstract. *The article discusses one of the newest technologies of road construction that uses for treatment of gravel-sand mix by cement and bitumen emulsion. And the effectiveness of the use of bitumen emulsion is justified.*

Keywords: *Base, Cement-bitumen emulsion treated base, hydration, adhesion, dispersion, gravel-sand mixture, Cement, bitumen emulsion.*

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СПОСОБЫ ВОЗВЕДЕНИЯ ДОРОЖНОГО ОСНОВАНИЯ ИЗ ГРАВИЙНО–ПЕСЧАНОЙ СМЕСИ, ОБРАБОТАННОЙ ЦЕМЕНТОМ С ДОБАВЛЕНИЕМ БИТУМНОЙ ЭМУЛЬСИИ





Аннотация. В статье рассматривается одна из новейших технологий дорожного строительства, использующая для обработки гравийно-песчаной смеси цементно-битумную эмульсию. И обоснования эффективности применения битумной эмульсии.

Ключевые слова: Основание, обработанное цементно-битумной эмульсией основание, гидратация, адгезия, диспергирование, гравийно-песчаная смесь, цемент, битумная эмульсия.

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SHAG`AL-QUM ARALASHMASIGA SEMENT VA BITUM EMULSIYASI BILAN ISHLOV BERIB YO`L ASOSINI QURISHNING USLUBLARI

Annotatsiya. Ushbu maqolada shag'al-qum aralashmasini sement va bitum emulsiyasi bilan ishlov berishda qo'llaniladigan yo'l qurilishining yangi texnologiyalaridan biri muhokama qilinadi. Va bitum emulsiyasidan foydalanish samaradorligi aniqlanadi.

Kalit so`zlar: Asos, Sement bilan mustahkamlangan asos, gidratatsiya, adgeziya, dispersiya, shag`al-qum aralashmasi, sement, bitum emulsiyasi

Introduction

In modern conditions requirements for the quality of construction of all road structures have increased dramatically. Therefore, where climatic, hydrological, morphological and other diversity have always created and continue to create special difficulties in provision high class roads, the question is urgent. Which is due to the need to meet the requirements of road transport while reducing the cost of construction roads.

At the stage of road construction one of the most important is the issue of improving the quality of base course. Only the appropriate quality of cement treated base (CTB) and high efficiency of its production can ensure competitiveness in the market of construction materials technology. Every year the variety of CTB increases, the scope of their application expands, the requirements for them, as well as the raw material base production. In the technology of CTB production, multicomponent recipes with additives-regulators have been switched to, new physico-chemical processes are used, complex equipment with automation elements is used, etc.

The use of cement—based primers in the structural layers of road structures allows us to solve the complex task of increasing the efficiency of road construction under the mandatory condition of ensuring the required level of quality and leading to a reduction in the cost of road construction by 20-40% [1, 2]. Currently, more than 3 billion square meters of cement treated base roads have been constructed and operated all over the world" [3,4]. Currently, a large number of base technologies have been developed abroad,





and their number is growing every year. At the same time, bitumen, lime, cement, as well as synthetic resins are used as a binder [5,6]

The advantage of material treatment is a significant improvement in the water-thermal regime of the roadbed. And the presence of higher strength properties of treated bases, compared with granular materials, allows you to reduce the thickness of the pavement by 20-50%, which reduces the amount of expensive materials, and allows to reduce the need for road transport, reduce labor costs and reduce the cost of construction of the pavement as a whole. [5,6,7,8,9]. One Of the most common defects of bases processed using cement, the formation of transverse and longitudinal cracks in it after laying this layer. The main reason for the formation of these cracks is the increase in the amount of cement in the mixture, albeit in small quantities. These cracks are of course repeated in the coating and have a negative impact on the quality of the road bed structure on the flooring. Many researchers was established [10] that bitumen emulsion is the most effective additive for increasing the physical and mechanical parameters of cement treated materials (CTM). By varying its content, it is possible to achieve flexural strength, and in some cases increase it, and improve other indicators. The material obtained in this way, in comparison with classical CTM, has a higher deformability, crack resistance.

Construction Methods

In CTB construction, the objective is to thoroughly mix a gravel-sand mixture (GSM) material with the correct quantity of cement and enough water to permit maximum compaction. The resulting CTB must be adequately cured to provide the necessary moisture needed for cement hydration to fully harden the CTB mixture. The fundamental control factors for quality CTB are: 1) proper cement content; 2) adequate moisture content; 3) thorough mixing; 4) adequate compaction; 5) proper curing;

The construction steps are: reparation, checking and calibration of equipment, correcting any soft subgrade areas and shaping the area to proper crown and grade.

The main two different methods are used in the construction of the CTB, mixing in the central mixer and mixing in place. The method of mixing in place is one of the construction technologies that are now widely used today, the most popular name of which is called “recycling”.

In our research main aim is the propose the improved construction methods for cement treatment of base (gravel-sand mix) addition bitumen emulsion. We propose two methods same as classic CTB construction, mixing on place and using central mixing plant. In the first method proposed use recycler machine (figure no.1) and average recycling thickness 16-22 cm. Mixed-in-Place Processing:

- Transportation material (GSM) to construction site;
- Laying of GSM by moto grader;
- Spreading cement;
- Applying water and bitumen emulsion and mix;
- Compacting, Finishing and Curing.





Figure 1. Recycler

Second proposed method is Central plant (figure no.2). Central plant processing:

- Mixing GSM, cement, water and bitumen Emulsion in central plant;
- Transportation fresh mix to construction site
- Hauling and spreading by asphalt paver;
- Compacting;
- Finishing;
- Curing.



Figure 2. Central mixing plant

Compaction starts immediately after the fresh mix 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. Compacted and finished layer contains sufficient moisture for adequate cement hydration. The newly constructed base should be kept moist (by lightly watering or misting) for a 7-day period, or a moisture-retaining cover or curing compound can be placed over the base soon after completion to retain the moisture and permit the cement to hydrate. If the road will have an asphalt surface, a bituminous prime coat can be applied at any time, as this will act as a curing membrane. The finished layer surface is kept moist until the curing compound is applied.



Wetting of mineral components with water

Some researchers have suggested adding bitumen emulsified in a cement treated base. During mixing, bitumen heated to operating temperature (120-160 °C) is introduced into the resulting mixture, where it is dispersed. But, this method not effective for the cement treatment base, because cement treated materials mixes require low water content, and high-quality dispersion of bitumen is feasible in a certain range of water content in the mixture, above and below which it is ineffective or impossible. During mix design of cement treated materials water content founds by optimum moisture content. Therefore, increased or decreased water content in the mixture will be negative effective to the strength and other properties of ready compacted layer.

The mechanism of hydration and hardening of cement in the presence of bitumen emulsion

Cement is a hydraulic binder that hardens in water and on air, obtained by the combined fine grinding of clinker and the required amount of gypsum. Cement has a composition in the region of 67% CaO, 22% SiO₂, 5% Al₂O₃, 3% Fe₂O₃ and 3% other components, and normally contains four major phases, called alite, belite, aluminate and ferrite. The hydration process is expressed by the equation:



The structure of gravel-sand mixture treated with cement addition bitumen emulsion (CTBBE) includes two thermodynamically incompatible binders cement and bitumen emulsion and water. This provides the grounds for creating a complex structure, which cannot be attributed to crystallization or coagulation. Bitumen emulsion and cement are antagonists. Oil fractions of bitumen harm the structure formation of cement, water and hydration products interfere with the formation of bitumen bonds. This prevents a clear understanding of the processes of structure formation of CTBBE. Unlike cements, the dispersed medium of cement-bitumen systems is not the aqueous phase, but the aqueous emulsion of bitumen, which contains, in addition to purely oil phase, many different active centers and surface-active substances. Therefore, the formation of strong structures in such systems, of course, will differ in certain properties. Theoretically, the structure of any of the compositions of the “cement-bitumen-water” system can be represented as a set of the following elements: cement, bitumen, water, cement-bitumen interface, bitumen-water interface, cement-water interface, cement-bitumen-water interface.

According to [11] the particle size of cement and sand and the double action of interfacial film and interracial charge layer, the mortar system has good stability. When the dry materials and bitumen emulsion just contacted, the system is still in a relatively stable state. Figure 3 shows the influence of bitumen emulsion on mixture workability. Figure 3(a) shows dispersion distribution of cement, sand, bitumen particles, and emulsifier molecules. When the dry materials contacted with bitumen emulsion, the hydration reaction of cement with water can produce a large number of Ca²⁺, K⁺, Na⁺, OH⁻, SO₄²⁻, and HSO₃ plasma, attracting the surrounding free emulsifier molecules (Figure 3(b)). The fluidity and extensibility of mixture can be improved by bitumen



emulsion and the fluidity is influenced by the bitumen emulsion dosage. The main reason is that when the molecular content of free emulsifier is low, the cement particles begin to absorb bitumen emulsion around the cement particles (Figure 3 (c)). Due to the reduction of free water in the system caused by cement hydration reaction and the adsorption of cement particles on bitumen emulsion, the mortars can gradually lose stability and demulsification and condensation occurred on the surface of cement particles. The hydration of cement particles and water is prevented and the volume fraction of the continuous phase is not decreased. Thus, the increase of internal friction between dispersed phases in mixture prevented and the fluidity improved (Figure 3(d)).

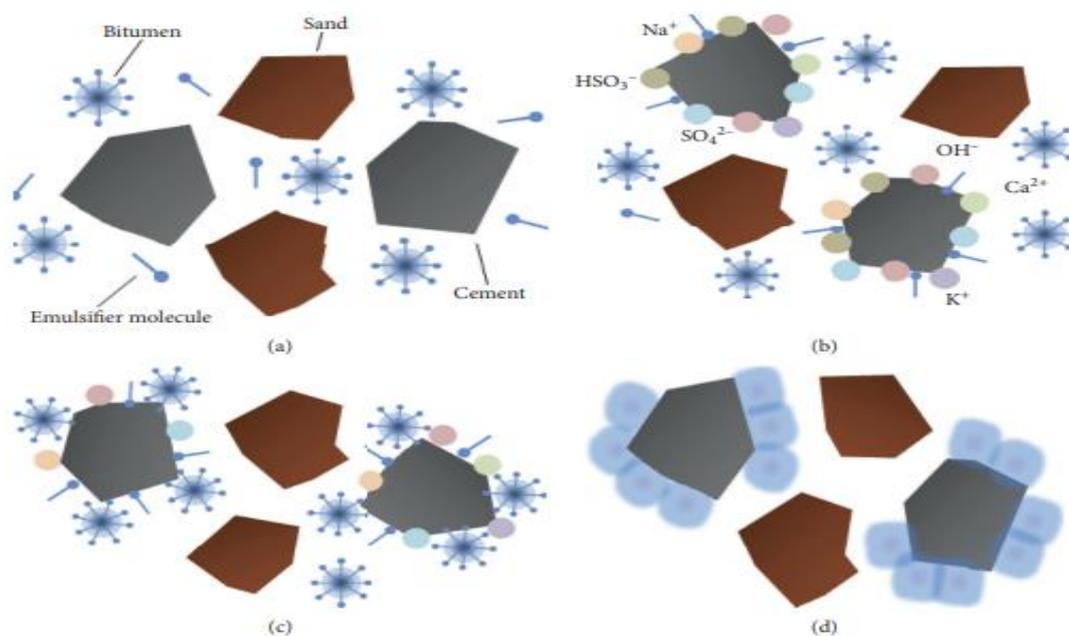


Figure 3. Influences of bitumen emulsion on mixture workability: (a) contact stage; (b) prereaction stage; (c) late stage of reaction; (d) demulsification and coagulation stage.

On the basis of theoretical studies, a structural model of CTBBE complex binder has been developed, which is represented by cement aggregates that have been hydrated to varying degrees and a number of interfacial transition layers (Figure 4).

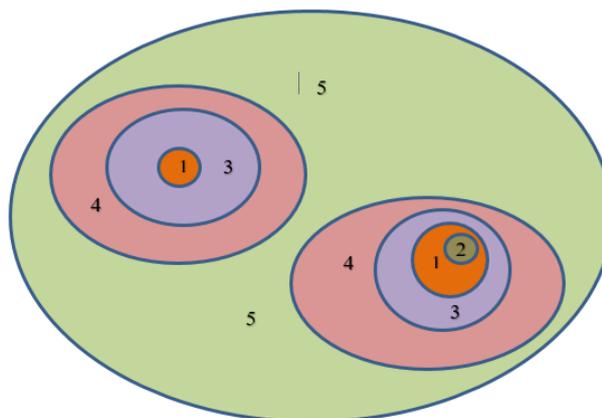


Figure 4. Structural model of mixture with cement and bitumen emulsion binder:

1- zone of hydrated cement; 2- zone of non-hydrated cement; 3- interfacial transition layer on the cement side; 4- interfacial transition layer on the bitumen side; 5- unstructured bitumen zone.

Conclusion

In a conclusion for increasing the mechanical and physical properties of treated base is more effective to adding bitumen emulsion. Using bitumen emulsion is more practicable and less environmental impacts depends of foamed bitumen. Based on all of the above, it can be assumed that the addition of bitumen emulsion to the composition of a mixture can play an important structure-forming role. Firstly, bulk waterproofing of mixture with bitumen can contribute to reducing late and secondary hydration of cement. Secondly, acting as a damping component, bitumen can prevent the development of micro cracks, increase the noise absorption increase the level of internal stress dissipation (relaxation) and absorb some of the external energy, applied to the material, partially unloading the mixture skeleton.

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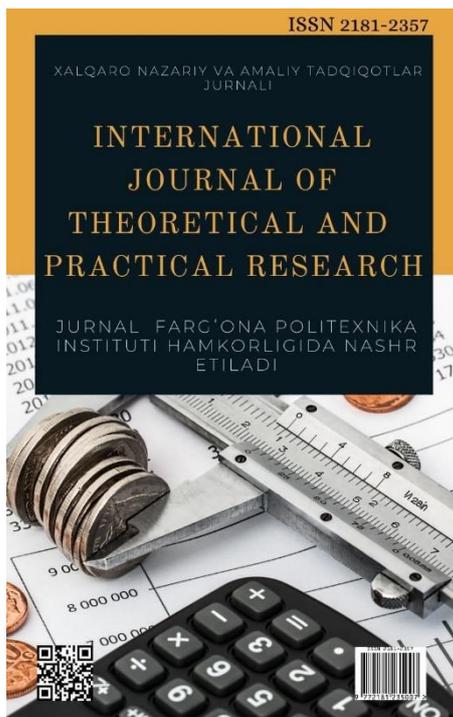
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ЭЪЛОН



Хурматли ҳамкасабалар “Al-Ferganus” нашриёти ва “Xalqaro nazariy va amaliy tadqiqotlar jurnali” электрон журнали Ўзбекистон таълим хизматлари бозорида ўзининг фаолиятини бошлаганлигини маълум қиламиз.

Ажойиб имкониятдан сиз биринчилар қаторида фойдаланиб илмий нашрларингизни чоп этишингиз мумкин.

“Al-Ferganus” нашриётимиз томонидан Сиз тақдим этган дарслик, ўқув қўлланма, монография ва илмий рисодаларга ISBN, Doi халқаро рақамли идентификаторларни бириктириш, уларнинг электрон замонавий андозадаги муқовалар ва ишланмаларнинг электрон макетини яратиш, нашриётда эълон қилинган ишларни электрон ахборот нашрларида жойлаштириш хизматлари кўрсатилади.

Бизнинг нашриётимизнинг бошқа нашриётлардан фарқи шундаки, тезкор ва сифатли хизмат кўрсатамиз ҳамда энг асосийси биз Сизнинг ишларингизни Алишер Навоий номидаги Ўзбекистон Миллий кутубхонаси ва Россия Миллий кутубхонаси фондларига бепул жойлашга шунингдек, Россия илмий иқтибослик индекси (РИНЦ ва E – library) платформасига, CrossRef базаларига шартнома асосида жойлаштиришга кўмаклашамиз.

“Xalqaro nazariy va amaliy tadqiqotlar jurnali” ISSN 2181-2357 электрон журнали ҳам ўз фаолиятини бошламоқда. Бизнинг журналда Ўзбекистон Республикаси Олий аттестация комиссиясининг куйидаги ихтисосликлари физика-математика, кимё, биология, геология-минералогия, техника, қишлоқ хўжалиги,





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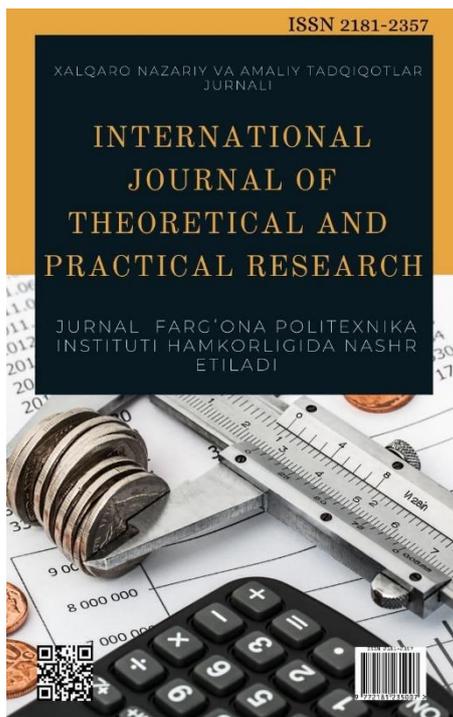
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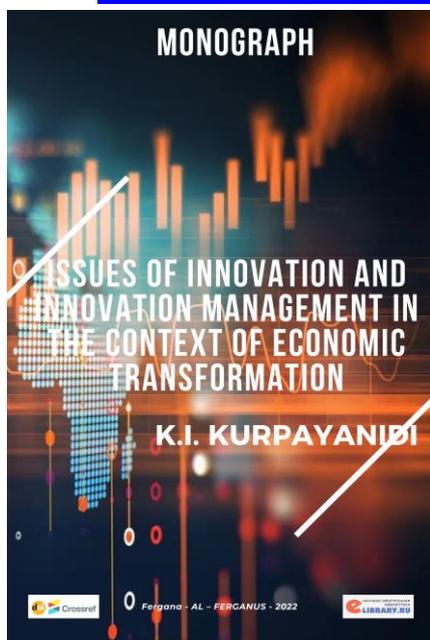


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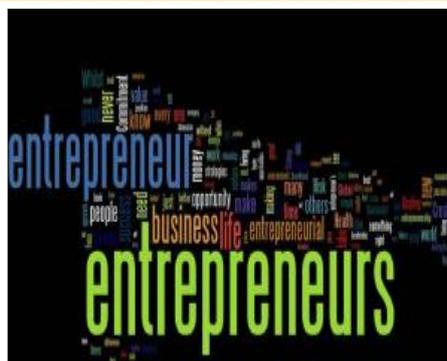
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competitive national
innovation system.
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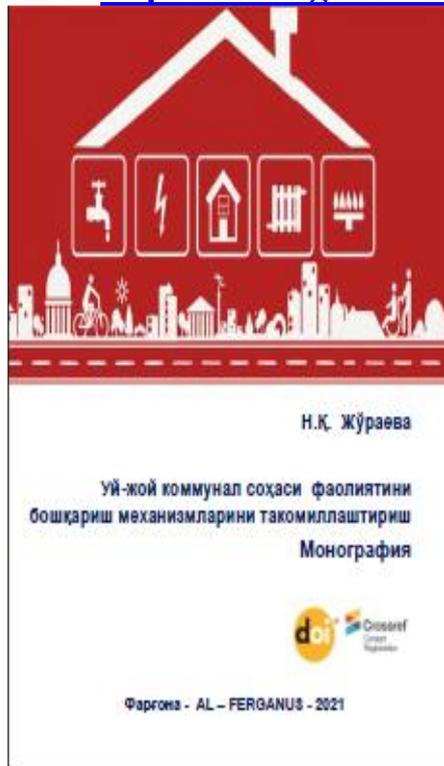


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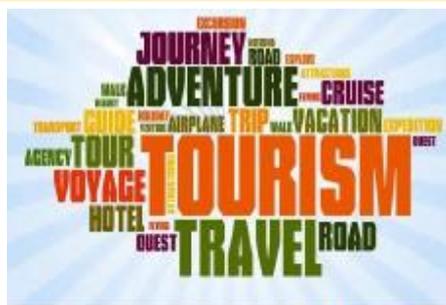
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