JOURNAL OF TRANSPORT

ISSUE 4, 2024, vol. 1
ISSN: 2181-2438

SLIB.UZ
Scientific library of Uzbekistan

RESEARCH, INNOVATION, RESULTS

TOSHKENT DAVLAT TRANSPORT UNIVERSITETI

Tashkent state transport university

JOURNAL OF TRANSPORT

RESEARCH, INNOVATION, RESULTS

ISSN 2181-2438

VOLUME 1, ISSUE 4

DECEMBER, 2024

jot.tstu.uz

TASHKENT STATE TRANSPORT UNIVERSITY

JOURNAL OF TRANSPORT

SCIENTIFIC-TECHNICAL AND SCIENTIFIC INNOVATION JOURNAL

VOLUME 1, ISSUE 4 DECEMBER, 2024

Founder of the scientific and technical journal "Journal of Transport" – Tashkent State Transport University, 100167, Republic of Uzbekistan, Tashkent, Temiryoʻlchilar str., 1, office: 465, e-mail: publication@tstu.uz.

The "Journal of Transport" publishes the most significant results of scientific and applied research carried out in universities of transport profile, as well as other higher educational institutions, research institutes, and centers of the Republic of Uzbekistan and foreign countries.

The journal is published 4 times a year and contains publications in the following main areas:

- Business and Management;
- Economics of Transport;
- Organization of the Transportation Process and Transport Logistics;
- Rolling Stock and Train Traction;
- Infrastructure;
- Research, Design, and Construction of Railways, Highways, and Airfields: Technology and Organization of Construction, Management Problems;
- Water Supply, Sewerage, Construction Systems for Water Protection;
- Technosphere Safety;
- Power Supply, Electric Rolling Stock, Automation and Telemechanics, Radio Engineering and Communications, Electrical Engineering;
- Materials Science and Technology of New Materials;
- Technological Machines and Equipment;
- Geodesy and Geoinformatics;
- Car Service;
- Information Technology and Information Security;
- Air Traffic Control;
- Aircraft Maintenance;
- Traffic Organization;
- Operation of Railways and Roads;

Tashkent State Transport University had the opportunity to publish the scientific-technical and scientific innovation publication "Journal of Transport" based on the Certificate No. 1150 of the Information and Mass Communications Agency under the Administration of the President of the Republic of Uzbekistan. Articles in the journal are published in Uzbek, Russian and English languages.

CONTEXT / MUNDARIJA

A. Ernazarov, J. Tojiev, T. Bobobekov
The study of indicators of the quality of traffic management in the conditions of the city of Jizzakh using GPS-tracks………………………….**58**

Kh. Kamilov, S. Sulaymanov
Modeling the neutral state of the "human-operator" system……………**65**

V. Soy, N. Mukhammadiev, D. Abdullaeva
Methodological basis for the use of additives for the production of complex modified cement binders…………………………………………**70**

V. Soy, N. Mukhammadiev, D. Abdullaeva
Development of a methodology for predicting the properties of multicomponent high-quality concrete taking into account the surface properties of mineral fillers and structural simulation modeling ………**75**

A. Mukhitdinov, D. Turgunov, M. Numanov, J. Ravshanbekov
The share of transport vehicles in changing the atmospheric composition………………………………………………………………**79**

M. Rasulmuhamedov, A. Boltaboeva
Development of an information system for the educational quality control department and strategies for its successful implementation……………**84**

A. Tukhtakhodjaev
Intellectual approaches to optimizing data flow in freight documentation processes…………………………………………………………………**89**

I. Makhamataliev, V. Soy, N. Mukhammadiev, G. Malikov
Concrete mixture……………………………………………………………**92**

K. Musulmanov, S. Omonova
Research on methods for greening the street network of Yashnabad district……………………………………………………………………**95**

J. Abdunazarov, A. Nishonov
Assessment of the public transport coverage rate by researching the population density (on the example of the Jizzakh city)……………**100**

Concrete mixture

I.M. Makhamataliev[1][a], V.M. Soy[1], N.R. Mukhammadiev[1][b], G.B. Malikov[1][c]

[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: concrete mix for the production of precast concrete structures for the construction of buildings and structures for housing, public, industrial and transport purposes, containing cement, crushed stone, sand, chemical additive - superplasticizer C-3, still bottoms of the production of Na-carboxymethyl cellulose (KOH), mineral filler and water, as a chemical additive is used superplasticizer based on polycarboxylate esters MasterGlenium ACE 430, and as a mineral filler - basalt fibers with a diameter of 17 µm and a length of 6-12 mm with the following ratio of components, wt.

Keywords: span structure, process line, prestressed state, adhesion, formwork, steam heating, reinforcement bundle

1. Introduction

The invention relates to the field of the building materials industry and can be used in the preparation of concrete mixtures for the manufacture of precast concrete and reinforced concrete structures.

Concrete mixtures are known that contain: cement, crushed stone, sand, superplasticizer, mineral additives and water [1,2]. In these concrete mixtures, fly ash from thermal power plants and screenings from crushed granite rocks are used as mineral additives. The use of these mineral fillers reduces the consumption of cement in concrete, but they are expensive, since their production and delivery require large energy and transport costs. In addition, fly ash is a man-made waste obtained from burning coal in thermal power plants, as a result of which it does not have a stable composition and properties, which certainly has a negative effect on the quality of the resulting concrete.

A concrete mixture is known that contains the following components, wt.%: cement - 17.41-18.37, crushed stone - 40.79-41.42, sand - 32.22-32.64, superplasticizer C-3 - 0.098-0.110, mineral filler - 0.96-1.91, water - the rest [3], where dusty waste from the production of asphalt concrete, formed during the heating and drying of fillers and captured by the aspiration system (finely dispersed mineral product of gas purification - TMPG), is used as a mineral filler.

The disadvantage of this composition of the concrete mixture is that the mass use of mineral filler TMPG in construction is not possible, since this mineral filler is used mainly for the preparation of asphalt concrete. In addition, the introduction of TMPG into the composition of concrete will contribute to a sharp increase in the water demand of the concrete mixture and, as a consequence, a significant decrease in the strength of the concrete.

A concrete mixture is known that contains the following components, wt.%: cement - 17.41-18.37, crushed stone - 40.79-41.42, sand - 32.22-32.64, superplasticizer C-3 - 0.098-0.110, mineral filler - crushed concrete scrap to a specific surface of 2200-2500 cm2/g - 0.96-1.91, water - the rest [4].

The disadvantage of this concrete mix composition is that obtaining a mineral filler in the form of concrete scrap crushed to a specific surface of 2200-2500 cm2/g requires significant energy costs associated with the processes of crushing and grinding solid construction waste, which will significantly reduce the efficiency of using this mineral additive in the composition of concrete. In addition, the high degree of dispersion of the mineral filler leads to a significant increase in the water demand of the concrete mix, and this, as is known, contributes to an increase in the porosity of concrete and, as a consequence, is the reason for insufficiently high strength and frost resistance of concrete. The closest in essence, i.e. the prototype of the invention is a concrete mixture containing the following components, wt.%: cement - 13.64-17.29, crushed stone - 40.84-41.16, sand - 32.00-32.43, superplasticizer C-3 - 0.049-0.054, still bottoms of the production of Na-carboxymethylcellulose (KOH) - 0.049-0.054, mineral filler - 1.91-5.81, water - the rest [5], where zeolite-containing rock crushed to a specific surface of 2500-3000 cm2/g is used as a mineral filler.

The disadvantages of the prototype are the relatively low rates of the concrete mixture hardening process, which leads to an increase in the time it takes for concrete to gain stripping strength and a decrease in the turnover of forms in the production of factory-made structures, as well as relatively low: concrete compressive strength and frost resistance of concrete. The purpose of the invention is to accelerate the hardening process of concrete mixture, increase the tensile strength and frost resistance of concrete.

2. Methodology and materials

The set goal is achieved by the fact that in the composition of the concrete mixture, including cement, crushed stone, sand, chemical additive - superplasticizer based on naphthalene sulfonates C-3, still residues of the production of Na-carboxymethyl cellulose (KOH), mineral filler and water, as a chemical additive is used superplasticizer based on polycarboxylate esters MasterGlenium ACE 430, and as a mineral filler - basalt fibers with a diameter of 17 µm and a length of 6-12 mm with the following ratio of components, wt.%:

cement	13.64 - 17.29
crushed stone	40.84 - 41.16

[a] https://orcid.org/0009-0002-5945-2565
[b] https://orcid.org/0009-0004-2390-6961
[c] https://orcid.org/0000-0003-3691-1079

sand 32.00 - 32.43
superplasticizer MasterGlenium ACE 430 0.049 - 0.054
KOH 0.049 - 0.054
mineralfiller 0.96 – 1.91
water the rest

The effect of using MasterGlenium ACE 430 as a superplasticizer in a concrete mix is that the molecules of this superplasticizer are quickly adsorbed on the surface of cement particles and promote accelerated dispersion of the latter due to electrostatic and steric repulsion forces. The molecular structure of the polymers of polycarboxylate ethers of the MasterGlenium ACE 430 superplasticizer has a significant effect on the strength of concrete at the early stages of hardening. The unique molecular structure of the MasterGlenium ACE 430 superplasticizer promotes a multiple increase in the contact surface of cement particles with water compared to the molecules of the C-3 superplasticizer, which completely cover the cement surface and prevent water from accessing them, slowing down the hydration process of the cement binder.

As a result of the effect of the MasterGlenium ACE 430 superplasticizer molecules on the cement binder particles, an earlier release of hydration heat, acceleration of hydration product formation, and, as a consequence, an earlier increase in the strength of cement concrete are observed. The introduction of basalt fiber into the concrete as a micro-reinforcing mineral additive helps to increase the resistance of concrete to deformations without destruction in the most critical period of hardening, i.e. in the first 2-6 hours after laying the concrete mix. In addition, basalt fiber in the composition of cement concrete takes on tensile stresses from external loads and significantly increases the tensile strength of concrete. The positive effect on the frost resistance of concrete when using basalt fiber should be associated with the involvement of a certain amount of air bubbles by the fiber, which allow free water in the concrete structure to expand and contract in cycles of alternate freezing and thawing.

Thus, the claimed concrete mix composition is novel and involves an inventive step, since the applicant did not find any technical solutions similar to those of the proposed invention when searching through sources of patent and scientific and technical documentation.

To experimentally verify the claimed concrete mix composition, comparative studies were conducted on two competing compositions (the prototype and the proposed composition).

According to the prototype, the concrete mix was prepared as follows. The zeolite-containing rock crushed to a specific surface area of 2500 cm2/g was mixed with cement until homogeneous for 45-60 s, after which this mixture was added to the pre-mixed crushed stone and sand. Then 2/3 of the mixing water was added to the mixer together with an aqueous solution of superplasticizer C-3 and the mixture was mixed for 60-90 s, then the remaining water was added and the final mixing of the mixture was performed.

The stated composition of the concrete mixture was prepared as follows. Basalt fibres with a diameter of 17 μm and a length of 12 mm were mixed with cement until a homogeneous state was obtained for 45-60 s, after which pre-mixed crushed stone and sand were added to this mixture. Then 2/3 of the mixing water was added to the mixer together with an aqueous solution of MasterGlenium ACE 430 superplasticizer and still water from the production of Na-carboxymethylcellulose (KOH) in the ratio (1:1) specified in the application, the mixture was mixed for 60-90 s, then the remaining water was added and the final mixing of the mixture was performed.

The following were used in the experimental studies: Portland cement grade CEM0 52.5N produced by JSC Akhangarancement (GOST 31108-2020), coarse aggregate - crushed stone of fraction 5-10 mm from the Eyvalek quarry, with an average density of 1400 kg / m3 (GOST 26633-2012), fine aggregate - river quartz sand from the May quarry with a fineness modulus Mkr = 0.68 and an average density of □2000 kg / m3 (GOST 26633-2012), basalt fiber with a diameter of 17 μm and a length of 6-12 mm produced by JV LLC MEGA INVEST INDUSTRIAL (Jizzakh region), polycarboxylate superplasticizer MasterGlenium ACE 430, produced by BASF (Germany), which is a cloudy beige liquid with a density 1.06±0.02 g/cm3, zeolite-containing rock of the Beltau deposit (Navoi region).

3. Results

The obtained concrete mixtures were used to form standard-size 15x15x15 cm cube samples in the amount of 6 pieces for compression testing. The samples were stored under normal temperature and humidity conditions for 28 days, after which they were tested for compression. (GOST 28570-90). Frost resistance of concrete was determined using the standard method according to (GOST 10060.1-95). The ratio of concrete mixture components and the obtained sample test results are given in Table 1.

Table 1

Ratio of components of concrete mixtures and obtained results of tests of concrete mixture samples and concrete specimens

Type of superplasticizer and mineral filler	Degree of cement filling, %	Concrete mix composition: numerator – kg per 1 m3 of mix, denominator – wt.%							Compressive strength, MPa			Tensile strength, MPa	Frost resistance, brand
		Cement	Filler	Sand	Crushed stone	Superplasticizer	KOH	Water	At the age of, days				
									1	3	28		
Concrete mix according to prototype													
Superplasticizer C-3, zeolite-containing rock	10	416/17,29	46/1,91	780/32,43	990/41,16	1,31/0,054	1,31/0,054	170/7,07	14,1	29,9	46,8	2,7	F200
	20	370/15,49	92/3,85	770/32,24	978/40,95	1,25/0,052	1,25/0,052	175/6,86	15,6	31,7	51,8	3,3	F200
	30	324/13,64	138/5,81	760/32,00	970/40,84	1,17/0,049	1,17/0,049	180/7,07	24,4	31,0	47,5	2,9	F200
Concrete mix on request													
Superplasticizer MasterGlenium ACE 430, basalt fiber	2	461/19,16	1,0/0,04	780/32,43	990/41,16	1,31/0,054	1,31/0,054	170/7,07	22,5	40,4	57,2	5,7	F300
	3	460/19,10	1,6/0,06	770/32,00	978/40,95	1,25/0,052	1,25/0,052	172/7,16	24,4	42,6	60,8	6,2	F300
	4	459/19,04	2,2/0,10	760/31,50	970/40,24	1,17/0,049	1,17/0,049	175/7,27	24,6	43,4	61,4	6,5	F300

4. Conclusion

The analysis of the obtained results (Table 1) shows that for the proposed composition of the concrete mix in all 3 examples there is an increase in the compressive strength of concrete compared to the composition of the concrete mix according to the prototype by 15-20%. At the same time, the increase in the strength of concrete in the early stages of hardening (1 and 3 days) also exceeds the indicators by an average of 10-15%. The tensile strength of concrete obtained according to the proposed composition exceeds the indicators of concrete according to the prototype by 1.8-2.0 times, and the frost resistance of concrete increases by 50%. In addition, the energy costs required to obtain mineral filler from zeolite-containing rocks are reduced, since grinding zeolite-containing rocks to a specific surface of 2500-3000 cm2/g requires grinding them in the most common ball mills for at least 1 hour. Thus, the proposed composition of the concrete mixture allows for the full achievement of the set goals: ensuring acceleration of the hardening process of the concrete mixture, increasing the tensile strength and frost resistance of the concrete.

References

[1] Pashchenko V.A. Factory production of reinforced concrete bridge structures. - M: Transport, 1972. - P.248.

[2] Kolokolov N.M. et al. Construction of bridges. - M: Transport, 1975. -P.100.

[3] Patent SU No. 1601298 A1, priority date 29.02.1988, publication date 23.10.1990, authors: Musokhranov V.V., Agranovich G.Yu., Cherkasov K.A., Borodkin O.A.

[4] Batrakov V.G. Modified concrete. Theory and practice. 2nd ed. - M.: 1998. – 768 p.

[5] Adylkhodzhaev A.I., Makhamataliev I.M.,Tsov V. M., Turgaev J.F.,Umarov K.S. Theoretical bases of optimization of concrete microstructure with application of the imporved of mathematical planning of experiments. International Journal of Advanced Science and Technology (IJAST), Volume-8 Issue-9S2, July 2019, ISSN 2207-6360. (Online), p. 210-219.

[6] Баженов Ю.М. Технология бетонов XXI века / Академические чтения РААСН. Новые научные направления строительного материаловедения. Часть 1. Белгород, 2005. С.9-20.

[7] Hillemeiez B., Buchenau G. ,Herr R. Spezialbeton, Betonkalander 2006/1, Ernst Sbhn, p. 534-549.

Information about the authors

Makhamataliev Irkin Muminovich	Tashkent State Transport University, Department of Construction of Buildings and Industrial Structures, Doctor of Technical Sciences, Professor. E-mail: nemat.9108@mail.ru https://orcid.org/0009-0002-5945-2565
Soy Vladimir Mikhaylovich	Tashkent State Transport University, Department of Construction of Buildings and Industrial Structures, Doctor of Technical Sciences, Professor. Tel.: +998909521576
Mukhammadiev Nematjon Rakhmatovich	Tashkent State Transport University, Department of Construction of Buildings and Industrial Structures, Candidate of Technical Sciences, Associate Professor. E-mail: nemat.9108@mail.ru,, Tel.: +998909111106 https://orcid.org/0009-0004-2390-6961
Malikov Ganisher Bakhromkulovich	Tashkent State Transport University, Department of Bridges and Tunnels, doctoral student. E-mail: ganisherm@inbox.ru Tel.: +998901893094 https://orcid.org/0000-0003-3691-1079