ON NEW METHODS FOR SELECTING THE OPTIMAL MINERAL FILLER FOR COMPOSITE CEMENT BINDER

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Abstract : The article presents the results of theoretical and experimental studies on the development of a scientifically based methodology for the appointment of plasticizing chemical additives and mineral fillers when selecting the compositions of complex-modified concretes (CMC) at the design stage. A classification of plasticizing additives is proposed based on the degree of reduction of the surface tension of water when they are introduced and the activity of mineral additives based on the reduced hydration activity index, allowing for the production of highly economical CMCs with the required property indices.

Key words: Concrete, classification of additives, modification, plasticizer, mineral filler, surface tension, adsorption centers, hydration activity

The production of the main construction component such as cement is a very energy-intensive process. Therefore, to solve problems related to saving energy resources, it is necessary to switch to modern approaches to obtaining new-generation concrete, that is, to the production of modified concrete using composite binders. The essence of this approach lies in the partial replacement of clinker, the most expensive cement component, with reactive finely dispersed mineral components of natural and man-

made origin, possessing significant chemical activity and a reserve of internal energy.

To create high-quality binder compositions, it is necessary to initially purposefully manage the production technology based on the use of reactive mineral components, the use of chemical modifiers and modern technological methods to activate their properties and conduct research on the development of the most rational binder compositions.

In this regard, the development of new effective binder compositions using finely dispersed reactive mineral additives for the production of modified concrete used in monolithic and precast-monolithic construction is a pressing task in modern construction materials science.

The processes of formation of the structure and strength of modified concretes are currently poorly studied, and the results of the study of the influence of finely dispersed reactive mineral fillers on the properties of modified concretes have not been sufficiently studied and confirm the relevance of the issues of developing optimal formulations of composite binders and concretes.

Targeted optimization of the grain composition of concrete mixtures was achieved through the use of fillers .

Analysis of the results of the authors' studies [1-3] showed that mineral fillers with adsorption centers of intensities lying in the pKA region from -4 to 7 and more than 13 contribute to the catalytic activation of cement hydration. Active centers of mineral fillers in the pKA regions from 7 to 13 contribute to the acceleration of the adsorption of water molecules from the cement paste, thereby distracting from deeper participation in chemical interactions with the binder and thereby contributing to a decrease in the rate of hydration processes in the cement binder.

Taking into account the above, we have proposed a new criterion - “the indicator of reduced hydration activity”, which, in our opinion, allows us to more accurately assess the contribution of the surface activity of mineral fillers to the course of the processes of interactions and transformations occurring in the hydratable medium.

Table 1

Content of adsorption centers on the surface of mineral fillers

No. p/p	Name of mineral filler	Number of centers, 10^3 mg-eq / m^2				General quantity centers
		-4 …0	0…7	7…12.8	> 12.8	
		R_{ol}	P_{kb}	R_{ob}	R_{kl}	
1.	Sand	8.04	9.11	8.75	1.88	27.78

	Quartz					
2.	Sand dune	4.12	7.08	9.95	1.07	22,22
3.	Gliezh	13.22	16.47	10.08	2.87	42.64
4.	Basalt	23.41	22.15	11.16	1.96	58,68
5.	Zeolite containing rock	102.08	24.88	12.62	2.14	141.72

The proposed indicator is designated by the symbol – P_{pga} and is determined by the formula:

$P_{pga} = P_{kv} + P_{kl} + 0.33\ P_{ol} - 0.1\ P_{ob}$, where (1)

R_{kv}, R_{kl}, P_{ol}, P_{ob} – the number of adsorption centers in the regions 0< pKa <7; pKa >13.0; -4< pKa <0; 7< pKa <13.0 in 10^{-3} mg-eq /g. c respectively .

This criterion, characterizing the acid-base properties of the surface of mineral fillers, allows scientifically substantiated classification of mineral fillers by the degree of their impact on cement systems. In general, the following classification of mineral fillers is proposed by the criterion P_{pga} - the indicator of the reduced hydration activity (Table 2).

Table 2

Classification of mineral fillers by the reduced hydration activity index P_{pga} .

No. p/p	Type of mineral filler	Criterion values P_{pga} .	Potential efficiency in cement systems, cement savings in %
1.	Low-active	from 0< up to . <10	Up to 10%
2.	Medium active	from 10< up to . <25	10-20%
3.	Highly active	from 25< up to <50	20-30%
4.	Super active	Over and above > 50	Up to 50%

For the mineral fillers accepted for study, the calculation of this criterion , i.e. the indicator of the reduced hydration activity, is presented in (Table 3).

Comparative analysis of mineral fillers by the criterion P_{pga} allows us to predict their efficiency in cement systems and characterize them by their degree of activity, for example: dune sand - slightly active ; quartz sand, glyage , OEP - moderately active; basalt, OMP, fly ash Angrenskoy TE S - highly active and zeolite-containing rock - super active.

Table 3

Criterion P_{pga} in mineral fillers

No. p / p	Name of mineral filler	Transformed data		Criterion $P_{pga.}$	E y, MPa
		0.33 R_{ob}	0.1 P_{ol}		
1.	Sand Quartz	2.65	0.87	12.77	200
2.	Sand dune	1.36	0.99	8.52	180
3.	Gliezh	4.36	1.01	22.39	120
4.	Basalt	7.72	1,12	30.71	290
5.	Zeolite containing rock	33.68	1.26	59.44	300

The developed Patent No. IAP 07520 allows to determine **the composition of** filled cement systems with local mineral fillers, which makes it possible to design concrete with the required physical and mechanical properties.

REFERENCE NCES

1. Adylkhodzhaev AI, **Makhamataliev** IM, Tsov VM, Turgaev JF, Umarov KS 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.

2. Bazhenov Yu.M. Concrete technology of the XXI century / Academic readings of the RAASN. New scientific directions in construction materials science. Part 1. Belgorod, 2005. P.9-20.

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

4. 4 . Adylkhodzhaev AI, Makhamataliev IM, Tsoi VM and others. Innovative materials and technologies in construction / Monograph, ed. Adylkhodzhaeva AI, T.: “Fan va technology”, 2016. – 292 p.

5. Цой, В. М., & Абдуллаева, Д. Ф. (2023). ИССЛЕДОВАНИЕ ВЛИЯНИЯ КРЕМНЕЗЕМСОДЕРЖАЩИХ ДОБАВОК НА СТРУКТУРУ КОМПОЗИЦИОННЫХ ВЯЖУЩИХ: ИССЛЕДОВАНИЕ ВЛИЯНИЯ КРЕМНЕЗЕМСОДЕРЖАЩИХ ДОБАВОК НА СТРУКТУРУ КОМПОЗИЦИОННЫХ ВЯЖУЩИХ.

6. Адилходжаев, А. И., Махаматалиев, И. М., Цой, В. М., & Шаумаров, С. С. (2019). Научно-обоснованная методика подбора добавок при

проектировании состава комплексно-модифицированных бетонов. Научно-технический вестник Брянского государственного университета, (2), 269-279.

7. Мухаммадиев, Н. Р., & Цой, В. М. (2021). ОПТИМИЗАЦИЯ СОСТАВА РЕЗИНОТЕХНИЧЕСКИХ ИЗДЕЛИЙ С ПРИМЕНЕНИЕМ СОВРЕМЕННЫХ МОДИФИКАТОРОВ В РЕСПУБЛИКЕ УЗБЕКИСТАН. In Актуальные вопросы современной науки: теория, технология, методология и практика (pp. 73-79).

8. Адилходжаев, А. И., Махаматалиев, И. М., Цой, В. М., & Шаумаров, С. С. (2019). Прогнозирование эффективности введения минеральных наполнителей в цементные композиты. Научно-технический вестник Брянского государственного университета, (1), 105-112.