INFLUENCE OF PLASTIFYING ADDITIVE ON THE GRANULOMETRIC COMPOSITION OF CEMENT

Narov R.A.
Candidate of Technical Sciences, Professor
https://doi.org/10.5281/zenodo.11401939

Abstract

Results of the study of CAFA plasticizing additive effect on grinding fineness, granulometric properties of concrete, obtained by combined grinding of the klinker with CAFA additive in a spherical mill are given in the paper.

Аннотация

Мақолада тадқиқотларнинг натижалари, САФА пластификацияловчи қўшимчаларнинг зарралари майдалаш юпқалигига, цементнинг клинкерни САФА қўшимчаси билан қўшиб шарли тегирмонда майдалаш билан олинган гранулометрик таркиби ва физик-механик хоссаларига таъсири келтирилган.

Аннотация

В статье приведены результаты иследований, влияния пластиқицирующей добавки САФА на тонкость помола, гранулометрические свойства цемента полученного совместным помолом клинкера с добавкой САФА в лабораторной шаровой мельнице.

Keywords. Plasticizing additive SAFA, adsorption, films, internal friction, grains, sedimentation analysis, clinker, grinding fineness, nodular surface, granulometric composition.

Ключевые слова. Пластифицирующая добавка САФА, адсорбция, плёнки, внутреннее трение, зерна, седиментационный анализ, клинкер, тонкость помола, узелная поверхность, гронулометрический состав.

Introduction.

The production of both assembly and prefabricated reinforced concrete structures is one of the most material, energy and labor intensive areas of the construction industry. As domestic and foreign construction experience shows, one of the promising areas for improving concrete technology and one of the real ways to increase the strength of cement in the initial stages of hardening with economical cement consumption is to increase the specific surface area of cement and use the plasticizing additive SAFA [2, 4]. Works [3] indicate the prospects of using plasticizing water-soluble resins, characterized by a complex of valuable properties, as additives to cement concrete. The effect of additives is very complex and depends on the functional composition, structure and concentration, as well as on the mineralogical composition of cement. The study of the influence of surface-active additives on cement compositions and concrete mixtures showed the effectiveness of their use to improve the granulometric composition of cement.

Main part.

In a simplified form, the mechanism of action of surfactants is their adsorption at the water-air or water-solid interface and a decrease in surface tension at the interface. It creates

thinning films on them that reduce the coefficients of internal friction between cement grains. Surfactant molecules, consisting of electrostatic charges of opposite signs, repel cement particles from each other, creating a water shell around them, preventing them from sticking together. This determines the plasticizing effect of SAFA.

As is known, the initial stages of cement hardening are significantly influenced not only by the mineralogical composition, but also by the fineness of grinding, as well as the granulometric composition. Hydration is more favorable and strength increases most intensively for cements with a certain granulometric composition. The increase in cement strength depends not only on the specific surface area of the cement, but also on its grain composition.

Previously cited studies have established [3] that the strength of cement after 1-2 days is due to the presence of a fraction less than 5-7 microns, after 7 days a fraction less than 18-22 microns, and after 28 days a fraction of 23-27 microns, and in later periods fractions greater than 40 microns.

Research to determine the effect of the amount of SAFA additive on the grinding fineness of clinker and on the granulometric composition of cement, as well as the strength properties of the resulting cement, was carried out in the laboratory of the Research Institute of Building Materials. To conduct the experiment, clinker from the Akhangaran cement plant was used. Clinker grinding was carried out in a 10 kg ball mill. Metal balls of different diameters were used for grinding. Clinker grinding was carried out with and without the introduction of additives in varying quantities, and the grinding time was the same. As previously noted, the fineness of grinding and the granulometric composition of cement is one of the main factors determining the physical and mechanical properties of cement. By introducing the SAFA additive into the mill when grinding clinker, you can increase the productivity of the grinding unit or increase the fineness of cement grinding at the same grinding time.

*In our studies, we used a plasticizing additive as a grinding intensifier.*SAFA and was introduced into the mill in the range from 0.02 to 0.2% of the ground mass. And the effect of the additive was determined by the fineness of grinding and the granulometric composition of the resulting cement. First, the influence of the additive on the increase in the fineness of cement grinding was determined at the same grinding time with different amounts of additives. The results obtained are shown in Table 1.

Table 1

Influence of the amount of SAFA additive on grinding fineness

No.	**Type of additive**	**Quantity additives, %**	**Time Grinding, min**	**Remainder on sieve 0.08, %**	**Specific surface area cm^2/g**	**Promotion productivity mills, %**
1	2	3	4	5	6	7
1	**Test**		60	8.9	2870	100
2	Safa	0.02	$\frac{60}{50}$	$\frac{4.4}{9.1}$	$\frac{3489}{2865}$	117

3	Safa	0.05	$\frac{60}{47}$	$\frac{3.8}{9.8}$	$\frac{2870}{3655}$	128
4	Safa	0.10	$\frac{60}{45}$	$\frac{3.1}{9.6}$	$\frac{2870}{3865}$	131
5	Safa	0.15	$\frac{60}{45}$	$\frac{4,1}{9,6}$	$\frac{2870}{3470}$	126
6	Safa	0.2	$\frac{60}{50}$	$\frac{4,8}{9.9}$	$\frac{2870}{3050}$	121

From Table 1 it can be seen that the greatest increase in grinding fineness is observed when 0.05 and 0.10% of the additive by weight of the clinker loaded into the mill is introduced into the mill. At the same time, the specific surface area of cement increased from 2850 to 3940 cm/g, i.e. increased by approximately 15-17% when 0.10% SAFA additive was introduced into the mill. At the same time, the grinding time was the same (60 min). The results obtained can be explained by the fact that the SAFA additive, adhering to the clinker surface, reduces the surface tension [3] and helps to reduce its hardness. From the conducted research it is clear that the maximum reduction in hardness is achieved when 0.05 and 0.10% SAFA, by weight of the ground material, is introduced into the mill. As the amount of additive increases beyond the optimum, the adsorption effect of reducing the strength of solids is known to decrease. This is apparently due to the appearance of a second adsorption layer.

As the dispersion during grinding increases, the speed of the grinding process decreases, which is associated with increased surface interactions of destructive particles. To fully characterize the resulting cement with the addition of SAFA, it is necessary to take into account its fractional composition, since, other things being equal, including the same specific surface area, the activity of cement is determined by its fractional composition.

The next stage of research was to study the effect of different amounts of the SAFA additive on the fractional composition of cement crushed to approximately the same specific surface area.

Using the method of sedimentation analysis, we determined the effect of the SAFA additive on changes in the fractional composition of cement obtained by grinding with and without additives. Table 2 shows the results of sedimentation analysis.

2-table

The influence of the amount of additive on the fractional composition of cements

No.	Additive	Amount of additive %	Specific surface cm^2/g	Fractional composition of cement microns, %						
				<80	80-60	60-40	40-20	20-10	>10	sum
1	2	3	4	5	6	7	8	9	10	eleven

1	-	-	2870	9.80	10.95	27.69	27.35	10.36	13.68	99.81
2	SAFA	0.02	2882	8.51	8.48	22.37	28.48	12.39	18.66	98.75
3	-„-	0.05	2888	7.52	5.17	19.46	31.67	14.34	20.65	99.67
4	-„-	0.10	2780	7.59	3.49	16.80	34.34	16.36	21.00	99.59
5	-„-	0.15	2875	8.7	5.31	19.30	31.71	14.8	19.85	99.71
6	-„-	0.2	2870	8.89	7.60	25.69	30.68	11.95	14.90	99.63

From the results obtained, it is clear that in the cement obtained by joint grinding of clinker with the addition of 0.10% SAFA, compared to the control, there is a decrease in the fraction of 65-75 and 35-55 microns in size by 35-40%, while a simultaneous increase in the fraction of 10 microns by 20% , fractions 10-20 microns by 35-45%, and fractions 20-40 microns by 10-12%.

Thus, research has established that the best indicator of fractional composition. The resulting cement is provided by co-grinding clinker with the addition of SAFA in an amount of 0.1% by weight of the clinker. The resulting cement was subjected to physical and mechanical tests. Normal density decreased by 4%, and water demand by 14-15%, the beginning of setting decreased by 43-48 minutes, which satisfies the physical and mechanical properties of the requirements of RST Uz - 742-96. Improving the fractional composition obviously had a positive effect on the kinetics of structure formation of cement paste, both in the early and subsequent stages of hardening.

Research was carried out to determine the strength properties of cements obtained by grinding clinker in a ball mill with and without the addition of SAFA additive. Beams 40x40x160mm were formed from solutions of normal thickness. The samples hardened for 3.7 and 28 days in a humid environment. After time, the samples were tested for bending (MI 100), and the halves of the beams were tested for compression in a 10 t press. The results obtained are shown in Table 3

table 3

Cement strength indicators,
obtained by co-grinding clinker with an additiveSAFA

No.	View supplements	Quantity input additives, %	Ultimate strength Rb,/ Rcom MPa of samples after 24 hours.		
			3	7	28
1	Test	-	3.1/33.3	4.2/44.4	5.6/48.1
2	SAFA	0.05	7.0/44.5	8.4/52.5	8.2/56.4
3	SAFA	0.10	7.2/49.4	8.8/58.1	8.3/67.6
4	SAFA	0.15	4.3/41.40	5.7/47.8	6.1/57.9

The data given in Table 3 indicate that the strength of cements obtained by co-grinding clinker with the addition of SAFA in an amount of 0.05-0.10% of the clinker weight, compared with control samples, after 3, 7 and 28 days of hardening in under normal conditions increased by 28-33%, 21-23% and 19-21%, respectively.

Conclusion.

By increasing the strength of cement samples with SAFA additives, it is possible to save 20-21% of cement in order to obtain the same strength as control samples.

References:

1.Rheological properties of concrete mixture with SAFA additive. Republican Scientific and Technical Conference with the participation of foreign scientists. Tashkent 2018
2.Recommendations for the use of chemical additives in concrete M.: Stroyizdat 1999.
3.Batrakov “Modified concrete” M.: Stroyizdat 2000.
4.Bazhenov Yu.M. Concrete technology. Publishing house of the Association of Higher Educational Institutions. M.: 2002
5.Solomatov V.I., Adylkhodzhaev A.I., Solikhov B.G. Cement concrete with fillers from waste from the production of construction materials and products. Penza. 1999
6.Narov R.A. “Research on the use of the SAFA additive as a grinding intensifier” Proceedings of the Republican Scientific and Technical Conference. Tashkent 2017.
7.Narov R.A. Rational mixtures of aggregates for concrete. Magazine "Architecture. Construction. Design" TASI 2017.
8.Narov R.A. “The influence of fillers on the shrinkage deformation of concrete. Republican scientific and technical conference with the participation of foreign scientists. Tashkent 2017.
9.Adylkhodzhaev A.I., Solomatov V.I. Fundamentals of intensive separate concrete technology. Tashkent: publishing house FAN, AN.RUz.1993.
10.Janitor L.I. Testing of concrete mortars. M. 2014.
11.Takhirov M.K., Salomatov V.I. Narov R.A. Recommendations for the use of acetone-formaldehyde resins as additives. T.1993.