INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGIES
www.journalsresearchparks.org/index.php/IJOT e-ISSN: 2615-8140|p-ISSN: 2615-7071
Volume: 02 Issue: 10 | OCT 2020

The use of ash of thermal power plants in mortar mixtures and concrete

[1]Rakhimov Shavkat Turdimurotovich, [2]Babakulova Nilufar Bahramjanovna

[1]Doctor of philosophi (PhD) on technical Sciences, Associate Professor of the Department "Technology of building materials, products and structures" Tashkent Institute of Architecture and Civil Engineering, Uzbekistan
E-mail: raximov.12081979@mail.ru
[2]Senior Lecturer of the Department "Technology of building materials, products and structures" Tashkent Institute of Architecture and Civil Engineering

---***---

Abstract - *Our research is devoted to the issue of using waste from the mining industry (waste rock sand, waste from the mining and processing of marble), the energy industry (fly ash from thermal power plants), the copper smelting industry (copper smelting slags) in the preparation of filling mixtures used for filling the worked-out space in underground mining works.*

Keywords: *filling mixtures; industrial waste; polymineral material, raw materials for construction, fly ash; copper smelting slags; developed space.*

1. INTRODUCTION

An analysis of domestic and foreign literature has shown that in recent years a new leap has taken place at ore mining facilities with backfill technologies. There is a tendency of increasing use for the preparation of hardening backfill as a binder and fillers of various wastes and by-products of the industry, first of all, mining, fuel and energy and chemical.

The use of waste is beneficial from both economic and social points of view. So, in comparison with the use of natural raw materials, the costs of exploration work, the construction and operation of quarries are excluded, the costs of fuel, energy and transport are significantly reduced, the cost of mined ore and finished products is reduced, the land occupied by dumps is reduced, the raw material base of the building materials industry is expanding as well as the issues of protecting the environment from pollution.

2. MATERIAL AND METHODS

It has been established that fly ash can be used without processing as an additive when grinding cement clinker (up to 15 % of the cement mass) without changing the properties of cement clinker; plasticizing additives for light and heavy concrete, mortars (up to 60% of the mass of cement); raw materials for the construction and strengthening of road bases (up to 20 % of the mass of cement and sand); additives in the production of clay bricks (up to 45 % of the volume of bricks); instead of sand in the production of lightweight concrete products (15-25 % of the volume of aggregates); component for the production of local binders (up to 80 % of the binder mass) grades 75-400; raw materials for mineral fertilizers and neutralization of acidic soils in agriculture [1].

Fly ash refers to polymineral materials containing, depending on the type of coal being burnt, varying amounts of a glassy phase (40-65 %), in the form of spherical particles up to 100 microns in size, dehydrated clay substances, mullite, magnesite, quartz, various calcium compounds, magnesium, sulfur. In contrast to the coal enrichment rock, coal as such is absent in TPP fly ash, and its combustible part is represented by various modifications of coke residues.

Fly ash is characterized by a different chemical composition depending on the coal deposit. It should be noted that the chemical and mineralogical compositions, as well as the structural-physical properties and the content of the combustible residue in fly ash change depending on the field of the electrostatic precipitator, in which it is taken. This explains the fact that the technological properties of fly ash, its fusible characteristics and the nature of the formation of the structure of the resulting building material will be different [2].

In the field of using the astringent properties of ash, studies were carried out by domestic and foreign scientists B.I. Nudelman, M.K. Tokhirov, U.A. Gaziev,

RESEARCH PARKS

INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGIES

www.journalsresearchparks.org/index.php/IJOT e- ISSN: 2615-8140|p-ISSN: 2615-7071

Volume: 02 Issue: 10 | OCT 2020

P.P. Budnikov, P.I. Bazhenov, Yu.M. Butom, Yu.Burov S., Kinas V.Z., Popov N.A. and others. The first qualification of fuel slag and ash based on the type of source coal was proposed by N.A. Popov [3]. Hydration products are: low-basic hydrosilicate CSH (B) as a result of a decrease in the concentration of lime in solution, hydrogenite, monosulfate $3CaO \cdot Al_2O_3 \cdot 12H_2O$.

Along with these main new formations in ash binders, depending on the hardening conditions, the following characteristic formations of the crystalline phase are observed: under normal hardening conditions, gelsagonal hydroaluminates and hydrosulfoaluminates, during steaming, the beginning of the formation of hydrogen garnets, and during autoclave treatment, an increase in the amount of hydrogen garnets.

3. RESULTS

Table-1 shows the chemical compositions of the ashes of the main coal basins, which are most used in construction or tested for this purpose. The presented set of ashes from different coal basins can be considered as consisting of two classes. The first class includes ashes that, when mixed with water, harden into a stone-like body. To the second class, which harden when mixed with water, but in the presence of lime, i.e. showing the properties of pozzolans.

Table 1. Sol chemical compositions of major coal basins

№	Name of thermal power plants	P.P.P	Content,% for calcined substances						
			SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Na_2O+K_2O
1	Irkutsk (Angarsk)	5,0	60,5	20,7	5,4	6,4	1,20	0,2	0,11
2	Krasnoyarsk	1,02	44,2	9,98	12,54	27,71	4,30	0,95	0,32
3	Nizhny Tagil	0,69	53,95	24,25	11,66	3,25	3,15	0,90	1,7
4	Novosibirsk	15,52	56,61	23,62	6,93	7,05	1,94	0,42	3,04
5	Stupinskaya	1,34	47,35	34,2	13,5	1,72	1,84	0,40	-
6	Syzran	2,7	42,16	13,6	6,28	28,32	2,53	5,82	2,0
7	Sredneuralskaya (Ekibazstuz coal)	5,35	57,66	33,18	3,20	0,62	0,30	0,13	0,19
8	Tom-Ustinskaya	11,78	59,60	22,4	10,27	5,34	1,08	0,22	0,19
9	South Kuzbass	9,15	55,51	31,04	5,73	4,24	1,21	0,44	1,83
10	Irsha-Borodinskaya (Kansk-Achinsk coal)	2,3	47,0	13,0	8,1	25,4	5,2	0,83	0,4
11	Angren	3,7	35,80	18,45	15,30	18,30	4,15	3,80	0,5

the strength of the cement stone by 22-Studies of the influence of lime and PAF additives on the strength of ash-cement compositions allowed the author to establish the optimal dosage limits: lime 5-6 %, ACF, FESMAL and SDB-M-0.3 % of the ash-cement mass. The introduction of these additives provides an increase in the strength of the cement stone by 22-30 %, and the ash-cement composition by 25-34 %. Therefore, in our opinion, it is rational to use the ash obtained at Angrenskaya SDPP as an additive to mortars and concretes in order to save binder and partially replace small aggregates.

Research carried out by scientists on fly ash at the Angrenskaya SDPP is of considerable interest to us. In the works [4] Tokhirov M.K., Kasimov I.K. etc., it is recommended to use fly ash in concrete to replace part of the cement in an amount of no more than 10-15%. This improves the workability of the concrete mix, reduces shrinkage and heat generation during concrete hardening. At the same time, ash slows down the process of concrete hardening in the initial period, reduces water permeability and frost resistance.

But the introduction of a plasticizing air-entraining additive based on a water-soluble SAFA resin made it possible to accelerate the hardening of concrete. The fly ash of the Angrenskaya SDPP with a dispersion of 3500 cm^2/g was used as a mineral additive, and its amount varied from 20 to 40 %. High dispersion of ash, fusion of particles of different granulometry have a positive effect on the workability of the concrete mixture, especially with a low consumption of binder. The combined use of active mineral and plasticizing-air-entraining additives provides up to 30% savings in cement in concretes of grades 200-400 without impairing the workability and strength of concrete. At the same time, frost resistance increases up to 200 cycles, which is a consequence of the concrete air content increased by 3-4 %.

4. DISCUSSION

Makhamadaliev I.M. [5] used fly ash from Novoangrenskaya SDPP with Ssp.=300 m^2/kg as a filler when receiving concrete mixtures on an activated cement binder. The additives to the cement were superplasticizer S-3, LST, KZhN — the bottoms liquid of sodium carboxymethyl cellulose production and SVK — concentrated feedstock runoff at Electrokhim. He established the features of hydration of a filled cement binder with MNZ - a modified ash filler and that it is possible to obtain an ash-cement binder with a 28-50 % decrease in cement consumption and low water demand, all this makes it possible to obtain an ash-cement stone with increased structural and mechanical characteristics due to the use of MNZ and high-speed mixing.

Studies of the influence of lime and PAF additives on the stre

Analysis of domestic and foreign literature on the use of ash from thermal power plants allows us to conclude that most of the works are devoted to the production of ash-cement compositions with the

www.journalsresearchparks.org/index.php/IJOT e-ISSN: 2615-8140|p-ISSN: 2615-7071

Volume: 02 Issue: 10 | OCT 2020

introduction of a large range of chemical additives, using high-speed mixing or rotary-pulsating devices for preparing various types of concrete.

Development of optimal compositions of filling mixtures was carried out by calculation-experimental method based on the data of the mathematical planning method, with further refinement in the manufacture of test mixes of filling mixtures under laboratory conditions with testing of the actual rheological and physico-mechanical properties of mixtures and hardened samples (Table 2).

Table 2. Optimal compositions and physicomechanical properties of filling mixtures based on superplasticizer

Composition numbers	Amount of materials per $1m^3$ of mixture, kg							The mobility of the mixture cm	The density of the mixture kg/m^3	Average compressive strength, MPa (in a day)		
	Portland cement	Fly ash	Copper smelting slag	Empty rock sand	Sand based мраморных	Water	The number of "FREM C-3" compared			7	28	60
1	160	40	-	1200	400	242	4,0	11-12	1845	5,28	8,94	10,85
2	128	32	-	1200	400	238	3,2		1804	3,46	6,18	9,22
3	120	30	-	1200	400	236	3,0		1793	3,36	5,56	7,44
4	96	24	-	1200	400	230	2,4		1762	2,38	4,84	6,65
5	80	20	-	1200	400	226	2,0		1738	2,15	3,42	4,32
6	64	16	-	1200	400	222	1,6		1719	1,13	1,87	2,47
7	160	-	40	1200	400	238	4,0		1838	5,16	8,16	10,28
8	128	-	32	1200	400	234	3,2		1802	3,29	5,86	8,96
9	120	-	30	1200	400	230	3,0		1782	3,18	5,29	6,45
10	96	-	24	1200	400	228	2,4		1762	2,16	4,26	6,21
11	80	-	20	1200	400	224	2,0		1733	1,95	3,17	3,94
12	64	-	16	1200	400	218	1,6		1710	1,06	1,79	2,38

5. CONCLUSION

We use ash-cement compositions for filling mixtures that differ from concretes in different physical and mechanical characteristics (strength, mobility, etc.), as well as in the operating conditions of filling massifs, we consider topical issues of research on the use of waste rock sand, marble processing waste, fly ash , slags of copper-smelting production, Portland cement and superplasticizer for obtaining filling mixtures used in underground operations in the extraction of minerals [6]. The scientific and technical level of the study is characterized by the patent of the Agency for Intellectual Property of the Republic of Uzbekistan IAP 06006 and IAP 06046.

REFERENCES:

[1] Volzhensky A.V. Concrete and products from slag and ash materials / A.V. Volzhensky, Yu.S. Burov, B.N. Vinogradov, K.V. Smooth. M .: Stroyizdat, 1969, pp. 389-392.

[2] Ivanov I.A. Light concrete based on ash from power plants / I.A. Ivanov. M .: Stroyizdat, 1986, pp. 42-47.

[3] Popov N.A. About rational ways of complex use of power plant ash / N.A. Popov, I.A. Ivanov J. M .: Building materials, No. 8, 1963.

[4] Shah Taher Muhammad. Gold concrete with SAFA / Shah Taher Muhammad, I.K. Kasimov, M.K. Tokhirov Zh. T .: Architecture and construction of Uzbekistan, 1984, No. 5.

[5] Makhamadaliev I.M. Concretes on activated binder and ash filler / I.M. Makhamadaliev. Author's abstract of the dissertation of the candidate of technical sciences, Tashkent, 1993.

[6] Rakhimov Sh.T. Development of optimal compositions, research of physical and technical properties, durability and effectiveness of filling mixtures based on industrial wastes // Abstract of the dissertation of the Doctor of Philosophy (PhD) in technical sciences, Tashkent, 2019. -10-12 P.