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INTERNATIONAL JOURNAL
EIJMRMS
Next Scientists
European International Journal of Multidisciplinary Research and Management Studies
SJIF 5.954 2022

EUROPEAN INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND MANAGEMENT STUDIES
ISSN: 2750-8587
DOI: https://doi.org/10.55640/eijmrms-02-12-58
https://eipublication.com/index.php/eijmrms
Volume: 02 Issue: 12 December 2022
Published Date: - 23-12-2022

Page No.-274-280

IMPROVING THE EFFICIENCY OF INDUSTRIAL WASTE PROCESSING

Yo'Ldasheva Muhayyo Alisher Qizi

Fergana Polytechnic Institute, Uzbekistan

ABSTRACT: - This article is about optimizing the composition of filler mixtures obtained using industrial waste, portland cement and superplasticizer, researching the formation of structure, properties and efficiency.

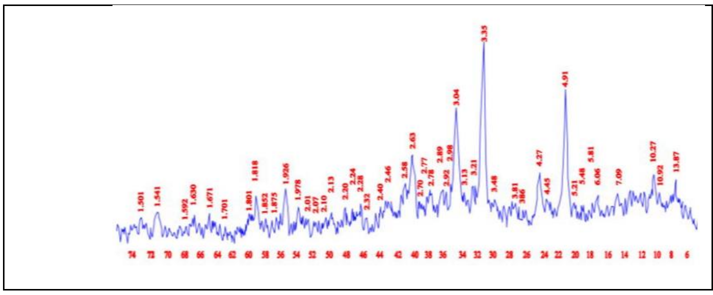
KEYWORDS: Industrial waste, filler, mixture, sand, marble, connective compositions, portland cement.

INTRODUCTION

In this, the composition and properties of the filling mixtures obtained from the waste generated in various industries were analyzed, the expansion of the raw material base in the extraction of mixtures and the mining industry (sand based on loose rocks, marble processing waste), fuel and energy industry (thermal power plant fly ash), solutions to the problems of reuse of copper smelting industry waste (copper smelting rock) and methods of increasing the efficiency and plasticity of filler compounds are presented. The analysis of the state of production of filling mixtures showed that the use of traditional calcium binders, including portland cement, does not allow the production of filling mixtures that fully meet the necessary requirements. The proposed methods for improving the physical and mechanical properties of mixtures are associated with the use of binders in large quantities, the use of natural resources and technological methods, and require additional labor costs and energy consumption. Therefore, the scope of scientific research aimed at the use of local raw materials and various industrial wastes in order to reduce costs and improve product quality in the field of production of filling mixtures used for filling mountain voids by material scientists and specialists is increasing.

Main part

Descriptions of the starting raw materials of multi-component fillers, methods of selected experimental studies and information on improving the properties and technology of cuperplasticizer fillers are presented. As initial raw materials, sand based on loose rock and marble processing waste, copper smelting stone, fly ash, portland cement and superplasticizer "FREM C-3" were used in the research. As a result of the study of the properties of the initial raw materials, it was found that: New Angren ThPS (Thermal Power Station) electrofilter ash is a finely dispersed material with a specific surface area of 4500 cm2 /g. Copper smelting rock consists of quartz, calcite, hydromica, quartzite with different mineralogical activity. Marble processing waste is used as sand, mineralogically composed of quartz, calcite, pyrite, chlorite, albite, hydromica and dolomite. The bulk modulus of the sand crushed from loose rocks was My=3.3-3.5. 400 brand Portland cement produced at the Bekobod cement factory was used in the research work. Chemical additive superplasticizer - "FREM C-3" increased the plasticity and strength of the filling mixture, reduced the water-cement ratio. The water solubility of FREM S-3 superplasticizer improved the adsorption of these additive macromolecules on Portland cement, ash and stone particles. Standardized methods as well as modern physic-chemical analysis methods were used in the experimental studies. In particular, infrared-spectroscopy and electron microscope analysis were used to study the structure of the filler mixture. The IRAffinity-1 spectrophotometer of the SHIMADZU Company and the EVO MA10 Carl Zeiss electron-scanning microscope of the OXFORD INSTRUMENTS company were used for this. In addition, the research used a mathematical method of planning experiments to optimize the composition of the filler mixture. The possibilities of "cement-ash" and "cement-rock" binders are opened to eliminate the shortcomings of cement-based filling mixtures. The hydration products of these binders differ from the hydration products of portland cement. The study of the formation of the structure resulting from the interaction of Portland cement and fly ash (active mineral additive), copper smelting rock, loose rocks and sand based on marble processing waste, and a chemical additive in the composition of the mixture was carried out using the above research methods. In order to determine the process of structure formation in the filling mixtures based on cement, "cement-ash-superplasticizer" and "cement-stone-superplasticizer" binding compositions, samples stored under normal hardening conditions for 28 days at a temperature of 20 0C with a relative humidity of 95% were studied and X-ray phase analysis was performed (see Figures 1, 2, 3).



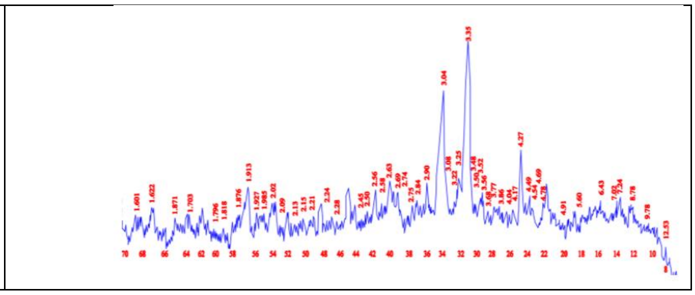


Figure 1. Radiograph of control, Portland cement (28 days) hardened filling mixture	Figure 2. X-ray image of the hardened filling mixture (28 days) with the optimal composition, "cementul-superplasticizer"

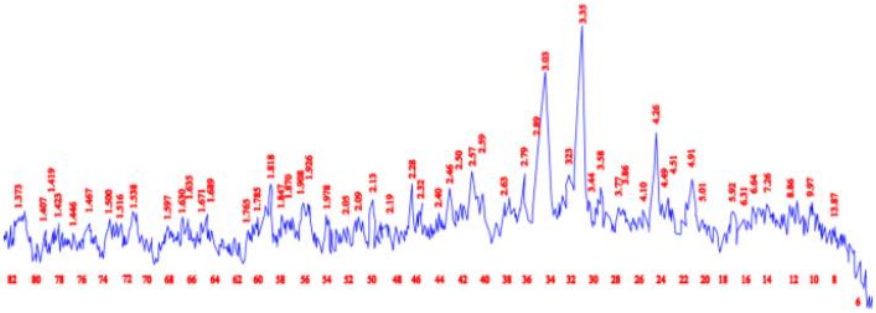


Figure 3. X-ray image of a hardened filling mixture (28 days) consisting of "cement aggregate-superplasticizer" with optimal composition

Based on X-ray analysis of a sample taken from a control, portland cement (28-day) hardened backfill mixture, quartz (d=4.27; 3.35; 2.46; 1.818 Å), calcite (d=3.86; 3.04; 2.28 and 1.875 Å), plagioclase (d =3.71 Å), portlandite (d=4.91; 2.63; 1.926 Å), bassanite (d=6.06; 2.98; 2.77 Å), hydromica (d=10.27; 4.45 Å), β-Sa2SiO4 (d=2.78; 2.63 ; 2.20 and 1.978 Å), plumberite (d=5.48; 2.07; 1.67 Å), calcium hydrosilicate (d=2.89 Å) minerals were found. Based on the X-ray analysis of the cement-ash-superplasticizer (cement-ash-superplasticizer) hardened filler mixture (see Fig. 2), quartz (d=4.27; 3.35; 1.818; 1.543 Å), calcite (d=3.86 ; 3.04; 2.28; 1.913; 1.876 Å), dolomite (d=2.90; 2.02 Å), plagioclase (anorthite) (d=4.04; 3.68; 3.22 Å), calcium feldspar (d=3.77; 3.25; 2.15 Å), presence of hydromica (d=9.78; 4.49 Å) minerals, as well as portlandite (d=4.91; 2.63; 1.927 Å), tetracalcium aluminoferrite (d=7.24; 2.78; 2.63 and 1.93 Å), calcium hydrosilicate (d=7.02; 2.56 Å)), it was found that small basic hydrosilicates such as gillebrandite-2SaO•SiO2•H2O (d=12.53; 4.78; 2.90 Å) were formed. Based on the X-ray analysis of the hardened filler mixture (see Fig. 3) consisting of "cement-stone-superplasticizer" (28 sut.) with optimal composition, quartz (d=4.26; 3.35; 1.818; 1.538 Å), calcite (d= 3.86; 3.03; 2.28 and 1.870 Å), presence of calcium feldspar (d=3.77; 3.23 Å), dolomite (d=2.89 Å) minerals, portlandite (d=4.91; 2.63; 1.926 Å), hydrosilicate (d= 9.97; 5.01 and 4.50 Å), Sa2SiO4 (d=2.79; 2.62; 2.19 and 1.978 Å), bassanite (d=5.92; 2.98; 2.79 Å), gillebrandite (d=6.64; 5.92; 4.43; 2.89 Å), calcium hydrosilicate It was found that new minerals of hydrosilicates such as aluminate-CaAl2 •Si2O10•3H2O (d=10.89; 2.63 Å) were formed. Infrared-spectroscopy analyzes of control and optimal composition filler mixture samples hardened for 28 days were conducted and their main mineral constituents were determined. Solidified filler mixture samples are distinguished by the incompleteness of the hydration process and the variable components of the solidification products, where spent ash and unhydrated cement clinker are the cementing agent. Differential-thermal analyzes of control and optimal composition hardened (28 days) filling mixture samples were carried out, the behavior of minerals in the mixture and the formation of new minerals under the influence of endothermic and exothermic effects in the temperature range of 60-900 0C were determined.

It was concluded that the behavior of the control and optimal composition samples under the influence of heating depends on their composition, the method of obtaining the products, the nature of the included components and the conditions of preparation of the samples. The increase in thermal stability was as follows: control (17.16%), "cement-ash-superplasticizer" sample (16.52%), "cement-stone-superplasticizer" sample (11.44%)). Hardening of cement-ash filling mixtures is explained on the basis of hydration of calcium oxide, anhydrite and the interaction of the indicated products with ash crystals hydrolyzable in an alkaline medium and amorphous clay substances. From the results of X-ray phase, infrared-spectroscopy and differential-thermal analyzes of the control and optimal composition hardened filler mixture samples, it was determined that the samples obtained with the optimal composition are better than the control samples, because the optimal composition contains more quartz, calcite minerals, and ettringite during the initial solidification. mineral, and hydration products such as portlandite, calcium hydrosilicate and calcium tetracarbonate hydroaluminate were formed. These newly formed minerals increase the strength and durability of the filling compound. The amount of bound water in the "cement-ash-superplasticizer" mixture was 16.5% during the 28-day hardening period. As a result, the ash slowed down the hydration process in the mixture, and caused the formation of a "clinker fund", which ensured that the mixture continued the hydration process during the next solidification period. Due to the interaction of the main components in the hydration of the binders over time, it was found that the strength of the filler mixture increases. As a result of the inclusion of ash and rock in the composition of the mixture, the number of newly formed minerals during the hydration process increased, as a result, the strength of the hardened filler mixture increased over time. Thus, during the solidification of filler mixtures under normal conditions, hydration of calcium oxide (CaO) of ash, hydration of portland cement minerals, interaction of amorphous clay substance of ash with calcium hydroxide, and carbonization of the cementing composition took place. The presence of a large amount of calcium oxide (CaO) in the used dry fly ash sample cannot completely convert to Ca(OH)2 during the solidification period of the mixture, which serves as a reserve for increasing the strength of the backfill mixture over time. In the tests carried out on the samples taken from the filling mixture, the change in strength during 7, 28, 60, 90 and 180 days confirmed this hypothesis.

CONCLUSION

Through the mathematical method of planning experiments, it was proposed that the strength of filler mixtures depends on the amount of components in it. On the basis of the established law, an optimization model was developed, which envisages reducing the binder consumption and ensuring the relationship between the composition and properties of the mixture. By using it, the optimal composition of filling mixtures consisting of "cement-ash and superplasticizer", "cement-copper smelting stone-superplasticizer" with a density of 1710-1845 kg/m3 and a 28-day strength of 1.79-8.94 MPa was developed. By determining the coefficient of tolerance of the composition of the studied filler compounds in various aggressive environments, they showed their tolerance and durability. The inclusion of "FREM C-3" superplasticizer increased the resistance of the filler mixture to aggressive environments. The water and moisture hardening strength of samples with 20% fly ash and 2% superplasticizer added to Portland cement continuously increased, which was caused by the active interaction of ash with Ca(OH)2. The results of our research show that composite binders based on fly ash and copper smelting stone, as well as "FREM C-3" superplasticizer, increased the water and moisture resistance of the filling mixtures.

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