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SELECTION OF INITIAL CHARGE MATERIALS FOR MUD PROTECTION STRUCTURES

Abstract. In this article we consider the selection of initial charge materials for structures of mud protection structures. To study the development of the optimal content of the composite material used to erect a protective structure, it is necessary to determine their physicochemical properties of the starting charge materials. As initial charge materials in the form of fillers, the use of Karaganda steel melting slag waste from Arcelor Mittal Temirtau JSC plant, granulated electrothermophosphor slag of Novo Zhambul Phosphor Plant, and mineral wool as micro-reinforcement are proposed.The waste of slate-pipe production and Portland cement of M300 grade are used as binders.X-ray phase analysis of samples of electrothermophosphor slag and steel-smelting slag was carried out on a DRON-3 instrument in the angular interval 8-640.

Key words: Electrothermophosphor slag, steel-smelting slag, composite material, mud protection structures.

Introduction. In modern conditions, when the activation of dangerous geological processes is influenced by human economic activity as well as natural factors, the problem of implementing effective protective measures and structures with the current degree of development of mountainous and foothill areas acquires a mass significance for the state.Dangerous geological and natural processes determine the conditions for economic development of the areas, as intensive development causes serious difficulties for the construction and operation of various structures; therefore, it requires taking preventive protective measures.

The development of a general line in the implementation of engineering protective measures and facilities without an analysis of the current conditions of the protection systems is impossible [1].

The bulk of the constructed facilities on the territory of the Republic of Kazakhstan played a positive role in reducing damage during the passage of debris flows and is ready to fulfill its functions in the future.

A number of facilities have been destroyed as a result of extreme situations of natural disasters, such as mudflows, avalanches, landslides which can be an example of the inefficient design solutions. Part of it fell into disrepair due to inadequate ongoing and major repairs during operation.The imperfection of protective structures and the fragility of their functioning is largely determined by the lack of the necessary regulatory framework for their design, construction and operation.

Methods of research. To study the development of the optimal content of the composite material used to erect a protective structure, it is necessary to determine their physicochemical properties of the starting charge materials.As initial charge materials in the form of fillers, the use of Karaganda steel melting slag waste from Arcelor Mittal Temirtau JSC plant, granulated electrothermophosphor slag of Novo Zhambul Phosphor Plant, and mineral wool as micro-reinforcement are proposed.The waste of slate-pipe production and Portland cement of M300 grade are used as binders.

Chemical content of Portland cement in% of mass:Al_2O_3 – 4.00, Fe_2O_3 – 4.04 CaO -65.70, MgO – 1.93. SO_3 -2.5, SiO_2-21.50. Chemical composition of mineral wool wastes, in% by weight:Al_2O_3 – 9.7, Fe_2O_3 -1.6, CaO – 39.0, MgO – 2.2, SO_3-0.9, SiO_2-45.80.Chemical composition of waste of slate-pipe production, in% of mass:Al_2O_3 -3.85, Fe_2O_3-4.145, CaO -50.0, MgO – 53.5, SO_3-1.65, SiO_2-20.80.

Physico-chemical analysis of slags in the scanning electron microscope ISM-6490LV. Chemical content of steelmaking slag (Karaganda city), in% of mass:Na - 0.83, Na_2O -1.12, Mg -5.25, MgO - 8.70, Al - 5.59, Al_2O_3 - 10.56, Si – 15.40, SiO_2 - 32.95, S - 1.32, K - 0.89, K_2O – 1.07, Ca – 28.21, CaO – 1.07, Ti – 0.55, TiO_2 – 0.91, Mn – 0.46, MnO – 0.60, Fe – 0.81, Fe_2O_3 – 1.15, Ni – 0.22, NiO – 0.27, O – 40.47.

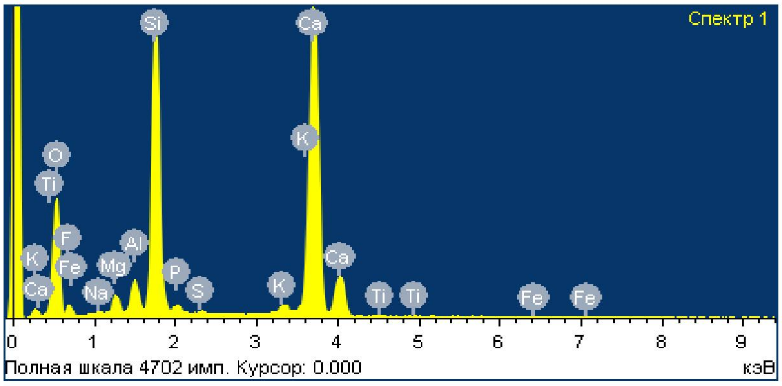
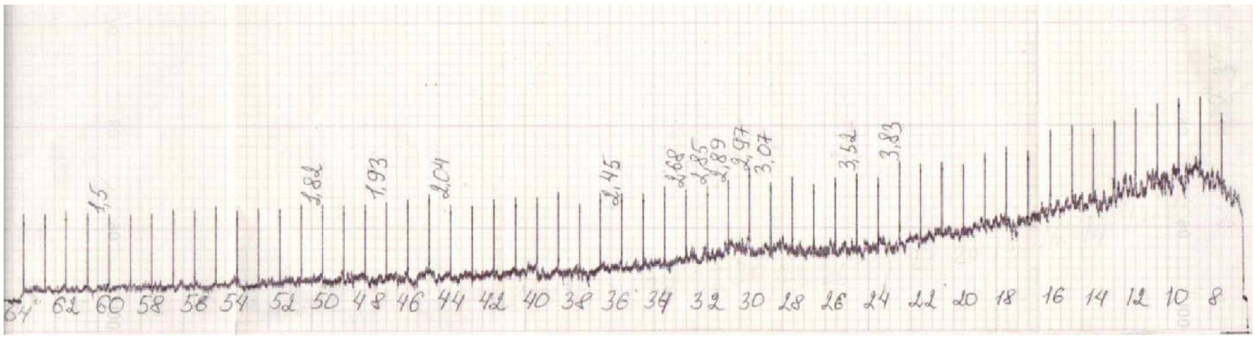


Figure 1 - Spectral analysis of steelmaking slag (Karaganda city).

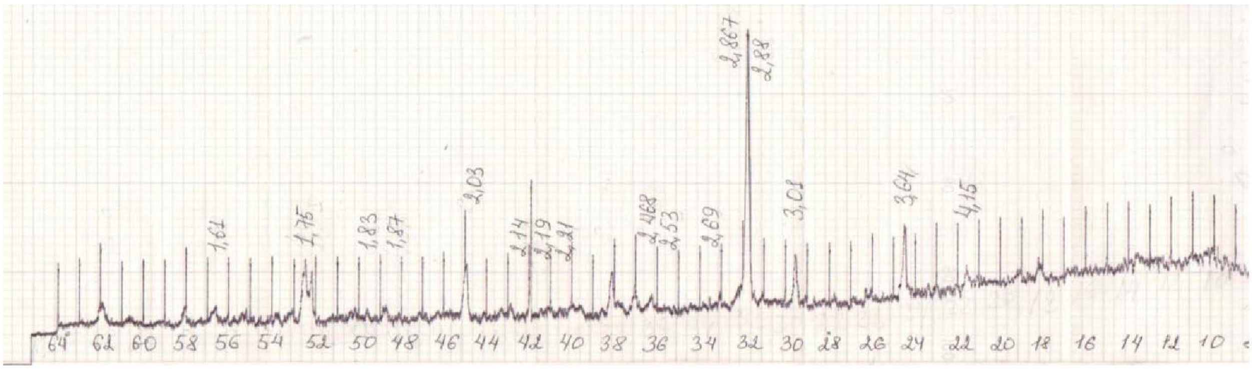
Chemical composition of electrothermophosphor slag (Taraz city), in% of mass:F – 4.83, Na – 0.31, Na_2O – 0.42, Mg – 1.47, MgO – 2.44, Al – 2.14, Al_2O_3 – 4.04, Si – 17.69, SiO_2 – 37.84, P-0.64, P_2O_5 – 1.47, S – 0.22, K – 0.84, K_2O – 1.01, Ca – 33.53, CaO – 46.91, Ti – 0.09, TiO_2 – 0.14, Fe – 0.28, Fe_2O_3 – 0.40, O -37.97.X-ray phase analysis of samples of electrothermophosphor slag and steel-smelting slag was carried out on a DRON-3 instrument in the angular interval 8-640.

The diffractogram of electrothermophosphor slag shows that the sample has mainly a vitreous phase. The components of the crystalline phase are calcium pyrosilicate $Ca_3Si_2O_7$ with values of interplanar distances$\frac{d}{n}$ = 2.89-2.68-3.07A^0 and calcium metasilicate $CaSiO_3$ c$\frac{d}{n}$ = 2.97-3.83-3.52A^0. In small amounts melilite of variable composition is present from 2CaO • Al_2O_3 • SiO_2 to 2CaO • Mg • $2SiO_2$ with values of interplanar distances $\frac{d}{n}$= 3.07-2.85-2.45-2.04-1.93-1.82-1, 51A^0.



The presence of merwinite (3CaO • MgO • $2SiO_2$) with analytical lines$\frac{d}{n}$ = 2,867-2,69-2,21-2,03-1,87A^0 was established on the diffractogram of the steel-smelting slag. The intensity of the diffraction maxima c$\frac{d}{n}$ = 4.15-3.64-2.88-2.69-2.53-1.83A^0 indicates the presence of monticellite (CaO • MgO • SiO_2) also in the sample there is an iron-containing phase-wustite (FeO) with values of interplanar distances$\frac{d}{n}$ = 2.14 - 2.468 - 1.51A^0.

The results of the physical-chemical and X-ray-phase analyzes made it possible to recommend the optimal content for composite materials production, which has a low cost for use in the construction industry and waste disposal in industry.A composite content of composite material including Portland cement, waste of mineral wool and slate-pipe production, electrothermal phosphorus slags and steelmaking slags was developed.



Results of the study. On the basis of an analytical review of domestic and foreign literature and patent sources, research tasks have been carried out to develop more robust composite materials for the production of mud protection structures.

To propose for discussion in the Ministry of Emergency Situations of the Republic of Kazakhstan "Kazselezashchita" the results of the study, in order toallocate funding for carrying out after a detailed study and obtaining a sample of a mud protection structure, as well as testing its model shape in conditions close to real.

The discussion of the results. The most difficult task for science in the field of engineering protection of territories is how to predict the approach of danger and what measures to take to reduce the risk of natural disasters. With a scientifically substantiated approach to solving these problems, it is possible to save huge material resources, improve the ecology, and, most importantly, preserve people's lives.

Conclusions. Dangerous natural processes of exogenous origin of mud flows are widespread in the mountainous regions of Kazakhstan, occupying about 10% of its territory. About one-fourth of the republic's population lives in areas that are more or less susceptible to the effects of dangerous processes, and about a third of its economic potential is concentrated.

At present, the natural risk caused by the manifestations of dangerous processes exceeds the acceptable level. The existing system of measures to prevent damage is not entirely adequate to threats. The schemes of protection of territories from dangerous processes developed in the 1980s have not been fully implemented and are now largely outdated. This is due, on the one hand, to the appearance of more progressive methods of protection, on the other hand, with the appearance within the zones of exposure of dangerous processes of new economic objects, often erected without regard for natural hazards.

General schemes for protecting the population and territories from hazardous natural processes should include the full range of protective measures, not limited to, as was the case in the schemes of the last century, only engineering facilities.

The results of the conducted experiments and industrial tests made it possible to recommend the optimal composition for the production of strong bending mud protection structures, which has a low cost for use in the construction industry. Resource-saving and energy-saving technologies were developed with the use of production wastes, phosphorus, steel, mineral wool and slate-pipe production.

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СЕЛДЕН ҚОРҒАЙТЫН ҚОРҒАНЫС ҚҰРЫЛЫМДАРЫ ҮШІН БАСТАПҚЫ ШИКІЗАТТАРДЫ ТАҢДАУ

Аннотация: Бұл мақалада селден қорғайтын қорғаныс құрылымдарын үшін бастапқы шикізаттарды таңдау қарастырылған. Қорғаныс құрылымын тұрғызуға арналған композициялық материалдың оңтайлы құрамының зерттеу үшін, бастапқы шикізаттардың физикалық-химиялық қасиеттерін анықтау қажет. Бастапқы шикізаттар ретінде Қарағанды қаласындағы АҚ «Арселор Миттал Темиртау» зауытының болат балқыту қалдығының шлагы, Жаңа жамбыл фосфор зауыты қалдықтарының электро термофосфорлы шлагы және микро күшейту ретінде минералды мақта алынды. Сонымен қатар тұтқыштар ретінде шиферлі-құбыр өндірісінің қалдықтары мен М300 маркалы портландцемент қолданылды. Электротермофосфорлы және болат балқыма шлактарының рентгено-фазалық талдауы ДРОН-3 құралында 8-64^0 бұрыштар арақашықтығында интервалында) жасалынды.

Түйін сөздер: Электротермофосфорлы шлак, болат балқыма шлак, композициялық материал, селден қорғайтын қорғаныс құрылымдары.

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ПОДБОР ИСХОДНЫХ ШИХТОВЫХ МАТЕРИАЛОВ ДЛЯ СЕЛЕЗАЩИТНЫХ КОНСТРУКЦИЙ

Аннотация. В данной статье рассматриваются подбор исходных шихтовых материалов для конструкций селезащитных сооружений. Для изучения разработкиоптимального состава композиционного материала, применяемого для возведения защитных сооружении требует необходимости определения их физико-химических свойств исходных шихтовых материалов. В качестве исходных шихтовых материалов в виде заполнителей предлогается применение отходов Карагандинского сталеплавильного шлака завода АО «Арселор Миттал Темиртау», гранулированный электротермофосфорный шлак Ново Джамбулского Фосфорного завода, а минеральная вата как микроармирование. Отход шиферно-трубного производства и портландцемент марки М300 применямые как вяжущие. Исследован рентгено-фазовый анализ образцов электротермофосфорного шлака и сталеплавильного шлака проводился на приборе ДРОН-3 в интервале углов 8-64^0.

Ключевые слова: Электротермофосфорный шлак, сталеплавильный шлак, композиционный материал, селезащитные конструкции.