APPLICATION OF ADDITIVE PFM-NLK IN SLAG-CONCRETE ON THE WASTE OF THE NERJUNGRINSKY STATE DISTRICT POWER STATION REPUBLICS SAKHAS (YAKUTIA)

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According to the development plan of South Yakutsk up to 2013, various construction materials will be required, therefore, an urgent need for a qualitative, quick-constructing, and, at the same time, affordable dwellings, as well as low storage building arises. Considering the modern economic condition in the country and republic, it becomes necessary to receive cheap construction materials, particularly concrete wall stones, on local aggregates [1].

Ashes and slag of burning solid fuels (coal of different types, flammable shales, peat) at thermal power stations (TPS) occupy one of the leading positions in volumes of industrial waste. Annual output of ashes and slag exceeds 1 million tons at many TPSs and reaches 5 million tons at power stations that burn multi-ash fuel.

It is known that ashes and slags can be processed into almost any constructing material, items, or constructions, necessary while constructing dwellings and industrial buildings, agricultural objects, roads, hydrotechnical constructions, etc. Nevertheless, the volume of used ashed and slags from TPSs in building remains insignificant – app. 3 % of their annual output [2, 3].

A necessity to use ashes and slags is defined not only by economical concepts, but also by important requirements towards environmental protection. A replacement of natural raw materials by ashes and slags would provide for protecting subsoils. Removing ash and slag discharge will have a positive effect on atmospheric air, as, when distributed by wind over large areas, they impact environment and people's health negatively.

Most of the country's regions search for a possibility to transfer to cheaper local construction materials in order to decrease costs of construction. This article studies implementation of slag from Neryungrinskaya State Regional Power Station and other boilers, sifting granite fraction down to 5 mm, as aggregates of producing cement wall stones that can allow to decrease costs of low-level construction.

In order to decrease consumption of cement we suggest using poly-functional modifier of concrete PFM-NLK. In its consuming characteristics, addition of PFM-NLK according to specification 2493-010-04786546-2001, dd. 01.06.2001 corresponds to the requirements of GOST 24211 «Additions for concrete and construction solutions. General technical conditions». It refers to the type of plasticizing – water-reducing additions that increase solidity, placeability, and frost-stableness, does not carry corrosion activity towards steel carcass in concrete. First recommendations to use this addition were developed by specialists of Yakut State Project Scientific-Research institute of Building, State Utility Enterprise Scientific-Research Institute of Iron and Concrete. Ist is a mix of components that are combined in optimal proportions: superplasticizing agent S-3 («POLYPLAST SP-1»), technical lignosulphonate (TLS), hydrophobizing silicone liquid GKZH-10(11) [4].

This article provides the composition of concrete at local aggregates of concrete wall stones with implementation of the addition PFM-NLK and without it in order to decrease their cost.

The main objective of this work is to receive solidity characteristics of concrete samples with addition of PFM-NLK and without it at age of 7 and 28 days, and define optimal compositions of concrete and wall stones, used in low-level construction at lower cost.

All materials, used as aggregates in production of slag-concrete wall stones, were tested according to the requirements of GOST. According to the scheme of developing construction material industry in South Yakutiya, there are 8 deposits of building stone in Neryungrinskiy region. Deposit «Granitnoe», located near the town of Neryungri, is in industrial processing.

Sand from siftings of fraction is a non-organic loose material with grain size up to 5 mm. It is received from sifting breakings of rock while producing road metal and from waste of enriching ores of ferrous and non-ferrous metals and non-metal fossils, and from other branches of industry. During the test we defined that sifting of granite breaking, selected form the deposit «Granitnoe» does not correspond to GOST 8736-93; slag of Neryugrinskaya State Regional power station can serve as an aggregate according to GOST 25592-91 (common non-sorted small-grain (M) ash-slag composition with 22 % of grains over 5 mm, pouring density of 395 kg/m^3).

Consumption of materials for slag concrete was defined according to prescriptions [5]. Optimization has been carried out through varying consumption of Portland cement, PS slag, anf introducing the addition PFM-NLK.

Table provides compositions of slag concrete with using siftings of granite breaking and the received physical-mechanic characteristics at age of 7 and 28 days.

According to the received data we have constructed dependences of slag concrete solidity on Portland cement consumption (Fig. 1), and its density – on consumption of slag from Neryugrinskaya SRPS (Fig. 2).

The results of defining main physical-mechanic characteristics of slag concrete

Number	Расход на 1 m³, kg				Water/ Cement	Solidity of concrete composition, c	Solidity of slag concrete, kg/m³	Solidity under axis compression, MPa, at age of	
	Cement	Granite sifting	Slag	PFM-NLK				7 days	28 days
1	355	620	460	0	0,63	16	1555	5,1	9,2
2	355	445	480	0	0,58	17	1390	3,5	4,6
4	380	435	390	0	0,58	11	1375	3,4	5,5
3	400	480	500	0	0,58	12	1495	5,3	8,2
5	370	650	480	2,2	0,66	14	1710	14,4	19,7
6	400	505	535	2,4	0,60	14	1645	13,2	18,0
7	425	515	535	2,5	0,56	12	1610	10,9	18,7
8	455	465	525	2,7	0,52	16	1620	15,1	16,9

From graphics at Fig. 1 you can see that introduction of concrete modifier PFM-NLK in the composition of slag concrete increases its brand solidity almost two times, however, it decreases insignificantly under an increase in Portland cement consumption. At the same time, slag concrete without the addition shows a direct proportional dependence on Portland cement consumption.

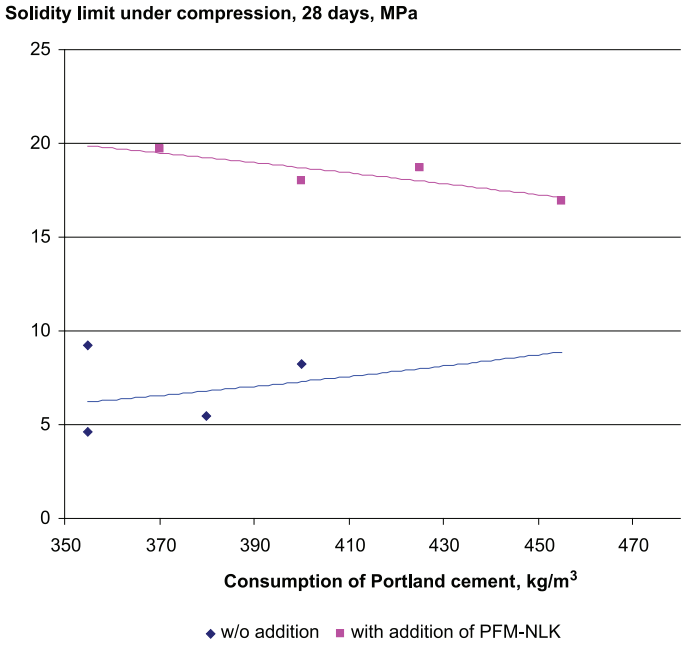

Fig. 1. Dependence of slag concrete solidity on Portland cement consumption and addition of modifier PFM-NLK at age of 28 days

While studying graphics at Fig. 2 we can conclude that along with an increase in slag consumption in concrete composition density of the latter decreases, but, if the modifier PFM-NLK is introduced, we can observe an increase in density of 15% under the same slag consumption. It can be explained by a denser packing of concrete mix aggregates.

As a result of this research we have received slag concrete of different brands of solidity with addition of modifier PFM-NLK and without it. While making calculations of cost of the developed slag concrete and comparing it with the cost of used heavy concretes we have receive d the following results: slags M75 without addition cost 46 rubles, with addition of PFM-NLK – 43 rubles, M100 correspondingly – 47 and 45 rubles, in other words, addition provides an economy of 4,3%. In comparison to the cost of heavy concrete blocks M75 – 130 rubles, the economy equals 65%.

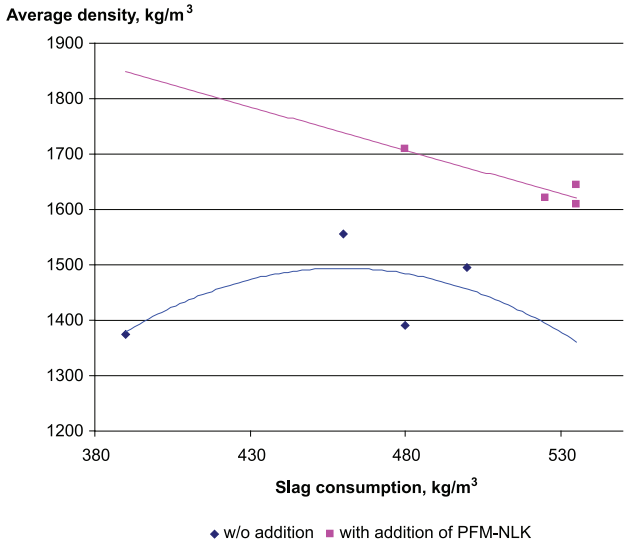

Fig. 2. Dependence of slag concrete solidity on slag consumption and addition of modifier PFM-NLK in dry condition

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FEATURES OF DESIGN AND CONSTRUCTION OF INDIVIDUAL HOUSES ON PERMAFROST SOIL

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Among basic peculiarities of the Extreme North, which should be considered in engineering, are not only severe climate and permafrost condition of soil, but also economical terms that are conditioned by distance and badly developed territories [1]. When projecting and construction of buildings and installations in conditions of severe climate it's specified to choose the type of foundation, which will ensure not only the stability of a building but also reduction of consumption of materials, terms of building and labour costs. As practice of building shows, in the North there are usually used columnar, pile, slabby and frame types of foundation. Advantages and shortcomings of traditional types of foundation, which haven't lost currency nowadays, were described in the work [2].

As a rule, individual developer chose the types of foundation and ways of their arrangement that he is able to use on his lot. That's why foundations for private houses, especially when it comes to wood house building, are simplified without taking into consideration of permafrost-soil conditions of the lot, as a result the house begins to sink unevenly in time.

The cost of foundations in the low-rise house building reaches 40% out of general estimated cost, in addition, individual building in Yakutiya (1–2 floor houses) make up more than 50% out of the house building of the republic. Bed constructions for northern regions have been constantly improved and in short time have gone the way of evolution from ordinary rubble tapes to highly industrial and technological piles, the immersion depth of which sometimes reaches 36 m [1].

One of the perspective areas in the northern foundation engineering is arrangement of foundations at the packed soil, what is successfully used at the regions of moderate climate at the pocket weak soils. It's feature is that at the process of foundation building under the base and around side borders there is created a packed soil with heightened indices of density, stability, bearing capacity. Foundation load at the base and side borders is passed firstly on to the packed soil, and then on to the soils of natural build, owing to that there is reached higher bearing capacity of foundations at the soil base.