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ASH-AND-SLAG WASTES IN THE CONCRETE CONTENT

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Given article shows and specifies the details of usage of ash-and-slag wastes in combination with binder concrete mixture. It is paramount to properly classify and characterize differences among ash-and-slag wastes depending on production methodology, CaO content, according to GOST 25818-91). This article clearly describes benefits and downsides of usage of ash-and-slag wastes as a binder in concrete mixtures. The main focus was aimed at these particular features: strength, specific surface area, density, workability, delamination, water loss and water demand. Both domestic and international scientific communities pinpoint by their researches that ash-and-slag waste introduction in cellular concrete shows good performance. Here we investigate the proper recommended ratio of cement and ash-and-slag wastes. Unique focus is given to chemical content of an ash-and-slag waste, which subsequently determines the property of and concrete mix. In addition, technical and economic benefits of usage of these wastes were also included.

Currently in Kazakhstan, the high infrastructure development forces numerous construction scientists and engineers to come up with new and innovative ideas and solutions for bettering and optimizing the construction process, in order to decrease the expenditure of construction materials and shortening the period of building completion.

Ash-and-slag wastes – is the main waste product of various thermal power plants, which is byproduct of increased energy demand in this great nation. Ash-and-slag is generated from coal usage by thermal power plants, and whenever it is disposed without recycling it, takes up huge amount of landscape, therefore decreasing productive agriculture lands. In addition, it pollutes nearby rivers, soil and air of numerous cities.

At this moment, ash-and-slag waste recycling is a hot topic among many construction experts, which aims to reduce its harmful effects, by secondary usage of ash-and-slag. It is also was proven that ash-and-slag greatly improves the quality of concrete, which represents the great opportunity for win-win strategy of recycling.

The main goal and task of the research

Goal: ash-and-slag waste application in concrete mix

Tasks:

1. Perform a classification of ash-and-slag waste
2. Research the advantages and disadvantages of addition of ash-and-slag in heavy and cellular concrete
3. Conclude the rational use of ash-and-slag in concrete content

Ash-and-slag wastes

Types of ash-and-slag wastes

Ash – is the unburned remaining, which is created from mineral contents during full combustion

Ash-and-slag wastes can be classified into following categories:

1. Ash. It is a direct result of combustion of dusty coal and it is captured by electric filters or any other device.
2. Fuel wastes. They are generated from combustion of coal by layer and cellular methods. After follows the sedimentation process in the lower combustion part and granulation of resulting water melting.
3. Ash-and-slag mixture. It is generated from wet combinatory deletion of captured ash and fuel wastes, made in chamber.

Content of CaO ashes can be divided into basic and acidic ones. Basic ashes show hydraulic activities and acidic ashes pozzolanic properties. (2)

1. Basic ash – small dispensed dust, which contains CaO, SiO2 in smaller amounts and Al2O3. Oxide and calcium contents are larger than 10%.
2. Acidic ash – small dispensed dust, which mainly contains SiO2 and Al2O3. Calcium contents are almost at 10%.

All GOST 25818-91 ash documentations, depending on amount of coal combustion, divided into:

1. Anthracitic, gained from anthracite, semi-anthracite and slim rock coal combustion;
2. Carboniferous, gained from rocky coal combustion;
3. Brown coal, gained from brown coal combustion.

Ash activity highly influences on viscosity of building material, due to gradation of following parameters:

1. Active;
2. Hidden active;
3. Inert.

Active ashes are self-combining substances, which gives an opportunity to reduce the usage of building materials by exempting the need in solidifier components.

The last two remaining ashes require additional solidifiers' activators, which are acidic ones. (1)

Pic. 1: It is Ash-and-slag wastes

Influence of ash-and-slag components on heavy concrete

According to experiment results, in order to improve the quality and reduce the cost of production of heavy and high-quality concrete, it is suggested to include ashes from rice husks with high content of active silica. This method was designed for Vietnam, due to the fact that rice is the fundamental agricultural product; therefore the combustion leaves numerous wastes. (4)

According to Vietnamese Agriculture Ministry in 2016 44.5 million tons of rice was produced. From 1000 kg of rice, 200 kg of husks can be gained, when burned generate 40 kg of ashes from 1 ton. If we apply this calculation, we can determine that 365000 tons of ash-and-slag is creat-

ed from all that rice. Active micro silica contents in rice husk ash ranges in 86.72-90.93%, which means that in it there are 2-10 m2/g. This recommendation reveals that those products can easily replace high cost silica.

However, ash seeds contain high precision of scramble and little to zero effective area; therefore they get equally distributed in the mixture, effectively filling in the gaps between concrete particles. Micro filler allows increasing the density of mixture, due to tight filling of the gaps. So the lack of open spaces creates the smooth surface. (5)

Antifreeze properties were also studied, and it shows that they were not influenced by the introduction of ash-and-slag. Moreover, it greatly improves workability, due to the fact that ash reduces friction between particles. It is important to notice that ash contents must not be above 30%, so it would not increase the expenditure the binder usage and reduce the strength of the concrete. (3)

Please note that concrete containing ash-and-slag wastes is much more economically beneficial, because of availability and cheapness of it.

Influence of ash-and-slag wastes on cellular and porous concrete

Slag and ash binders can be used in production of foam concrete and gas concrete. Ashes are heavily influenced to cyclic moisture and drought, therefore high pore concentration in cellular concrete serves as a negative indicator for ash-and-slag use. Porous concrete actively serves as absorbent, which are negatively influences ash-and-slag additives. In order to decrease the influence of external factors, cellular concretes are covered by hydrophobic solutions. (6)

Foam concrete is a reliable and demanded building material, which is made from natural components, and also from various additives gained from industrial wastes. It is experimentally concluded that it is much better to produce cellular concrete which contains ashes from combustion of hard fuel. It is known that use of ashes instead of the sand can positively influence quality of concrete. However, if more that 70% of sand replaced by ash, decrease of durability is observed. (7)

It is important to remember that one of the main causes of deaths during fire is a fall of building parts. During high temperature conditions, cellular and porous concretes known to show a significant change in physical and mechanical properties that leads to decline in strength of an object. According to numerous researches, ash-and-slag inclusion in both types of concrete greatly improves fire resistance, due to resistance to ultra-high temperature, because of high density of a material. (8)

Conclusion

Usage of ash-and-slag wastes in construction definitely shows great benefits, not only form economic stand point, but also from technical applicatory use.

1. Ash-and-slag waste reduces the expenditure on high cost building materials up to 20%.
2. It is proven that ash-and-slag increases density and reduces layering and water leakage. Acidic ashes increases sulfate resistance due to pozzolanic properties.
3. However, overuse of ash-and-slag can reduce the required concrete qualities, like durability. It is paramount to note that chemical content of ash, define its binding properties. (9)
4. Ash application ecologically advantageous and beneficial, nevertheless improper usage can lead to negative interactions of it with outside world.
5. It is highly recommended to apply this type of concrete to non-residential constructions: industry buildings, roads, bridges, tunnels etc. (10)

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ТЕХНОЛОГИЯ БЕТОНИРОВАНИЯ КОНСТРУКЦИЙ МОНОЛИТНЫХ ЗДАНИЙ С ПРЕДОХРАНЕНИЕМ ОТ ОБЕЗВОЖИВАНИЯ ПУТЕМ ПРИМЕНЕНИЯ ПЛЕНКООБРАЗУЮЩИХ СОСТАВОВ

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Аннотация. В статье рассмотрена система технологии бетонирования конструкций монолитных зданий в различных климатических условиях. Кроме этого рассмотрен непосредственно сам процесс бетонирования, сохранения требуемой подвижности бетонной смеси и снижения ее температуры. Сейчас монолитное строительство обеспечивает широкий простор для проектирования сооружений, поскольку оно подразумевает под собой возведение многоквартирных сооружений с различной планировкой. Несмотря на уникальные свойства цементного искусственного камня, этому материалу не помешает защита и после достижения проектной прочности и всех заложенных характеристик. Нанесение специальных пленкообразующих композитов предполагает простое распыление специальных составов на основе силиконов или натуральных полимеров на открытые поверхности конструкции, что позволяет улучшить свойства самого бетона и обеспечить прочность и долговечность сооружений.

В современном строительстве все чаще используются промышленные методы строительства монолитных железобетонных конструкций с использованием модульных систем (средняя, объемно-регулируемая, крупнотоннажная опалубка и др.), для ввода в эксплуатацию многоэтажных объектов в кратчайшие сроки и без больших капитальных затрат на строительство заводов по производству сборных конструкций. Такие здания и сооружения эффективно возводятся в новаторских условиях, в сейсмических зонах над выработками, благоприятных для упрочнения бетонных климатических условий, а также в строительстве зданий с гибкой планировкой этажного пространства и высокой нагрузкой. Технологические