Geophysical Research Abstracts
Vol. 21, EGU2019-18190, 2019
EGU General Assembly 2019

The cold binding fly ash aggregates production and ageing tests under the atmospheric effects

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Recently, several important studies focus on the recycling of industrial waste materials due to their storage problem. During the last decade, the use of concrete that produced from low density natural or lightweight arti?cial aggregates has increased in the construction sector. Considering the increases in supply and demand on lightweight aggregate included concretes along with limited resource of natural raw materials, researchers focused on producing arti?cial lightweight aggregate with low energy usages and environmentally friendly. Therefore, industrial wastes, such as ?y ash, are being used on arti?cial lightweight aggregate production. In this study fly ashes, were obtained from Yatagan Thermal Power Plant, used in light-coarse aggregate production. For this aim, a mould was designed that allows producing aggregates with 18 mm diameter geometry between cube to a sphere using the cold binding method. Herewith, a new alternative resource for aggregate could use for the areas (e.g., construction sites) with unsuitable raw materials. Another advantage of the designed mould is to produce fly ash aggregate applying pressing method using without any binding agent or sintering.

The aggregate production in this study based on a homogenous mixture of mainly fly ash, Portland cement and water. The strength and durability of produced aggregates in the concrete mix were tested several ageing tests (freezing-thawing, wetting-drying, external exposure environment).

Furthermore, aggregates were also produced traditional methods, and the results show that fly ash aggregates have similar or quite high strength than limestone aggregates that used in conventional concretes. The ?y ash aggregates that are produced by the cold binding method have approximately 5.9 MPa point load index, whereas limestone aggregates have 5.7 MPa. Additionally, the densities of fly ash aggregates are about 1.83 g/cm3, and limestone aggregates are 2.69 g/cm3. The strength of fly ash aggregate concrete (53.62 MPa) is higher than limestone aggregate ones (44.22 MPa). The density (dry and saturated), water absorption capacity and porosity of the ?y ash aggregates are less than limestone aggregates. The freezing-thawing ageing test, 44 cycles, results show that the strength of concrete samples decreased 1.73%. The changes in the rate of saturation and dry density are very low. The P wave velocity values were reduced by 3.66% after 44 freeze-thaw cycles. In general, it has been found that there are no significant changes in the physico-mechanical values after 80 cycles wetting-drying experiments of both limestone and fly ash concrete samples. The physical characteristics and strengths of both fly ash and limestone aggregates are determined to be the same after 270 days of exposure environment tests.