Porosity of Lightweight Fly Ash Agregates with Different Binders and Heat Treatments

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Abstract

In this study, coal fly ash was tested and the sintering process of this material was aimed at manufacturing sintered products for use as concrete aggregates. Addition of different binders such as bentonite and glass powder was attempted to improve the chemical and mechanical characteristics of sintered products. Influence of different sintering binders such as bentonite and glass powder and temperatures on the properties of ceramic materials was reported. It is concluded that the porosity of fly ash changed with the binder types, content and different temperatures.

Keywords: Fly ash, Bentonite, Glass powder, Aggregate.

1. INTRODUCTION

Fly ash is a byproduct of coal-fired electric generating plants. Fly ash particles are mostly spherical in shape and range from less than 1 μm to 100 μm with a specific surface area, typically between 250 and 600 m^2/kg [1]. Physical properties of fly ash mainly depend on the type of coal burned and the burning conditions.

Fly ash contains valuable oxide resources such as SiO_2, Al_2O_3, CaO, Fe_2O_3, and other oxides [2]. These oxides have been mainly considered as a low cost material resource for the ceramic industry. Moreover, fly ash is presented as a fine dust so it can be directly incorporated into ceramic pastes, with almost no pre-treatment. Therefore, coal fly ash is a good candidate for the ceramic industry as a raw material resource.

Bentonite is a clayey material consisting mainly of montmorillonite. Montomorillonite has one exceptional property, it can take up water into the interlayer space. This is connected with the typical swelling ability of bentonite, which is important for balling because it enhances the cohesion of particles in the ball and the ball strength depends on cohesion of particles [3, 4].

Due to its sorptive and catalytic properties, bentonite is widely used in a variety of industrial applications [5]. The clay is utilized as a pesticide carrier, an animal waste adsorbent, a catalyst and catalyst support, and a decolorizing agent in oil refining, and in the pharmaceutical industries.

Over the last few years considerable progress has been made in the development of new building materials from waste glass [6]. There are innumerable environmental reasons why sustained efforts should be made to reduce the amount of glass in the solid waste stream. Unlike other forms of waste, such as paper and organic constituents of garbage, it does not decompose when dumped on the land and constitutes a high proportion of incinerator residue.

In general, two essential physical–chemical changes in ash at elevated temperature need to exist simultaneously for gaseous bubbles to be generated and trapped inside the pyro-plastic mass, including the development of a glassy phase and evolution of gases from the dissociation of mineral components [7].

At present, little is known about the effects of the chemical composition of Çatalağzı fly ash on the optimum sintering conditions and the properties of sintered products. Therefore, the present study was also undertaken to search thoroughly into this subject. Çatalağzı fly ash was also utilized in other studies for other purposes and it is noted that its chemical properties does not change so much. Also, it is notable that Çatalağzı fly ash is the one which has Class F type properties specified in ASTM C 618 in Turkey.

The objective of the investigation was to study the thermal behavior and porosity of the fly ash aggregates produced by different binders and temperature treatments.