

INVITED SPEAKERS

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Methods to Improve Fly Ash Reactivity and Increase Its Reuse Potential in Construction Materials Industry

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Abstract: Fly ash, a by-product from coal combustion in thermal power plants, is one of the most abundant anthropogenic materials. It is estimated that between 500 and 750 million tonnes of this material is generated worldwide annually. Various recycling and reuse options have been recognized for a long time now, with the highest quantities of fly ash being used in construction industry, either as a raw material or as an additive in cement and concrete industry. Current utilization rates of fly ash are assessed to be around 90 % in EU, 70 % in China and 40 % in USA, but with global average at only 25 %. Very often, possibilities to reuse local fly ash are limited by its properties, i.e. reactivity. Particle size distribution, chemical and mineralogical compositions are the most important properties of a fly ash sample that influence its reuse potential.

This works shows the effects of mechanical and chemical activation of several fly ash samples from several power plants on the properties of the fly ash and the properties of different construction materials based on the fly ash. Mechanical activation of the fly ash samples was done in a planetary ball mill. Optimization of the activation process was performed by gradual decrease in the grinding balls to fly ash ratio, thus decreasing the energy used for the process. It was found that even with very low ball-to-powder ratio, such as 3, it was possible to achieve drastic improvement in fly ash properties, in terms of particle size distribution and specific surface area.

Both starting and mechanically activated fly ash samples were used as raw materials for synthesis of geopolymers (binder materials made 100 % of fly ash) and hybrid binders (high volume fly ash binders, in which up to 70 mass % of Portland cement was substituted by fly ash). Also, suitability of the fly ash samples as cement replacement material in concrete was evaluated. It was found that with proper chemical activation of the fly ash samples it was possible to produce binder materials with mechanical properties comparable, or even superior, to traditionally used Portland cement.

Keywords: Building materials, fly ash