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Sustainable Development and Utilization of coal-fired power plant residues

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Abstract

The combustion of high ash content coals promotes a serious environmental problem in southern Brazil. It is in the south, in the States of Rio Grande do Sul, Santa Catarina and Paraná, that the coal mines coal-fired power plants are located. The States of Rio Grande do Sul and Santa Catarina show areas that are already environmentally degraded with the resulting contamination of both surface and ground waters.

Brazilian coals are characterized, among others things, for very high ash content ranging between 45 and 60%. This represents 4.0×10^6 tons/year of ashes produced in 2005. Most of these ashes are deposited randomly in landfills and has contributed to the deterioration of the surrounding environment. Since just 30% of that total is commercialized for the production of building materials (bricks, blocks, cement), it is necessary to search for new alternative uses for this abundant residues and give a high added-value to coal ash.

The Brazilian coal ashes consist, basically, of aluminosilicate with high silicon and aluminum oxide contents. Depending on its origin, the iron oxide contents can vary over a wide range. Since coal ashes are composed of a large amount of silica e alumina and also due to a low ratio $\text{SiO}_2/\text{Al}_2\text{O}_3$, they can be converted into zeolite by alkaline hydrothermal activation. Various types of zeolites can be obtained by changing the source of ashes or activation parameters. The zeolitic material obtained contains a non-converted part of coal ash and the zeolite content in the conversion product varies as a function of the coal ash properties

and the conditions selected. The optimization of synthesis studied was specific for Brazilian coal ashes.

Zeolites have uniform pore sizes and large surface area that make them very useful materials for a wide range of applications such as ion exchange, molecular sieves, adsorbents, and catalysts.

The coal ash samples were obtained from a coal-fired power plant located in Figueira county, in the North of Paraná State, Brazil. The utilization of synthetic zeolites as the adsorbent for the treatment of the electroplating effluents, immobilization of heavy metals in soil, decontamination of actual acid mine drainage and removal of dye from aqueous solution has been evaluated. The results obtained in the project showed a great reduction in the pollutant concentration in treated waters and soil and demonstrated the high potential of the zeolites synthesized from Brazilian coal ashes as low-cost adsorbent material.

The production of synthetic zeolites from coal ashes constitutes an alternative and noble use for a residue that has historically contributed to the degradation of large areas located in the Brazil. The environmentally-friendly use of coal ash is important from the viewpoints of energy, economy, and environmental strategy in order to realize the concept of sustainable development.

Keywords: zeolite; coal ashes; low-cost adsorbent
