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An Efficient Technology for Production of Energy Sources and Reduction of Solid Wastes Simultaneously

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Suitable disposal pathways of waste plastics (WP) and coal fly ash (FA) have yet not been established which is a matter of great environmental concern. In this study, FA samples were modified with NaOH and H2SO4. The mineralogical and microstructural characterization were carried out by means of X-ray diffraction (XRD), fourier transform infrared spectroscopy (FTIR), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM/EDS) and Braunauer-Emmett-Teller's multilayer adsorption theory (BET). Waste low-density polyethylene (LDPE) and high-density polyethylene (HDPE) were degraded using a semi-batch reactor along with modified fly ash catalysts. The liquid products were analyzed using FTIR, nuclear magnetic resonance (1H, 13C, and DEPT-135 NMR), and gas chromatography–mass spectrometry (GC–MS). Experimental data showed that cenospheres were dominated with quartz and mullite glasses with both amorphous and crystalline phases. The acid treatment increased Si/Al ratios by removing impurities and dealuminations, whereas alkali treatment significantly increased total pore volume. Both of the waste plastics were degraded at 400–450 °C., and the highest yield of liquid fuel product (about 87.24 wt%) was achieved for base treated FA at a polymer and catalyst ratio of 25 w/w. The NMR results accompanied by GC–MS data ensure that obtained fuels contain both aliphatic (saturated and unsaturated) and aromatic hydrocarbons, and FA is an efficient catalyst to pyrolize waste plastics into light weight liquid (gasoline and kerosene) hydrocarbons. This plastic-to-fuel technology should be commercialized owing to be profitable and eco-friendly.

Biography

Dr. Bijoy Kumar Mondal is a chemist with many years of experience in analytical, environmental and material chemistry. He has extensive background on fabrication and characterization of porous zeolitic materials including nanomaterials, which can be used as catalysts as well as other environmental purposes. He has developed a sustainable technology (waste plastic-to-fuel), which is cost-effective and eco-friendly. He has been teaching chemistry for fourteen years, and published many research articles in peer-reviewed journals.