ABSTRACT

Biodiesel occupies a unique position in the area of renewable energy. Biodiesel serves as an alternate fuel to diesel due to the increasing demand, high cost of diesel and also to tackle energy crisis. In this study, biodiesel is prepared from Waste Cooking Oil (WCO) using Copper doped Zinc Oxide (CZO) nanocatalysts. Characterisation of synthesized copper doped zinc oxide nanocatalysts are done by X-Ray Diffraction (XRD) and High-Resolution Transmission Electron Microscope (HRTEM). In this work, Response Surface Methodology (RSM) based on Central Composite Rotatable Design (CCRD) is used to design experiments, find the optimum reaction conditions and study the effect of process parameters such as catalyst loading, copper loading, reaction temperature, reaction time and oil/methanol molar ratio on biodiesel yield. The regression equation for the RSM model is generated using the experimental results (32 experiments). A maximum yield of 96.3% is obtained at optimum conditions of copper loading to zinc oxide at 9.7%, catalyst loading at 2%, temperature at 70^{o}C, and oil to methanol ratio maintained at 5 for 48.5 minutes. Hence, it is established that nanocatalysts exhibited good catalytic activities on biodiesel production from waste cooking oil. Ultrasonication type transesterification is also carried out to enhance the transesterification process and is found to be better than the conventional method. Properties of biodiesel produced are compared with the American Society for Testing and Materials (ASTM) D6751 standard and found to be matched. The cost of biodiesel per litre works out to be 68 rupees INR, which is equal to the cost of diesel. The environmental impacts of using waste cooking oil for biodiesel production are investigated by Life Cycle Assessment (LCA) methodology. The performance and emission characteristics of biodiesel blends in an engine are studied with various

process variables such as blending ratio ranging from 20–100% and compression ratio in the range of 16 – 18 with engine load range of 0 –100%.

In the present work, the novelty is the use of copper doped zinc oxide nanocatalyst of 24 nm for transesterification of waste cooking oil (WCO). In this process, the following advantages were observed such as low cost, large scale production, higher yield and better control of reaction parameters.