Preface

Imminent energy crises and environmental challenges raised by the immoderate use of conventional energy sources lead notable attention to exploring alternative sources for sustaining the clean energy supply in future. In this consequences, energy derived from biomass in form of liquid biofuels i.e. biodiesel, bio-methanol, bioethanol etc. have potential to replace the fossil fuels from the transportation sector along with socio-economic independence of rural countries and reduction of GHG emission benefits. In recent years, biodiesel is viewed as globally implementable alternatives fuel to conventional diesel for automobile engines. To improve performance, combustion and emission behaviour, research has been focused on biodiesel which posits a better solution to these problems. Biodiesel comprises of fatty acid alkyl esters obtained from methyl transesterification of triglycerides existing in animal fats or vegetable oils.

Developing countries depend on other nations to meet energy needs and hence their economy is affected largely by international fuel market. Thus, Reliable

energy supply is a preeminent challenge for stable economic development. Moreover, biodiesel production can significantly reduce the foreign imports of diesel fuel. Biodiesel suitability in diesel engine was studied as neat and blended form with respect to engine performance and exhaust emission. Properties and composition of biodiesel are different from diesel fuel which are responsible for diverse results of combustion, performance and emissions. It has been proved that biodiesel helps to reduce GHG emission associated to poor combustion due to nonappearance of aromatic compounds as well as sulfur as it is renewable, nontoxic with high oxygen content fuel.

Heterogeneous catalyst usage for biodiesel production is economical and eco-friendly method since it does not required washing steps and eventually reduces the cost by reuse. To compete biodiesel with fossil diesel, reduction in cost is adequate. These catalysts share basic sites on their surface to catalyse the basic transesterification reaction. Barium aluminum oxide and potassium aluminum oxide as heterogeneous base catalyst were synthesized and characterized by several technique. In the present work, used vegetable oil and kusum oil were used as feedstocks for biodiesel production. Direct transesterification was performed for used vegetable oil, whereas, esterification followed by transesterification was followed for the synthesis of biodiesel from kusum oil by using above catalyst. Investigations were carried out on influence of reaction variables such as catalyst dose, methanol: oil molar ratio, reaction temperature, time and stirring speed and catalyst reusability on biodiesel conversion to achieve optimum reaction conditions at each stage. In addition, kinetic and thermodynamic analysis along with green chemistry matrix of the process adopted were also deliberated.

This thesis includes the synthesis of heterogeneous catalysts and their characterizations as well as application in transesterification reaction for biodiesel production; impact of reaction variables on FAME conversion; kinetic and thermodynamic investigation; green chemistry metrics; and characterizations of synthesized biodiesel. The results obtained are novel and interesting and have been recognised by experts in the area. The data generated may serve as baseline data for large scale production of biodiesel.