ABSTRACT

Present work describes the optimization of reaction parameters for biodiesel production using chemical and enzymatic transesterification of conventional as well as nonconventional feedstocks. Response Surface Methodology based upon central composite response surface design was used to optimize reaction parameters for biodiesel production. Different reaction parameters including catalyst/enzyme type, catalyst/enzyme concentration, reaction temperature, reaction time and methanol to oil molar ratio were optimized and comprehensive protocols were developed to achieve highest biodiesel yields using both chemical and enzymatic transesterification. During chemical transesterification, $NaOCH_3$ catalyzed transesterification was depicted to give highest biodiesel yields comparative to KOH, NaOH catalyzed transesterification whereas, during enzymatic transesterification, NOVOZYME-435 catalyzed transesterification resulted into higher biodiesel yields comparative to A.n.Lipase catalyzed transesterification reactions. Among different feedstocks studied, linseed oil exhibited highest biodiesel yield (96.5%) during chemical transesterification, while during enzymatic transesterification *Eruca sativa* oil exhibited best biodiesel yield (98.3%). For optimized chemical transesterification, 0.5 to 0.75% catalyst concentrations, 6:1 to 7.5:1 methanol to oil molar ratio, 45 to 52.5^{o}C and 60 min reaction time, whereas, for enzymatic transesterification 1.0 to 1.25% enzyme concentrations, 6:1 to 9:1 methanol to oil molar ratio, 30 to 32.5^{o}C reaction temperature and 60 to 96 hrs were depicted to be optimized reaction parameters to obtain highest product yields. Monitoring of transesterification reactions was carried out using FTIR spectroscopy and High Performance Liquid Chromatography (HPLC), while compositional analysis of synthesized biodiesels was performed with Gas Chromatography equipped with Mass Spectrometric detector (GC-MS).

Fuel characteristics including flash point, fire point, pour point, cloud point, density, ash content, kinematic viscosity, cetane number, higher heating value and oxidative stability were evaluated and found technically compatible and comparable with EN 14214 and ASTM D 6751 specifications. Furthermore, exhaust emission levels of CO, NOx and PM from the engine exhaust operated on biodiesel and its blends (B-5, B-20, B-40, B-50, B-80 and B-100) were also estimated. Prominent reduction in both CO and PM whereas, irregular trends in NOx emissions were depicted from engine exhaust operated on biodiesel and its blends comparative to engine

exhaust emissions based on petro diesel. Based upon the above described results, it can be depicted that biodiesel is an environment friendly alternative to the conventional petrodiesel.