

Figure 6.16 Kinetics plots of $- \ln(1-X)$ versus reaction time (min) at different reaction temperatures.....	132
Figure 6.17 Arrhenius plot $\ln k$ vs. $1/T$ relation of transesterification of kusum oil using $K_2Al_2O_4$ catalyst	134
Figure 6.18. Eyring- Polanyi plot ($\ln k/T$) versus $1/T$ of transesterification of kusum oil using $K_2Al_2O_4$ catalyst	134
Figure 6.19 1H NMR spectrum of synthesized biodiesel from kusum oil.....	136
Figure 6.20 ^{13}C NMR spectrum of synthesized biodiesel from kusum oil.....	137

List of Tables

Chapter 1

Table1.1 Biofuel policies of various countries and their mandate.....	11
--	----

Chapter 2

Table 2.1 First, second and third generation of feedstocks for biodiesel production.....	26
Table 2.2 Leading biodiesel producers worldwide in 2016, by country (in billion litres) and their major feedstock.....	27

Table 2.3 Advantages and disadvantages of catalysts used in the transesterification reaction.....	32
--	----

Table 2.4 Various homogeneous, heterogeneous and enzyme catalyst for biodiesel production.....	33
---	----

Table 2.5 Alumina based heterogeneous catalyst used in transesterification reaction.....	37
---	----

Chapter 3

Table 3.1 Important physicochemical properties of used vegetable oil (UVO) and kusum oil feedstocks.....	39
---	----

Table 3.2 ASTM specifications of biodiesel as diesel fuel.....	55
---	----

Chapter 4

Table 4.1 Basicity and base strength of synthesized catalyst BaAl ₂ O ₄	66
--	----

Table 4.2. Basicity and base strength of catalyst K ₂ Al ₂ O ₄	75
--	----

Chapter 5

Table 5.1 Reaction rate constants at different temperatures.....	85
---	----

Table 5.2 Calculated values of various thermodynamic parameters.....	88
---	----

Table 5.3 Fatty acid methyl ester composition of synthesized biodiesel.....91

Table 5.4 Comparison of fuel properties of synthesized biodiesel with diesel
using ASTM
specifications.....92

Table 5.5 Reaction rate constants at different
temperatures.....100

Table 5.6 Calculated values of various thermodynamic
parameters.....103

Table 5.7 Fatty acid methyl ester composition of synthesized
biodiesel.....106

Table 5.8 Comparison of fuel properties of synthesized biodiesel with diesel
using ASTM
specifications.....108

Chapter 6

Table 6.1 Reaction rate constants at different
temperatures.....118

Table 6.2 Calculated values of various thermodynamic
parameters.....120

Table 6.3 Fatty acid methyl ester composition of Synthesized
FAMEs.....123

Table 6.4 Compression of fuel properties of synthesized biodiesel with diesel using specifications.....	124	ASTM
--	-----	------

Table 6.5 Reaction rate constants at different temperatures.....	133
---	-----

Table 6.6 Calculated values of various thermodynamic parameters.....	135
---	-----

Table 6.7 Fatty acid methyl ester composition of Synthesized FAMEs.....	138
--	-----

Table 6.8 Compression of fuel properties of synthesized biodiesel with diesel using specifications.....	139	ASTM
--	-----	------

Chapter 7

Table 7.1 Summary of experimental work.....	150
--	-----