CHAPTER 3

OBJECTIVE AND METHODOLOGY

3.1 PROBLEM DEFINITION

After a thorough and critical review of the literature, the problem undertaken for investigation is to study the factors effecting the production of bio diesel from non-edible oils such as catalyst, reaction time and stirrer speed. The physical and chemical properties of the oil, bio diesel and its blends with diesel are to be studied and analyzed. The performance, combustion and emission characteristics of various bio diesel blends are to be analyzed, and the best blend among them is to be found. This blend is to be used at different injection timings to derive the best injection time for bio diesel-diesel blends.

3.2 OBJECTIVES OF THE STUDY

Based on the review of literature, the following objectives were framed for the present work:

- To study the fuel properties of raw oil, purified oil, different blend ratios of bio diesel with diesel.
- To identify the optimum value of the stirrer speed, catalyst concentrations, amount of solvent and reaction time for higher yield of bio diesel production from the raw oil and purified
pungamia oil were analyzed separately by different blend ratios.

- To formulate an empirical relationship to calculate calorific value for raw and purified oil-diesel blends and bio diesel-diesel blends.
- To study the fatty acid compositions and gas chromatography mass spectrum analysis of diesel, raw and purified pungamia oil, methyl / ethyl esters of pungamia oils and ethyl esters of neem oil.
- To study the engine performance, emission and combustion characteristics of bio diesel-diesel blended fuels.
- To study the optimum injection timing by selecting the best blend out of three selected bio diesel-diesel blends.

The present work involves both experimental and theoretical investigations to achieve the above objectives. The experimental investigation of bio diesel production was made and the properties, performance, combustion and emission characteristics were analyzed. Theoretical analysis on fuel properties of raw oil, purified oil and bio diesel were carried out. An empirical relation to calculate the calorific value of bio diesel, oil and their blends with diesel were formulated and validated with experimental results.

### 3.3 SCOPE OF THE PRESENT WORK

The scope of the present investigation includes:

- Optimization of various parameters to maximize bio diesel production.
- Qualitative and quantitative analysis of bio diesel.
- Operating the four-stroke compression ignition engine with diesel, ethyl, methyl esters and its blends with diesel as fuel.
- Comparing the engine performance with diesel.
- Combustion analysis of different bio diesel-diesel blends in C.I engine.

3.4 METHODOLOGY

The methodology used in the present is outlined below in a step-by-step manner as shown in Figure 3.1.

The important fuel properties like relative density, viscosity, flash point, cloud point, pour point, calorific value of raw and purified oil, methyl and ethyl esters of bio diesel – diesel blends were studied using ASTM specified equipment. The measured values of fuel properties are used to formulate mathematical equations. The quantitative and qualitative analysis of oil and ester were done using gas chromatography.

Optimization of the important parameters like stirrer speed, concentration of catalysts like NaOH, KOH, and reaction time for producing higher yield of methyl esters, ethyl esters, from raw pungamia oil and purified pungamia oil and ethyl esters of bio diesel from purified neem oil. A batch type bio diesel production unit was setup for this purpose.

A single cylinder experimental setup was established with necessary instrumentation to study the performance, combustion and emission characteristics of the diesel engine fueled with methyl esters, ethyl esters of pungamia oil and ethyl esters of neem oil and its blends with diesel having blend ratios of 20, 40, 60, 80, and 100 percent on volumetric basis.
Figure 3.1  Research methodologies for bio diesel production, study of fuel properties, engine performance, emission and combustion analysis
The present work involves both experimental and theoretical investigation to achieve the stated objectives. The aim is to have more data on bio diesel properties, performance emission and combustion in engines.

3.5 SALIENT FEATURES OF THE PRESENT WORK

Following are some of the salient features of the present work:

- The present investigation has been carried out on a production model single cylinder four-stroke compression ignition water-cooled engine.
- Commercial grade high-speed diesel oil, ethyl and methyl esters have been used as fuel.
- The different properties of raw oil, purified oil, ethyl and methyl ester – diesel blends viscosity, relative density, flash point, cloud point, pour point, calorific value, water and sediment, fatty acids and mass spectrum analysis were studied.
- Empirical relation for calorific value of bio diesel and its blends were formed using Statistical Package for the Social Science 16.0 version (SPSS) software.
- Exhaust emissions such as smoke, oxides of nitrogen (NOx), unburned hydrocarbon (UBHC) carbon dioxide and carbon monoxide have been measured at each operating point.
- Cylinder pressures for 90 continuous cycles have been measured at each operating point. Average of these cycles is used for heat release analysis.

To achieve the above stated objectives and methodology, a detailed experimental work has been carried out. The details of the experiments and equipments used are explained in chapter 4.