CHAPTER: 1

INTRODUCTION

1.1 OVERVIEW:
Augmented use and soaring price of fuel has generated various troubles reaching in, towards focusing more attraction of alternative and low cost alternate fuel. With the escalating demand of the energy for the human mankind, the reserves of the petroleum based fuels are diminishing day by day and requirement of the substitute fuel has come into picture. With the growing world populations, industries, vehicles, and equipment, energy demand the need for the substitute of petroleum fuels, which can provide ample support to people’s need is the major issue. Considering the crisis globally, the curiosity in alternative fuels is extremely high [1]. It becomes necessary to examine that the alternative fuels used as substitute must be derived from the renewable sources and ways and means should be devised to use this fuel without bringing any modifications in the geometry of the engine. Alcohols have provided an answer to this problem. So for (SI) engines, Ethanol is well thought-out to be the most fitting fuel [2]. The dependencies on the natural fuels are reduced by the analyzers and various efforts are being made to find the alternative economical fuel source. Eminent researches have contributed towards generating few alternative environmental friendly and cost-effectively viable fuels. [3]. The advancement in creating high efficiency and clean engines is the burning issue towards the achievement of the goals of researchers. Therefore, alternative fuels sources are sought. Important fuels of prime usage are natural gas, biogas, vegetable oil, esters alcohols derived from hydrogen and vegetable oils. Ethanol and methanol as fuels has proved to be the best solution provider for the existing replacement of fossil fuels for all those vehicles equipped with SI (spark ignition ) engines. The greatest benefit of using these as substitutes is that they are fluid and posses same physical and ignition properties as similar to gasoline. [4].

Major research work on the evaluation of the performance parameters of the engines, operated on alternative have shown us a way to either replace the petroleum reserves by using various alternative fuels or rather blending them with gasoline in different volumetric ratios. This will indirectly help us in saving energy power sources which are depleting at a fast rate and thus keeping human mankind at pace with the growing needs of energy. As natural fuels are used very lavishly it a great diminution in underground-based carbon resources have occurred. The chase for various alternative fuel sources, bearing a good relation harmoniously with the present sustainable development, energy conservation, efficiency and better preservation towards surroundings has become the call for the hour. Carrying on forward in the search of fuel, to this upcoming petroleum crisis the fuel which is derived biologically can endow with a realistic solution. Considering emissions effects which are continuously being emitted by the petrol and diesel driven automobiles have given our eminent scientists a food for thought. Several alternative energy resources has been identified which has the prospective to fulfill the requirement of the ever demanding increase of the petroleum usage. The basic aim of the prober and
scientists is to find an alternative source of fuel which can produce low emissions and as such counteract the needs of the environmental aspects also or in a better way to extenuate the emissions with higher consumption. [5].

Alcohol, especially ethanol, is well advised as a strong potential alternative fuels which is well thought-out for this purpose. Ethanol can be created from indigenous energy resources like biomass, coal and natural gas. Beside the issues of conservation, alcohol fuels has showed greater potential by offering solutions to a number of varied problems faced by different countries. Compared with petroleum fuels, alcohol fuels have the undesirable features of low calorific value and a high enthalpy of vaporization. Their high auto-ignition temperatures and, therefore, high octane ratings render them as more suited for replacement of gasoline in spark-ignition engines - an area which has benefitted from extensive research and implementation programmes especially for automotive applications. In 1975 Brazil, initiated its programme to substitute ethanol for gasoline in small cars [6].

Burning fossil fuels emit carbon dioxide (C0\textsubscript{2}), a gas which has been labelled as the chief heat trapping gas causing the well publicized phenomenon of greenhouse effect. With the greenhouse effect on earth, the concentration of CO\textsubscript{2} in the atmosphere is claimed to form a kind of blanket over the earth’s surface stopping heat to be radiated from the earth denying it being evading to outer space. The average temperature was found to be more due to this phenomenon, thus affecting the normal human life. The consequences of the increase of the degrees on the surface of the earth has generated a major threat for sea levels to raise, fierce storms, winds and heat waves [7]. Over the years, therefore, various agencies have sprung up World-wide to formulate rules and procedures to curb the increase of CO\textsubscript{2} and other environmentally damaging gases like CO, SO\textsubscript{2} and NOx. Reduction of CO\textsubscript{2} has been targeted as the main step in checking the emissions and this has been anticipated to be achieved by switching to non-fossil fuels, demanding higher-mileage cars and energy-efficient industries. The issue of viable development has drawn attention which accords environmental protection. It is the awareness and apprehension for environmental fortification that has provided the greater stimulation for the majority of the recent research in use of non fossil or other so called clean fuels for IC engines [8].

If alcohols are to be seriously chosen over petroleum fuels on a large scale, however, they must be deployed instead of gasoil. Without gasoil substitution crude oil importation levels in non-oil producing countries will have to be maintained to sustain the demand for gasoil. A challenge that humanity must take seriously is to limit and decrease harmful toxicants caused by various human activities. Guilty to the greenhouse effects are excessive traffic level which is increasing by bound [9]. The transport sector contributes heavily when it comes for the green house effects. As transport levels are quite anticipated to rise considerably especially in the developed countries which depend heavily on the transport sector, has by any means to search a solution of this problem of emissions to tackle the future requirement of the usage of petroleum products. Regardless of the ongoing activity to promote efficiency, the sector is still generating heavy amount of CO\textsubscript{2} which can prove fatal to
human life. Fairly drastic political decisions are pending to counteract the existing problem. Further the supply of petroleum is dwindling day by day and soon the reserves will be exhausted, so the need of alternative fuel has evolved sturdily. Replacement of natural fuel with biofuel is the decisive solution to the existing problem [10].

In the automobile sector Biofuels can be introduced to curb the need energy usage. Adapted vehicles or blending bio fuels with petroleum-based fuels for use with present vehicle fleets can be adopted. The two back-up are not, of course, mutually exclusive. Due to continuous change in the varying composition of gasoline and other alternate fuels; it becomes extremely important to comprehend the impacts of the new fuels on exhaust emissions. Various research and subsequent examinations has been done to examine the exhaust emissions which are readily being emitted by ethanol usage [11]. Studies of gasolines with ethanol contents with percentage less than 10% have generally shown that emissions of carbon monoxide (CO), unburned hydrocarbons (HC) are reduced with increasing ethanol content. According to the findings, blending of ethanol with gasoline has given small increase in NO\textsubscript{x} emissions; however this result is not unswerving among studies [12]. Pollutant emissions from fossils fuels are found to be higher as when compared with alternative and renewable alcohol fuels. In recent years, Ethanol has gained its importance and is readily used fuels in SI engines in varying percentages with gasoline to reduce the emissions of carbon dioxide, a green house gas which contributes to global warming [13].

1.2 CURRENT SCENARIO OF ENERGY CONSUMPTION:

- Proved non-renewable petroleum resources are estimated to last till 2049 and available natural gas resources till 2070.
- Half of the petroleum or 20% of the total energy is being consumed by 550 million automobiles.
- CO emission will increase by 65% over the current level till 2016.
- Earth temperature has increased by 3.5 deg centigrade from 1630.

1.3 OBJECTIVE OF PRESENT RESEARCH:

The objective of this thesis is to establish the effect of different gasoline-ethanol blends, containing up to 100% ethanol, on engine performance and emission characteristics of an SI engine. Artificial Neural Network (ANN) in MATLAB is employed as the measuring tool to analyze and validate the experimental results with the ANN predicted results. In order to achieve these objectives, a number of specific tasks were undertaken, which include:

i. The design and commission of a test rig used to carry out all the experimental tests included in this thesis.

ii. Several tests were carried out on a wide range of engine loading conditions at constant speed of 2500 rpm to evaluate the effects of increasing ethanol content in a gasoline-ethanol blend on:
• The physicochemical and combustion properties of the fuel, including stoichiometric AFR, Total specific fuel consumption, Brake specific fuel consumption (BSFC).
• Performance parameters.
• The main regulated emissions and combustion efficiency.
• Exhaust temperature and heat capacity.
• Also, the subsequent effect of these properties on power output and fuel consumption.

iii. An ANN model was developed to predict a correlation between brake power, torque, brake specific fuel consumption, brake thermal efficiency, volumetric efficiency and emission components using different gasoline–ethanol blends and speed as input data.

iv. Validation and test data were each set at 15% of the original data.

1.4 EXPECTED OUTCOME OF THE STUDY:
The expected outcome of this research is an analytical mathematical model for SI engines using ethanol-gasoline blends. The system can be used for predicting the performance and emission characteristics of Spark Ignition engines. The system should be of interest to designers, engineers, students who use the model for tutorials and consumers who like to compare the performance and emission of different Engines operative on variety of blends. Finally, numerical analysis will extend its application.