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Need for Alternative Fuel in India: A Study

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ABSTRACT: Rapid growth of industrialization and depleting resources of fossil fuels coupled with air pollution caused by exhaust gases emitted by diesel engines thereby causing global warming has necessitated the need for alternate fuel.

I. INTRODUCTION

In the last two decades, rapid growth of industrialization, liberalization of economy, cut throat competition and mergers and acquisitions have changed the global scenario and brought the world together. This has thrown ample of opportunities for the developing countries to follow the pace of industrialization and survival of the fittest became the ultimate slogan; "Energy is the basic need for economic development of any country" and the largest source of energy in India after coal is Petroleum diesel, about two third of which is imported from OPEC (oil and petroleum exporting countries). High dependence on imported fuel and due to frequent fluctuations in petroleum prices has made Indian economy insecure and has caused inflationary trends which are hurting the common man badly. This rapid development has necessitated the equal rapid expansion of transport sector (rail, surface, air and sea) which entail the use of internal combustion engines. Compression ignition engines namely diesel engines are supposed to be the most efficient engines as they achieve better fuel economy, lower carbon dioxides emissions than conventional spark ignition engines fuelled by gasoline. However, these engines tend to be more costly and emit high level of nitrogen oxides and particulate matter and are the major contributor to air pollution as it is extensively used in public transport and goods transport and are explained as follows:

A. Particulate matter emissions (PM)

The seriousness of the effects of particulate matter (Soot) can be understood by its health risks of Lung inflammatory reactions, Respiratory symptoms, Adverse effects on the cardiovascular system, increase

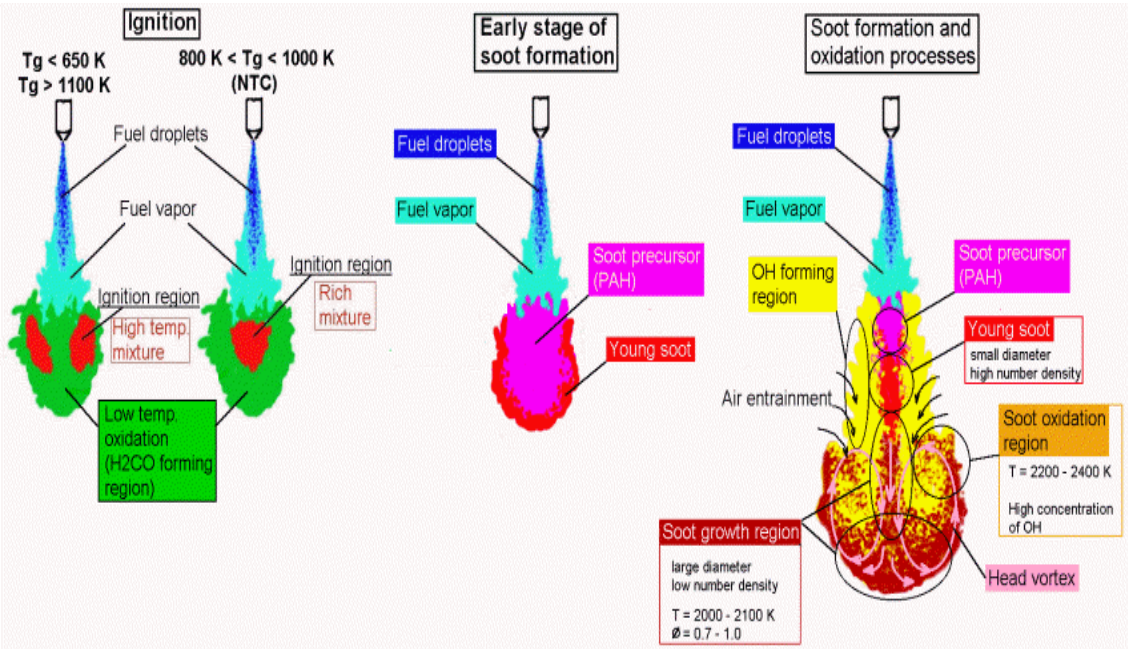

Fig. 1. Formation of Soot (PM).

in medication usage and hospital admissions, reduction in lung function in children, increase in chronic obstructive pulmonary disease etc. and hence it is therefore important to understand the reasons for its production in the engine exhaust and the remedy. Particulate matter is a general term normally used for a variety of condensed phase compounds that are formed during fuel pyrolysis when parent fuel is broken into smaller hydrocarbon fragments which find way through exhaust whose formation is shown in Fig. 1.

B. Nitrogen oxides emissions

Combustion process in IC engines can be described in scientific terms as the marriage of fluid mechanics and chemical kinetics which interact with the help of transport processes viz. convection, diffusion and thermal radiation leading to complex phenomena of flame ignition/ propagation/ extinction, turbulent combustion etc. The incomplete combustion causes formation of HC, CO, PM and NO_x which are shown in the Figure 1.2. As regards NO_x, it is observed from the following graph that nitrogen oxides increase in rich air-fuel mixture because more oxygen and lesser are present to heat it up.

C. Tradeoff between NO_x and particulate matter

Tradeoff is defined as the perfect balance between the parameters as otherwise control of one parameter affects the other one. The designers of diesel engines are having a tough time in designing a perfect engine which maintains a balanced tradeoff between NO_x and PM though they have been successful in designing low temperature combustion engine which are of two types viz. Homogeneous charge compression ignition engine (HCCI) and Premixed charge compression ignition engine (PCCI) which is found to have the following advantages:

- By lowering combustion temperature either through lean mixture or partially premixed combustion, heat loss from the cylinder is reduced leading to higher thermal efficiency.
- Lower temperature also helps in reducing engine-out NO_x emissions which is highly
- Lean combustion process is unlikely to generate particulate matter which has become a major concern for environment.

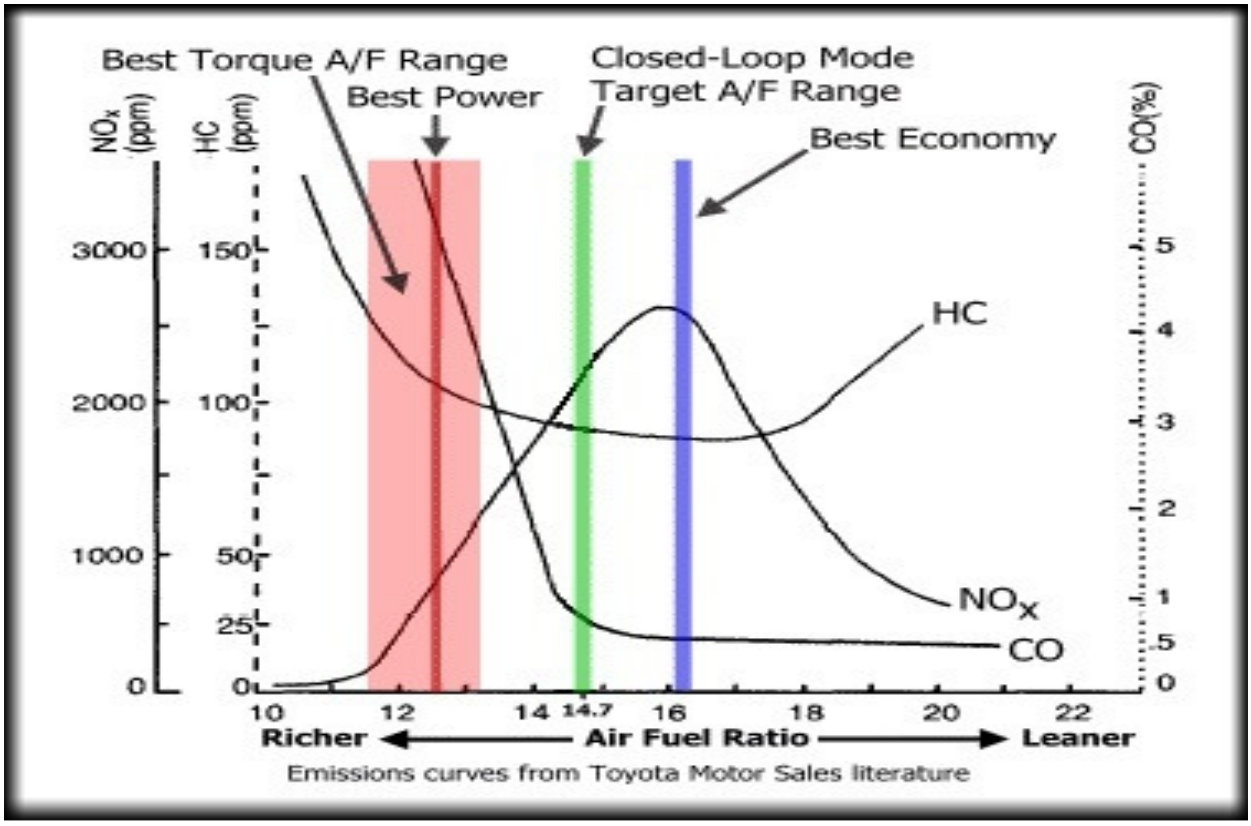

Fig. 2. Emission curve of NO_x, CO and HC.

II. NEED FOR ALTERNATIVE FUEL

Air pollution has become a major concern for every country and even the U.N and has been considered as the main cause of climate change. Though every effort is being made by all countries with stringent checks and regulations on the exhaust emissions, still it is a burning issue for the world. Though the global consumption of

fossil fuel is increasing day by day, it is a matter of concern for the whole world of depleting sources at a very fast rate. Combustion by fossil fuel releases large amount of greenhouse gases and carbon dioxide is the most significant of all these gases. The scientists from all the over the world have unanimously agreed that the average temperature of the earth is increasing and human activity is one of the principal causes as is evident from the global warming. Global climate change and increasing stringent emission regulations have become the motivational factor for the development and commercialization of renewal energy. In today's world with growing concerns over energy crisis, biodegradable renewable energy is considered to be the best alternative and has the ability to propel a nation to a new level of prosperity. Among the various types of renewable energy, biofuels stands at the forefront as a substitute to petroleum fuels.

Mother Nature has always been kind to human being and had even been looking after its energy needs, from the inception of universe, in a renewable manner. The industrial revolution in the nineteenth and twentieth century had thrown opened the opportunities to exploit the earth's fossil reserves i.e. fossil oil, coal and natural gas. Though these energy reserves looked to be unlimited in the beginning but the latest surveys expressed concerns not only in terms of its abundant availability but grave concerns of its harmful emission. The miracle of nuclear energy and its bitter experiences of leakages of radiations and its after effects has compelled us to be more cautious in its use as a clean energy source. Therefore the current circumstances have brought back renewable energy again into limelight

The global warming and its after effects has brought awareness among the researchers, Government agencies, automobile manufactures and even the United Nation which led to The Kyoto Protocol, an international treaty among192 parties that commits state parties to reduce man made greenhouse gas emissions (CO_2) which are supposed to be the major contributor towards global warming. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. Diesel engines though known for superior fuel economy and lower greenhouse gas emissions emit higher amount of particulate matter due to its heterogeneous combustion.

A. Alternative fuels

The worldwide stringent imposed emission regulations in view of air pollution and impact of global warming have made it imperative for the world and the researchers to focus their interest either on the domain of engines or fuel related techniques which might include alternate bio degradable or oxygenated fuels which can mitigate particulate emissions (Dogan, O., 2011).Given below are the considerations which are important and also motivate growing interest in alternative fuels and are:

-Control of exhaust emissions which are non-polluting and non-toxic.
-Production of fewer exhaust emissions that contribute to smog and global warming.
-Majority of alternative fuels are bio degradable: and
-It helps the nation to become self-sufficient and energy independent.

Alternative fuels are commonly known as non-conventional or advanced fuels which are derived from renewable bio-mass resources. It has strengthened the hands of the governments to promote sustainable development and ways to supplement conventional energy resources in meeting energy requirements of transportation fuels and India's vast rural population.

In India, very little effort has been made towards research, development and production of bio fuels. Developing countries also view bio fuels as a potential means to stimulate rural development and create employment opportunities. Therefore, keeping in view farmer's interest and food security, efforts are being made to develop bio fuels based on non-food feed stocks in India as Indian economy is largely dependent upon agricultural produce and the feed stocks could be produced on wastelands which are otherwise not suitable for agricultural production, thereby avoiding a possible conflict of fuel vs. food security . Some of the most researched bio fuels and having found use in quite a few European countries are:

-Bio fuels
-Biodiesel
-Bio-alcohol (methanol, ethanol and butanol)
-Hydrogen,
-Non-fossil methane, propane and natural gas
-Other biomass sources

III CONCLUSION

Indian Government is quite concerned with the effects of pollution on the deteriorating health of its people and alarming increase in global warming and has, to start with, introduced blending of gasoline with 10% ethanol. This step has not only reduced the air pollution but has considerably reduced dependence on imported fuel thereby saving in precious foreign exchange.

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