

Reasons to Reduce Our Reliance upon Crude Oil Based Internal Combustion Engines

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Abstract- Crude Oil based Internal Combustion Engines (ICE) have taken the major role in our country's transport, energy supply system and various appliances. This paper gives complete detail about not only our dependence upon the crude oil but also why we need to reduce the usage of it. Currently, there are more than 1.2 billion automobiles present in the road which are the basic sources of pollution that result in serious damage to the environment. It is noted that the certain harmful gases were formed as a by-product due to the variation in the engine combustion process and were released to the atmosphere through the exhaust pipe which causes serious effect to the human health; they were Hydrocarbons (HC), Nitrogen Oxides (NO), Carbon monoxide (CO) & Particulate Matter (PM). This paper also gives the complete situation about the crude oil energy scenario in India and the disadvantages of using it.

Keywords – Crude Oil Scenario in India, Emissions of Engines, Energy Technology, Internal Combustion Engine Generators

I. INTRODUCTION

The most important building blocks in human development is energy, it acts as a key factor in determining the economic development of a country. The energy sector has witnessed a rapid growth in order to fulfill the demands of a developing nation. For developing countries, the energy sector presumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them [1]. The country's most needed parameter to be considered as the acceleration for development is Electricity. The convenient methods for producing Electricity are attained through only non-renewable energy resources.

There is a critical situation waiting for our future generation about the consumption of all the resources of globe to produce electricity that our planet took billions of years to create. Over a short duration of shut down or an on-demand power source to supplement a renewable energy system, crude oil based engine-driven generators can provide a viable technological solution. The ICE generator is a mature technology that has been employed with great success the world over. Indeed, it is arguable that this success and the ubiquitous nature of the technology have led directly to many of the environmental crises facing our planet today.

Nevertheless, the disadvantages of the engine-driven generator are many, and in some applications, it is the appropriate technology for the job. Even today, the major power source of automobile is crude oil based ICE which are need to be changed gradually by an alternative source of energy.

II. CRUDE OIL ENERGY SCENARIO

Almost all of the ICE are using the chemical energy of the petrol or diesel which is basically extracted from crude oil. According to United States Energy Information and Administration 2017, United states leads the world oil production which contributes around 16% of world total oil (Oil includes crude oil, all other petroleum liquids, and biofuels) production (Production includes domestic production of crude oil, all other petroleum liquids, biofuels, and refinery processing gain) followed by Saudi Arabia of about 12% and Russia of about 11%.

The top 10 countries listed in the figure.1 have contributed around 53% of total oil production in the world and their needs were fulfilled by them and these countries have a stabilized economy compared to the other countries[2]. From the figure.1. it is clear that the more than the half of the oil production in the world is contributed by 10 countries in the world. Figure 1 explains about the distribution of 98.06 million barrel oil production from the top 10 countries and the rest of the world in the year 2017.

India is soon likely to overtake China as the second-largest oil consuming economy in the world. Figure 2 explains about the top 10 oil consuming countries and the rest of the oil consumers in the world in 2016. From the figure.2 it is clear that around 60% of the total oil consumption in the world was by only 10 countries in the world in that USA contributed for about 20% followed by Russia of about 13% and India of about 5% of total consumption in the world[2].

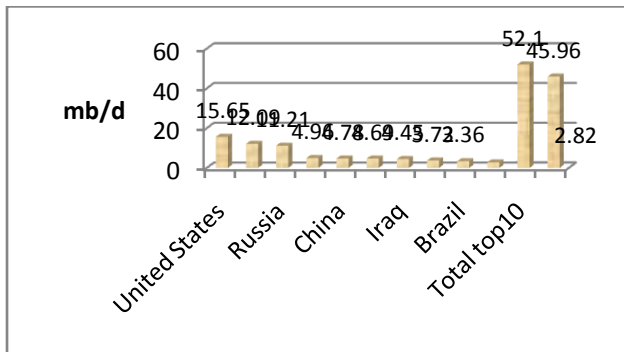


Fig.1.world oil production in 2017 (figure shows the top 10 largest countries and the rest of the world oil production in million barrels per day)

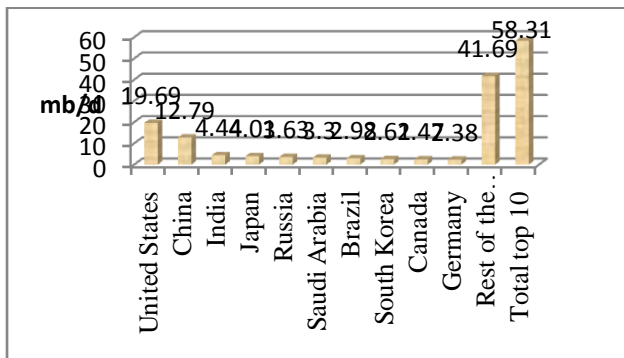


Fig.2.world oil consumption in 2016 (figure shows the top 10 largest countries and the rest of the world oil consumption in million barrels per day).

1. Crude Oil usage in India

Due to the increase in the population of the automobiles in India and electricity, the demand for crude oil has been constantly increasing in the past three decades. Most form of crude oil that we are using in India is diesel and petrol. Amirta sen, et al, have clearly investigated the future oil demand in India will increase because of the increase in the vehicle sales which leads to increase in the pollution [3]. Diesel is mainly used for automobiles and generators of companies and home appliances and the most common usage of petrol is automobiles and where the speed requirement is more.

Diesel growth has been somewhat inconsistent over the period under observation due to the cyclicity of demand. Diesel is mostly used in goods transportation and agricultural (tractor) operations; notably, both agricultural and power generation demand tend to be seasonal. But the inconsistency of diesel demand is also due to the effect of the gradual removal of diesel subsidies and the substitution effect with gasoline – this is reflected in the Indian auto industry, in which product demand has

arguably swung towards gasoline[4]. Overall, diesel demand growth over 2015 has been strong – a record figure of 20.2 per cent (totaling 1.47 mb/d) being seen in September. By November, growth had slowed dramatically to 1.6 per cent as floods in southern India curtailed economic activity, but it picked up in December to achieve a total of 1.57 mb/d. Diesel demand in January 2016 picked up to 1.52 mb/d, with y/y growth rising to 0.11 mb/d (7.9 per cent). Average growth in gasoline demand (based on y/y changes) has been consistently high, at around 12 per cent between April 2014 and December 2015. February and April 2015 were notable months as demand growth in both touched 20 per cent (y/y).

A record 25.5 per cent (y/y) (0.53 mb/d) was reached in September; this was followed by a marginally lower y/y growth in October (totaling 0.52 mb/d), before a rise to 17.2 per cent in November, and to 0.50 mb/d (total) in December, growing further by 51 thousand b/d (y/y) in January 2016[5]. The majority of this growth has been driven by the Indian automobile sector, particularly two-wheeler sales in addition to passenger cars [5]. During the period 2007-08 to 2016-17, the imports of Natural gas and Crude Oil increased by 15.42% and 5.46% respectively. Compound Annual Growth Rate (CAGR) of Production of Coal & Lignite in 2016-17 over 2007-08 are 3.79% & 2.9% respectively whereas their consumption grew at 5.29% and 2.22% respectively during the same period.

Exports of the Coal during 2007-08 to 2016-17 increased at a CAGR of 27.22% against the decrease in imports by (-)3.84%[6]. In case of Crude Oil and Natural Gas, during the period 2007-08 to 2016-17 the Production increased by 0.54% and (-) 0.16% whereas Consumption increased by 4.63% & (-) 2.47%[6]. During the period 2007-08 to 2016-17, the imports of Natural gas and Crude Oil increased by 15.42% and 5.46% respectively[6].

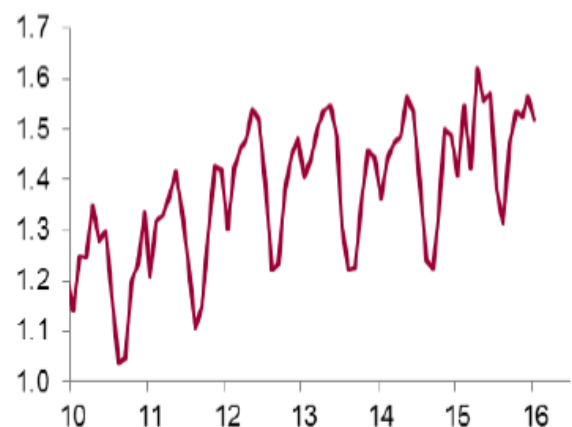


Fig.3.Diesel Sales (Figure shows the Diesel sales in million barrels per day from the year 2010 to 2016 in India).



Fig.4 Gasoline demand (Figure shows the gasoline demand in million barrels per day from the year 2010 to 2016 in India).

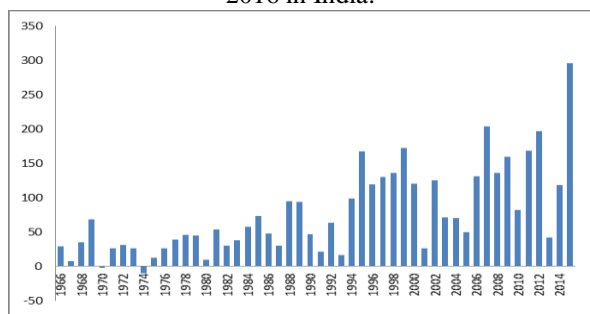


Fig.5 Crude Oil Consumption (Figure shows the Year-on-Year (y/y) Growth in India's Crude Oil Consumption in kilo barrels per day from the year 1965 to 2015 in India).

III. CRUDE OIL BASED INTERNAL COMBUSTION ENGINE GENERATORS

The main components of Internal Combustion Engine generators are fuel tank, air filter, carburettor (in case of petrol engine) fuel pump, IC engine, flywheel and a generator. Its principle of working is that converting the chemical energy stored in the fuel of petrol (in case of small engine generators) or diesel (in case of high load requirement) into electrical energy by rotating the shaft that is connected between the engine flywheel and the generator. The purpose of internal engine generator is to provide electricity to a house hold for a short period of time when there is a power cut.

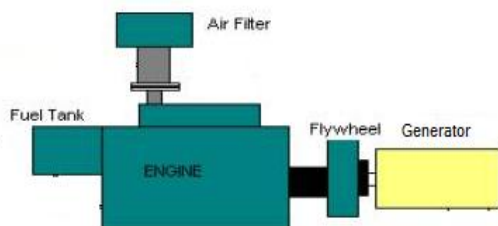


Fig.6. Crude Oil based ICE Generator (Figure shows the block diagram of the simple Internal Combustion Engine generator setup).

1. ICE generators Advantages

Chemical fuels that we are using in common are coal, lignite, gasoline, diesel, Liquified Petroleum gas (LPG), Compresed Natural Gas (CNG), Hydrocarbons, Methanol, biodiesel and hydrogen. With the help of a prime mover these fuels can be used to create mechanical energy and later that can be converted electrical energy[7]. One of the most necessary advantages is the fuel efficiency for diesel engines, as they use a lot less fuel than generators that run on gas. There are some diesel generators that just use up half the amount of fuel that others use even whereas they are functioning at the same capacity as the other generators.

This shows that it is a trustworthy choice for home use as it is able to supply nonstop power. Diesel as a fuel is calculated as being more cost-effective than alternative hydro carbonic fluids. This can spare you generally thirty percent of your expense cost if you use diesel in diesel generators. As a diesel generator does not include a spark plug, the cost to maintain the generator is a lot lesser than gasoline generators. But by diesel generators having glow plugs, it is assured to have a longer and greater life. It is a bother free experience when maintaining it but keeping in mind this is when the oil is changed and the unit is cleaned and the information of the guidebook are followed. Diesel engines are much lower in amount than other gen sets, and also operate for a lot longer as it cools down briskly since it has water and air cooled engine types. As long as diesel engines are look after on a regular basis, they are much longer lasting than alternative generators.

2. ICE generators Disadvantages

The Chemical fuels that we are using for the purpose of transportation and electrical generation will produce greenhouse gases and the hazardous effect of greenhouse gases were discussed by G.R.North[8]. Diesel operational generators are usually used in manufacturing applications since it can emit risky amounts of harmful smoke during exhaustion. It also produces a higher smoke compared to any other fuel generator. The unavoidable truth is that diesel powered generators are louder than gasoline and natural gas generators. Diesel engines are not easy to begin as compared to gas engine, especially when the weather is cold. Current diesel engines apply the glow plugs and heating elements to begin the engine. The units make the engine cylinders warm, including the air that goes to the engine. Glowing plugs and heating elements are timed so that there is an interruption to start diesel engines in that cold weather.

IV. REASONS TO REDUCE OUR RELIANCE UPON ICE GENERATORS

The main reason for us to reduce our reliance upon Internal Combustion Engine Generator is that our country is a non OPEC (Organization of the Petroleum Exporting

Countries). This means that we are still depending upon other countries for oil and our demand is constantly increasing over the decade.

1. ICE generators emissions

In ICE generators, diesel fuel is injected into a cylinder filled with high temperature compressed air. Emissions formed as a result of burning this heterogeneous air/fuel mixture depend on the prevailing conditions not only during combustion, but also during the expansion and especially prior to the exhaust valve opening. Mixture preparation during the ignition delay, fuel ignition quality, residence time at different combustion temperatures, expansion duration, and general engine design features play a very important role in emission formation.

In essence, the concentration of the different emission species in the exhaust is the result of their formation, and their reduction in the exhaust system. Incomplete combustion products formed in the early stages of combustion may be oxidized later during the expansion stroke. Mixing of unburned hydrocarbons with oxidizing gases, high combustion chamber temperature, and adequate residence time for the oxidation process permit more complete combustion. In most cases, once nitric oxide (NO) is formed it is not decomposed, but may increase in concentration during the rest of the combustion process if the temperature remains high [9]. The main problem areas for diesel engines are emissions of nitrogen oxides (NO_x) and particulates, and these two pollutants are traded against each other in many aspects of engine design[10].

Very high temperatures in the combustion chamber help reduce the emission of soot but produce higher levels of nitric oxide (NO). Lowering the peak temperatures in the combustion chamber reduces the amount of NO produced but increases the likelihood of soot formation. Better mixing of the air and fuel is the key to lower emissions. The NO produced rapidly oxidises to NO₂ (collectively called NO_x). NO_x combines with hydrocarbons or volatile organic compounds in the presence of sunlight to form low level ozone. This leads to smog formation.

2. World Oil reserves

The Table.I will shows the proved crude oil reserves of leading countries of the world, In that India accounts for only 0.3% of reserves. This shows that our country will depend for crude oil from other countries which are having more oil reserves. This is one of the reasons that we should reduce our reliance upon crude oil based ICE. Table 1 shows the oil reserves of various countries including Organization of Petroleum Exporting Countries (OPEC), non-OPEC, Organization of Economic Co-operation and Development (OECD) countries and non

OECD countries with the reserves to production ratio (R/P) in the end of 2017 [11].

Table.1 World Oil reserves (Table shows the total oil reserves available in the world)

Oil Reserves	At the end 2017			
	1000 million barrels	1000 million tonnes	Share of total (%)	R/P ratio
Total North America	226.1	34.2	13.3	30.8
Total South & Central America	330.1	51.2	19.5	125.9
Total Europe	13.4	1.7	0.8	10.4
Total Commonwealth Independent States	144.9	19.7	8.5	27.8
Total Middle East	807.7	109.3	47.6	70
Total Africa	126.5	16.7	7.5	42.9
Australia	4	0.4	0.2	31.6
Brunei	1.1	0.1	0.1	26.6
China	25.7	3.5	1.5	18.3
India	4.5	0.6	0.3	14.4
Indonesia	3.2	0.4	0.2	9.2
Malaysia	3.6	0.5	0.2	14.1
Thailand	0.3	#	◆	2.1
Vietnam	4.4	0.6	0.3	36
Other Asia Pacific	1.2	0.2	0.1	12.6
Total Asia Pacific	48	6.4	2.8	16.7
Total World	1696.6	239.3	100	50.2

- less than 0.05

◆ - less than 0.05%

V. CONCLUSION

The major input for the economic development of a country is Energy. As our country is depending on oil for so many commercial as well as household applications, it is not possible to eliminate the complete usage, but we can reduce our usage on various applications and find the alternate as well as convenient way. From the Table I it is clear that the total crude oil reserves in India is very low compared to the other developed countries, which leads to the scarcity of the oil as well as the high demand of the oil

in our country. So it is necessary to reduce our dependence upon crude oil based energy production. So, we should move on towards the utilization of non-conventional energy resources like solar power, wind power, geothermal power etc. The use of renewable resources of energy is rapidly increasing worldwide. Solar power, one of the potential energy sources, is a fast developing industry in India. The country's solar installed capacity has reached 12.28 GW in year 2016-17 as compared to 6.76 GW during the year 2015-16[6]. We have already implemented so many techniques in the field of generating electricity (renewable source of energy) and automobile (hybrid vehicles, electric vehicles & alternative fuels). By this we can reduce our reliance upon crude oil based Internal Combustion Engines.

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