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The Need to Know the Right Fuel for Different Engines in Developing Countries

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Abstract

Many engines have been destroyed as a result of the constant use of wrong petroleum products on them. This paper attempts to educate people on the need to know the right fuel for different engines in the developing countries. Using the wrong fuel on an engine has always resulted from the adulteration of petroleum products by our major and independent marketers of these products in the developing countries so as to maximize profit at the expense of these engines. A lot of engines have been grounded because of long usage of the wrong fuels on them. These were the outcomes of ignorance. Although, the Department of Petroleum Resources (DPR) under the Nigerian National Petroleum Corporation (NNPC) has often conducted sanity in all petroleum products' stations in Nigeria to ascertain the availability of unadulterated products in order to guarantee safe buying of these products. In spite of this regulation, marketers still indulge in the adulteration of their products. The people worst hit by the scarcity of petroleum products especially kerosene are those in the rural parts of the country. Many have resorted to the usage of diesel fuel in their kerosene lambs or even drive their engines with an unapproved fuel. This has created global warming as a result of acute air pollution emanating from the wrong usage of these petroleum products. To eradicate this ugly trend of using the wrong petroleum products on our machineries Governments at the local, states and federal levels should set up an orientation committee on proper usage of petroleum products. This committee will expose the danger involve in adulterating and using these petroleum products wrongly.

Keywords: engine, fuel, NNPC, DPR, Nigeria

INTRODUCTION

Before we talk about the need to know the right fuel for different engines in this paper, it is proper to know how the drilling and refining of oil is carried out in order to produce the different petroleum products (Chughtai, O. and Shannon, D., 2006). It is not possible for us to put petroleum or oil directly out of the ground into cars and expect them to operate. To make use of the resource of fossil fuels, humans have developed drilling, refining and methods to harness fossil fuel energy. Early oil explorers relied heavily on intuition and guesswork to find the precious "black gold". These daring entrepreneurs were known as "wildcatters". A fabled technique used by the wildcatters is the "old hat". They would basically toss their hat up in the air and wherever it landed, they drill. When the wildcatters got lucky, and struck oil, it would typically gush up the drill pipe, hence, a gusher. Oil companies today contain gushers because they are a safety hazard and environmental concern (Chughtai, O. and Shannon, D., 2006). After discovering an oil field, it is the task of the oil company's engineers and technicians to get it out. Not all oil fields turn out to be gushers and even the ones that are virtually loose pressure, leaving a lot of untapped fossil fuel resource in the reservoir. Even with modern extraction techniques, 100% of the oil in any given field is still not yet recoverable (Bartok, W. and Sarefim, A. F., 1991).

Nigeria started using the petroleum products from crude oil when it was first discovered in Oloigbiri in Rivers State of Nigeria in 1958. The use of this product increased sporadically with the advent of the industrial revolution about 30years ago (Isaac, O. F., Ojougboh, S. and Oweh, V. E., 2009). One thing an oil company does to facilitate the extraction process is setting up what is known as a 'Christmas tree,' a system of valves and pipes that regulate oil flow and pressure. Another system used in much smaller reservoirs not worth the expense of manning with technicians is the set up of beam pump. These are also known as 'nodding donkeys', they extract oil from small oil pools that do not contain much resource. In large oil fields, techniques such as water and gas injection are employed to maximize return of the investment. Pumping water and gas into the wells increases the pressure thereby allowing oil to flow upwards once more. Large oil fields can be found under the sea floor as well. To exploit these fields,

vast oil drilling stations, which are marvels of modern engineering, tap into these underwater deposits and bring them to the surface.

Although fossil fuels have been around long before humans even discovered fire, our prehistoric ancestors had no use for them. In the late 1800's, coal and gas were used as heat and light sources, steam locomotives as well. There were early automobiles too, but these vehicles were more of a novelty than a way of life. It wasn't until the 1940's did things change. Why the 1940's? The answer is that engineers and inventors had government support and extra incentive to develop fossil fuel technologies. World War II was the catalyst and not World War I because 'The War to End All Wars' was fought by men in trenches and mechanized warfare had only been developed late in the conflict. World War II had the German Blitzkrieg, or 'Lighting War'. This tactic utilized Shtuka dive bombers and Panzer tanks; German engineers enabled this, and were eventually countered by Allied technological advancements. From then on, usage and development of fossil fuels steadily rose (Chughtai, O. and Shannon, D., 2006).

The primary refining technique used to separate hydrocarbons and provide the ingredients for modern fuels is called fractional distillation. Hydrocarbons of different size and configuration usually have differences in boiling points that are large enough to be used as a method of separation. By vapourizing them, they tend to float upwards until the hydrocarbons condense which is where they are collected. Hydrocarbons as simple as butane and alcohols with few carbons are sorted along with more complex ones such as aromatics with 9 carbons. The fuels we commonly use today are a mixture of these hydrocarbons distilled from the petroleum extracted from the earth (Isaac, O. F., 2006).

The scarcity and hoarding of petroleum products in the developing countries have created a room for the Major and Independent Marketers to adulterate these petroleum products. The consequence of this has been the shortening of the life span of these machineries or engines that uses the different petroleum products for their performances. Many engines have often broken down as a result of not using the right fuels at the right time. The quest to get rich on time in the developing countries especially in Nigeria has forced many dealers of petroleum products to adulterate these products at the expense of the users in order to maximize profit.

In addition, people have also gambled by using fuels that are not needed by some engines to run these engines due to acute scarcity and hoarding of the required fuels for such engines.

THE FUELS' TYPES AND ENGINES

Gasoline is a highly specialized fuel that contains hydrocarbons ranging from butane to C10. It is designed for the Otto-cycle engine, also known as spark ignition or 4 – stroke engine. Some characteristics of gasoline or petrol enable the quick start at low temperature, fast acceleration, and low occurrence of stalling, relative quiet and low tendency to knock and good combustion efficiency of engines (Jenkins, D. R., 1981).

The next classification of fuels is the distillate fuels. They are kerosene, turbo-jet fuel, diesel, and heating oil. Kerosene was the first petroleum fuel oil to be widely used; this was before electric lights and after the days of animal and vegetable oil. Kerosene has become very popular in the developing countries especially in our country Nigeria where access to electricity is still very limited. However, it has become less popular in the developed countries.

Turbo-jet fuel was first developed in WW II for use in airplane engines. Because of constraints on petroleum products, namely gasoline (petrol) for tanks and other ground vehicles, this fuel was designed to make use of compounds not vital to gasoline production whenever possible. The result was a highly volatile fuel that led to many accidents in handling. Modern aviation fuel is still more volatile than gasoline; through it has become much safer than it previously was (Jenkins, D. R., 1981).

Diesel fuel and domestic heating oil are similar in composition. Domestic heating oils are not widely used in the US, though they still have limited application in the developing countries. Diesel fuels are used frequently in the world today in driving trains, boats, trucks, busses, etc. (Jenkins, D. R., 1981).

Fuel oils are mainly residuals from the fractional distillation process. They are more or less the leftovers from the production of other fuels. They are used in power generation plants. However, because of the low quality and high pollution content fuel oils are being used less often.

Out of all the fuels previously listed, gasoline (petrol), turbo-jet fuel, and diesel fuel were designed for usage in engines. A fairly good, simple definition of an engine is a device that converts chemical or heat energy into mechanical energy. Engines convert fossil fuel energy into a form that we can more readily use (Isaac, O. F., 2006). The majority of engines in the world today are internal combustion engines (ICE) (Loveth, P. B., 1982). This type of engine is found in most machines and vehicles that run on fossil fuels. The first ICE was invented by Nicolaus August Otto. There are four general types of ICEs. The first is the type designed by Mr. Otto

himself, the Otto-cycle engine. These are engines we typically find in cars and are four-stroke engines because they undergo four phases during operation: intake, compression, expansion, and exhaust (Loveth, P. B., 1982).

The second type of engine is known as a two-stroke engine commonly found in lawn mowers, outboard motors, and high performance recreational vehicles. The two main differences between the four-stroke and two-stroke engines are: a four-stroke engine causes two revolution in one cycle to produce power whereas the two-stroke engines only take one revolution to complete its cycle to produce power, and two-stroke engines require a gasoline/oil mixture as fuel. This is because the cylinder must be kept completely bathed in lubricants to prevent damage (Loveth, P. B., 1982).

Diesel engines, as you might know, require no spark plugs in the combustion process. Otherwise, the design of the diesel engine is not much different than the Otto-cycle engine. Instead of spark plugs, the diesel engine relies on compression and the heating of air in the fuel mixture to cause ignition. This is achieved as a result of diesel fuel having a lower boiling point and does not require much heat. Diesel fuel is cheaper to make than gasoline, though its high level of pollutants require it to undergo further filtration (Challen, B. and Baranseu, R. B., 1999).

The last type of conventional engine to be discussed in this paper is the wankel rotary combustion engine, named after its inventor, Felix Wankel. Out of the engines discussed, this one is the most 'revolutionary' (excuse the pun). The wankel engine does not use pistons, instead it uses a rotor. The rotor spins and drives the shaft by expanding fuel in the housing on the sides of the rotor. The wankel engine was used in the Mazda motor cars RX series of cars. For all the advantages of this engine, it had one major drawback; it was extremely inefficient in fuel consumption. The oil crisis of 1973 caused this engine to lose support and funding for further development to improve consumption. Currently the RX series of Mazda has made a RX-01 concept car. Wankel rotary engines can also be found in porches and other powerful sports cars (Yamamoto, K., 1969).

Aviation fuel, the turbo-jet fuel, is used by both jet and propeller aircraft today. Prop engines are designed similar to the 4-stroke engines of cars, though the demands on these two varieties of engines are quite different. To accommodate this prop engines are much larger and have higher power output. The distillate fuel they use is ideal for this purpose. With the inception of jet propulsion the fuels used did not change all that much. Even though it may be seen that the jet engine is very different, it is still considered to be an internal combustion engine (ICE). Jet engine technology has advanced greatly and there are many different types of them. Just to list a few, there are turbojet, turbofan, turboprop, turboshaft and ramjet designs. Each have specialized uses, mostly in the aviation technology (Chughtai, O. and Shannon, D., 2006).

Fuel type	MJ/l	MJ/kg	BTU/imp gal	BTU/US gal	Research octane number (RON)
1. Regular gasoline/petrol	34.8	~47	150,100	125,000	Min. 91
2. Premium gasoline/petrol		~46			Min. 95
3. Autogas (LPG) (60% propane and 40% butane)	25.5–28.7	~51			108–110
4. Ethanol	23.5	31.1[1]	101,600	84,600	129
5. Methanol	17.9	19.9	77,600	64,600	123
6. Gasohol (10% ethanol and 90% gasoline)	33.7	~45	145,200	121,000	93/94
7. E85 (85% ethanol and 15% gasoline)	33.1	44	142,750	118,950	100–105
8. Diesel	38.6	~48	166,600	138,700	N/A (see cetane)
9. BioDiesel	35.1	39.9	151,600	126,200	N/A (see cetane)
10. Vegetable oil (using 9.00 kcal/g)	34.3	37.7	147,894	123,143	
11. Aviation gasoline	33.5	46.8	144,400	120,200	80-145
12. Jet fuel, naphtha	35.5	46.6	153,100	127,500	N/A to turbine engines
13. Jet fuel, kerosene	37.6	~47	162,100	135,000	N/A to turbine engines
14. Liquefied natural gas	25.3	~55	109,000	90,800	
15. Liquid hydrogen	9.3	~130	40,467	33,696	

Energy Content of These Fuels

The specific energy content of a fuel is the heat energy obtained when a certain quantity is burned (such as a gallon, litre, kilogram). It is sometimes called the heat of combustion. There exists two different values of specific heat energy for the same

batch of fuel. One is the high (or gross) heat of combustion and the other is the low (or net) heat of combustion. The high value is obtained when, after the combustion, the water in the exhaust is in liquid form. For the low value, the exhaust has all the water in vapor form (steam). Since water vapor gives up heat energy when it changes from vapor to liquid, the liquid water value is larger since it includes the latent heat of vaporization of water. The difference between the high and low values is significant, about 8 or 9%. This accounts for most of the apparent discrepancy in the heat value of gasoline. In the U.S. (and the table below) the high heat values have traditionally been used, but in many other countries, the low heat values are commonly used.

Neither the gross heat of combustion nor the net heat of combustion gives the theoretical amount of mechanical energy (work) that can be obtained from the reaction. (This is given by the change in Gibbs free energy, and is around 45.7 MJ/kg for gasoline.) The actual amount of mechanical work obtained from fuel (the inverse of the specific fuel consumption) depends on the engine. A figure of 17.6 MJ/kg is possible with a gasoline engine, and 19.1 MJ/kg for a diesel engine. See Brake specific fuel consumption for more information.

CONCLUSION

The attainment of a stabilized economy depends greatly on the capacity of a country to effectively utilize her energy sources so as to boost economic growth and development. The frequent hoarding of petroleum products by major and independent marketers has encouraged people in the developing countries to cultivate the habit of using the wrong fuel in engines. If people were educated in the danger of adulterating petroleum products sold to the public then the life span of these used engines would not be shortened and economic growth and development would be enhanced. Frustration has also made people to use a different fuel for a different purpose. It is a common occurrence in the developing countries that people use diesel fuel in their kerosene lambs without minding the pollution created by using a diesel fuel in such situation. Kerosene which is a mostly used fuel in the rural areas has become an expensive petroleum product that is now above the reach of many rural dwellers. This has forced them to fall back on the easily available diesel fuel for cooking and lighting purposes.

To eradicate this ugly trend of using the wrong petroleum products on our machineries Governments at the states and federal levels should set up an orientation committee on proper usage of petroleum products. This committee will expose the danger involve in adulterating and using these petroleum products wrongly.

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