



Generations of Crude Oil

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Abstract: *This day in age, one of the world's main concerns is energy. Currently, we rely on petroleum to run our cars, and household central heat, and electricity in our homes. Petroleum is not only limited, but it is also dirtying up the world's air, and depleting the ozone layer as it is burned. Alternative fuels are one of the world's most talked about issues, and many solutions have been brought forth, yet none of them have been sophisticatedly acted upon. In my research I have mentioned the extraction of crude oil and some other methods like biodiesel through ethanol, algal oil and plastic pyrolysis oil, which could be possible alternatives in the near future when there would be very less crude oil available. It also includes the various techniques for extracting the same and which are economically as well as environmentally very feasible for the well-being of the people.*

Keywords: *Crude oil, Extraction, Drilling, Biodiesel, Algal Oil, Pyrolysis Oil*

I. INTRODUCTION

Energy is defined as the ability to do work. Petroleum is used to describe a broad range of hydrocarbons that are found as gases, liquids, or solids beneath the surface of the Earth. The two most common forms are natural gas and crude oil. Petroleum consists of a complex mixture of various hydrocarbons, largely of alkane and aromatic compounds. The colour ranges from pale yellow through red and brown to black or greenish, while by reflected light it is, in the majority of cases, of a green hue. Petroleum is a fossil fuel because it was formed from the remains of tiny sea plants and animals that died millions of years ago and sank to the bottom of the oceans. Global environmental concerns and decreasing resources of crude oil have prompted demand for alternative fuels. Global climate change is also the major environmental issue of our time. Global warming, the Kyoto Protocol, the emission of greenhouse gases, and the depletion of fossil fuels are the topics of environmental concern worldwide.

II. DRILLING AND CRUDE OIL EXTRACTION

Crude oil extraction begins after successful drilling. The three most popular extraction methods are:

1. Eruptive extraction: Each crude oil deposit has a natural layer pressure, which increases by up to one bar for every 10 meters of depth. Dissolved gas also flows together with the crude oil from the oil well, the combined flow resulting in pressure depletion in the well. Consequently, the gas begins to exit from the oil accompanied by volume enlargement. The exit of crude oil from the oil well in this case can be compared with the exit of soda water from the bottle when it is opened.
2. Gas elevator extraction: After eruptive extraction has ended naturally, one then sets the oil well under sufficient pressure that will force the oil out, and so extend the period of free flowing out of the oil. Gas elevator extraction has a distinct area of application. Frequently, one prefers to pump to gas elevators during extraction of oil from larger depths (approximately between 2500 and 3500 meters).
3. Pumping extraction: Pumping is the most frequently used artificial extraction method. The most important feature of this extraction method is the use of a pump. The pump consists of three sections: the deep pump, the pump linkage and finally the drive unit, which is represented by the pump support (so-called horse head) with the driving motor. The usual stroke rate for this pump varies from a few strokes up to 20 strokes per minute. A special problem in crude oil extraction arises if high viscous petroleum or bituminous petroleum is being extracted.

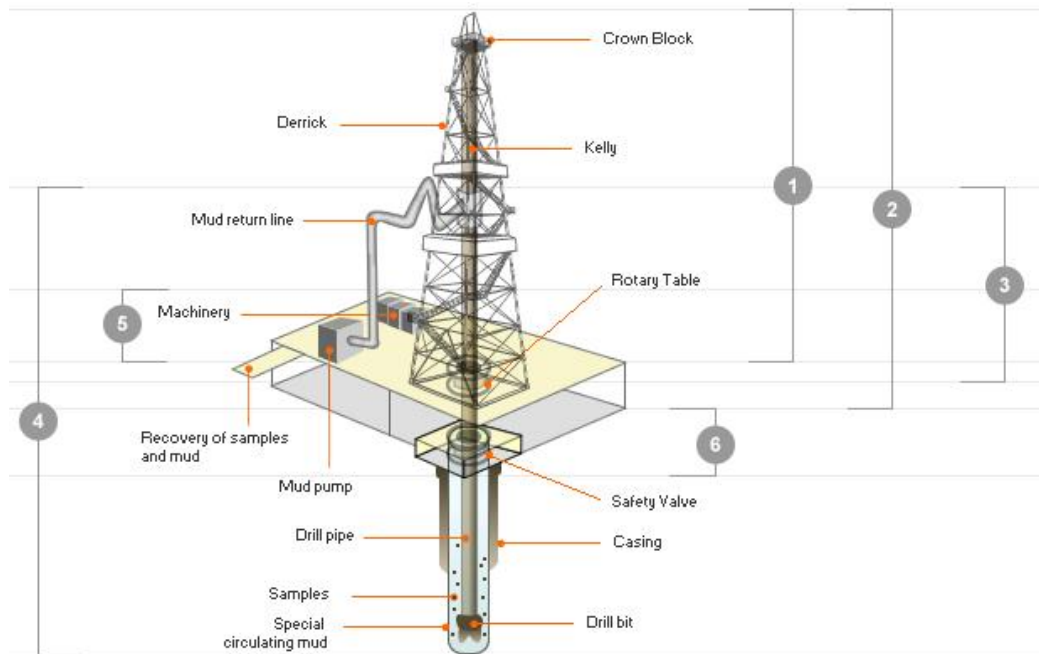


Figure 1: Drilling Tower

There is a significant number of oil wells in some places in the world, especially in Canada, with viscous and paraffinic crude oils, which are remote from practical power sources. Most of such oil wells are concentrated in deposits with porous traps. The most popular method for extraction of such oils is the thermal method. In this method, the oil deposit is opened for extraction by the opening of boreholes, which are located in a uniform triangular grid formed by a thirteen borehole system with six boreholes in each of the two concentric circles. These thirteen boreholes are located as follows: surrounding one central borehole is a circle (i.e. first concentric circle) of boreholes consisting of six boreholes, and a further six-borehole circle forming the second concentric circle. Thirteen boreholes are thus located so that each of the boreholes is located from the nearest ones by an identical distance. The heat-medium (for viscosity decrease of the petroleum) is carried out cyclically, with each cycle consisting of three stages. In the first stage, the introduction of the heat-medium is conducted simultaneously through the central input borehole and every second extraction borehole of an external ring. Crude oil is extracted from all the other boreholes. In the second stage, the introduction of the heat-medium is carried out through the central borehole as well, but the role of boreholes in the external ring changes: the heat-medium input boreholes now become extraction boreholes and the extraction boreholes now become heat-medium input boreholes. The amount of heat-medium introduced in the second stage is the same as that in the first stage. In the last stage, only the central borehole is used as the heat-medium borehole, and all the other boreholes play the role of extraction boreholes.

III. ETHANOL (BIODIESEL)

Due to increasing environmental awareness, Biodiesel is gaining recognition in the United States as a renewable fuel which may be used as an alternative to diesel fuel without any modifications to the engine. Biodiesel fuels can be produced from ethanol and vegetable oil, both agriculturally derived products. As such, they provide several advantages: they are renewable, they are safer, they are biodegradable, they contain little or no sulphur and they reduce engine exhaust smoke. Currently, the cost of this fuel is a primary factor that limits its use. One way to reduce the cost of Biodiesel is to use a less expensive form of vegetable oil such as waste oil from a potato processing plant. Biodiesel made from waste French fry oil may be cost competitive with diesel fuel and other diesel substitutes. Ethyl Esters may reduce emissions which may help open markets in urban areas. Ethyl Esters are made from ethanol and vegetable oil. They are therefore completely biomass derived products. Ethanol is less toxic, making it safer to work with than methanol. This study examines short term engine tests with hydrogenated soy ethyl esters (HySEE) and number 2 diesel fuel (D2).

A. Materials and Methods

The HySEE fuel production process utilizes 70 percent stoichiometric excess ethanol (absolute, 100 percent pure), or a molar ratio of 5.1: 1 ethanol to oil ratio. The total free fatty acids are determined and neutralized with the calculated addition of catalyst. Based on the amount of input oil by weight, 1.3 percent of KOH is used plus the amount to neutralize the free fatty acids. The following equations were used for the quantities processed:

$$\text{EtOH} = 0.2738 \times \text{Oil}$$

$$\text{KOH} = \text{Oil}/85$$

where: Oil = desired amount of oil, in litres

EtOH = amount of ethanol needed, in litres

KOH = amount of potassium hydroxide required, in kg

The waste hydrogenated soybean oil is heated to 49 degrees Celsius. The catalyst is dissolved into the alcohol by vigorous stirring in a small reactor. The oil is transferred into the Biodiesel reactor and then the catalyst/alcohol mixture is pumped into the oil and the final mixture stirred vigorously for two hours. A successful reaction produces two liquid phases: ester and crude glycerol. Crude glycerol, the heavier liquid will collect at the bottom after several hours of settling. Phase separation can be observed within 10 minutes and can be complete within two hours after stirring has stopped. Complete settling can take as long as 20 hours. After settling is complete, water is added at the rate of 5.5 percent by volume of the oil and then stirred for 5 minutes and the glycerol allowed to settle again. After settling is complete the glycerol is drained and the ester layer remains. Washing the ester is a two-step process which is carried out with extreme care. A water wash solution at the rate of 28 percent by volume of oil and 1 gram of tannic acid per litre of water is added to the ester and gently agitated. Air is carefully introduced into the aqueous layer while simultaneously stirring very gently. This process is continued until the ester layer becomes clear. After settling, the aqueous solution is drained and water alone is added at 28 percent by volume of oil for the final washing.

IV. ALGAL OIL

Algae, like corn, soybeans, sugar cane, wood, and other plants, use photosynthesis to convert solar energy into chemical energy. They store this energy in the form of oils, carbohydrates, and proteins. The plant oil can be converted into biodiesel; hence biodiesel is a form of solar energy. Algae can be a replacement for oil-based fuels, one that is more effective and has no disadvantages. Algae are among the fastest growing plants in the world, and about 50% of their weight is oil. This lipid oil can be used to make biodiesel for cars, trucks, and airplanes. Microalgae have much faster growth rates than terrestrial crops. The per-unit area yield of oil from algae is estimated to be between 20,000 and 80,000 L/acre/year; this is 7 to 31 times greater than the next best crop, palm oil. The lipid and fatty acid contents of microalgae vary in accordance with culture conditions. Algal-oil can be processed into biodiesel as easily as oil derived from land-based crops. A 1-ha algae farm on wasteland can produce over 10 to 100 times as much oil compared to any other known source of oil crops. While a crop cycle may take from 3 months to 3 years for production, algae can start producing oil within 3 to 5 d, and thereafter oil can be harvested on a daily basis. Algae can be grown using sea water and non-potable water on wastelands where nothing else grows. Algae farming for biofuels is expected to provide a conclusive solution to the food vs fuel debate. It can be inferred that algae grown in CO₂-enriched air can be converted into oily substances.

A. Biodiesel from Algal Oil

The energy density of biodiesel is comparable to petroleum diesel. The higher heating value of petroleum diesel is 42.7MJ/kg. Values for biodiesel vary depending on the source of biomass. Typically, biodiesel derived from seed oils, such as rapeseed or soybean, produces 39.5MJ/kg, while biomass derived from algae yields 41 MJ/kg (Demirbas 1998; Rakopoulos *et al.* 2006; Xu *et al.* 2006). There are three well-known methods to extract oil from algae:

- (1) Expeller/press
- (2) Solvent extraction with hexane,
- (3) Supercritical fluid extraction.

A simple process is to use a press to extract a large percentage (70 to 75%) of the oils from algae. Algal oil can be extracted using chemicals. The most popular chemical for solvent extraction is hexane, which is relatively inexpensive. Supercritical fluid extraction is far more efficient than traditional solvent separation methods. Supercritical fluids are selective, thus providing the high purity and product concentrations. This method alone can allow one to extract almost 100% of the oils. In supercritical fluid CO₂ extraction, CO₂ is liquefied under pressure and heated to the point where it has the properties of both a liquid and a gas. This liquefied fluid then acts as the solvent in extracting the oil. The lipid and fatty acid contents of microalgae vary in accordance with culture conditions. Algal oil contains saturated and monounsaturated fatty acids. The fatty acids exist in algal oil in the following proportions: 36% oleic (18:1), 15% palmitic (16:0), 11% stearic (18:0), 8.4% iso-17:0, and 7.4% linoleic (18:2). The high proportion of saturated and monounsaturated fatty acids in this alga is considered optimal from a fuel quality standpoint, in that fuel polymerization during combustion would be substantially less than what would occur with polyunsaturated fatty-acid-derived fuel (Sheehan *et al.* 1998). Oil levels of 20 to 50% are quite common. After oil extraction from algae, the remaining biomass fraction can be used as a high protein feed for livestock.

V. PLASTIC PYROLYSIS OIL

Appropriate waste management strategy is another important aspect of sustainable development since waste problem is concerned in every city. The waste to energy technology is investigated to process the potential materials in waste which are plastic, biomass and rubber tire to be oil. Pyrolysis process becomes an option of waste-to-energy technology to deliver bio-fuel to replace fossil fuel. Waste plastic is investigated in this research as it is the available technology. The advantage of the pyrolysis process is its ability to handle unsorted and dirty plastic. The pre-treatment of the material is easy. Pyrolysis is also non-toxic and does not produce environmental harmful emissions like incineration. Plastic pyrolysis oil has been investigated and found that it is able to run in diesel engine and the fuel properties of the oils are comparable to diesel oil. Pyrolysis oils is a complex mixture of C_5 - C_{20} organic compounds. The plastic pyrolysis oil is able to occur high chlorine content if the plastic is unsorted.

As known that plastic is a non- degradable petroleum based product. The old landfill area is found that degradable product is composted, become soil while plastic still exists. This problem is solved by converting waste plastic to energy by pyrolysis process.

As the petroleum based plastic is the polymeric material, the plastic pyrolysis process is the thermal de polymerization process in the absence of oxygen which is able to convert plastic into gasoline-range hydrocarbons. The waste plastic used in pyrolysis process is needed to be sorted and cleaned. The Polyethylene (PE) and Polypropylene (PP) which are the main component of the plastic in municipal solid waste are used in the process in order to prevent the contamination of chlorine in the oil. The classified waste plastic is processed from an autoclave pyrolysis reactor.

Table 1. Contents of municipal solid waste in the USA year 2010.

Component	Amount (Millions of tons)	Percentage (by weight)
Paper Waste	71.31	40.09%
Glass	11.53	6.48%
Metal	22.41	12.60%
Plastic Waste	31.04	17.45%
Woods	15.88	8.93%
Miscellaneous	25.69	14.44%

VI. CONCLUSION

The key rationale for reducing petroleum consumption lies in the fact that the market price does not account for its full social cost: the negative externalities or consequences associated with petroleum use such as greenhouse gas emissions and national security issues are not incorporated in the market prices. For economists, the standard policy response to these externalities is the imposition of a tax equal to the marginal value of the externality so that the market price would represent the full social cost of petroleum consumption. The policies discussed above are second-best alternatives to a tax policy and therefore will be less efficient than a tax (perhaps by a wide margin). Given the lack of political will to impose taxes on petroleum, second best may be all we have at the moment, but that is no reason to cease striving. Even in a second-best world, some policies are better than others. In the case of biofuels, we are concerned with their continued commercialization, the establishment of a robust market for them, and the growth of delivery infrastructure. In the case of new motor technologies (all electric or fuel-cell cars), we are concerned with continued technology development in this pre-commercial phase. Subsidies and mandates are better suited to commercialization, while policies focusing on R&D are better suited pre-commercialization. In the near future, biofuels will have to stand on their own without the large subsidies they are now enjoying, if only to protect the taxpayers from ballooning subsidy payments.

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