

Introduction

Canadians, as well as people from other industrialized nations, have become more and more aware of the impact of greenhouse gas emissions upon their environments. Global warming, once a far-off idea, now seems to be a real possibility. (NEIC, 2004). Because of concerns as to their effect on our atmosphere and possible changes to our climate and health, there has been renewed interest in finding ways to reduce these emissions. (Fuels, 2007). In fact, Canada was one of 160 countries to sign the Kyoto Protocol in 1995 committing to the reduction of it's emissions by 29 percent by the year 2010. (Kyoto, 2007). Although this goal will be difficult to achieve by that date, research and ongoing projects are taking place working towards this end.

A significant contributor to greenhouse emissions is those produced by the transportation sector in any given country. (NEIC, 2004). In looking into ways to reduce the production of these emissions, we can positively impact upon our environment. The use of biodiesels, fuels produced using renewable biological resources, is one way that we can make a significant difference. Although biofuels have been around for quite a long time, it is only relatively recently that renewed interest in environmental concerns and in finding alternatives to the world's limited fossil fuel resources has made these fuels a viable option. In fact, the incorporation of biofuels into our present system of transportation has already been shown to be an efficient and advantageous option.

What is Biofuel?

Biofuels or biodiesels are fuels that are, in essence, biodegradable and non-toxic. They are manufactured from vegetable oils, waste cooking oils, animal fats or tall oil (a by-product of

the pulp and paper industry). (NBEP, 2007). These oils undergo a process called transesterification whereby they are subjected to a reaction with an alcohol (usually methanol or ethanol) using a catalyst such as sodium hydroxide. The resulting chemical reaction produces an ester called biodiesel and a by-product called glycerin. (Canada, 2007)

Pure biodiesel fuel is significantly less flammable than petroleum diesel which burns at 50 degrees Celsius. Biodiesel's flashpoint (the temperature at which it will ignite if it is exposed to a spark) is about 150 degrees Celsius. Pure biodiesel tends to lose its viscosity or to *gel* at lower temperatures when compared to petroleum. (Canada, 2007). This can be a concern for its use in colder climates. Biodiesels are often used in combination with petroleum diesel and are referred to as biodiesel blends. These blends will have a flashpoint and a gel point somewhere between the two pure fuels depending on the mixture.

Biodiesel can be blended with diesel in any concentration but that which is used in Canada at the present time is usually a 5% or a 20% blend. (Canada, 2007). In France, however, where biodiesels are more commonly used, even for heating fuels, blends of up to 50% are employed. France is currently the world's largest producer of biodiesel. (Fuels, 2007).

History of Biodiesels

The transesterification of vegetable oils dates back to the mid-1800's where it was more likely used to distill out the glycerin which was used in the manufacturing of soap. Any source of complex fatty acids can be used to create biofuel and glycerin. Early manufacturers used oils derived from peanuts, hemp, corn and tallow whereas current sources come from soybeans, rapeseed, canola, corn, recycled fryer oil, forest wastes, sugar cane or by-products of slaughterhouses. (Yokayo Biofuels, 2006).

Two chemists, E. Duffy and J. Patrick, are credited with first experimenting with transesterification using vegetable oils to make soap in 1853, many years before the first diesel engine became functional. (Biodiesel Times, 2005). The resultant biofuel by-product was later named “biodiesel” after a motor engine inventor.

Rudolph Diesel, on August 10, 1893, first demonstrated the use of peanut oil to run his compression ignition engine. This date has since come to be known as International Biodiesel Day. (Wikipedia, 2007). He later won the *Grand Prix* (highest prize) for his innovation in 1897 at the World’s Exhibition Fair in Paris. He believed that biofuel was a viable alternative to the resource consuming steam engine. He was right, as vegetable oils continued to be used to power vehicles until the 1920’s. (Yokayo Biofuels, 2006).

Henry Ford was also a proponent of biomass fuels. He designed his 1908 Model T automobile so that it could be powered with ethanol, a common biofuel made from hemp or corn. (Yokayo Biofuels, 2006).

In the 1920’s, with the development of engines capable of utilizing a residue of the fossil fuel, petroleum, there began a rapidly growing trend away from using biofuels. The petroleum industry severely undercut biofuel sales so that the ideals promoted by Diesel and Ford went by the wayside. The American industrialists of the 1930’s such as William Randolph Hurst, the Rockefellers, and Andrew Mellon (then United States Secretary of Treasury), among others, all of whom had significant investments related to the petroleum industry, launched campaigns to discredit the use of hemp (i.e.; the Marijuana Tax Act of 1937) and thereby caused the demise of the biofuel industry. (Yokayo Biofuels, 2006)

With the scarcity of fossil fuels during the Second World War, biodiesel again came into popularity particularly among the military both in Germany and in the United States. After the war however, prosperity in the United States brought about a desire for mass-produced vehicles and once again, the industries fueled by petroleum made it so that biodiesel became less popular. (Yokayo Biofuels, 2006).

Dependence on Fossil Fuels

By the 1970's, however, most industrialized countries had become dependent on the use of fossil fuels as an energy source. As the world has only limited resources of these materials, countries where these resources are natural to them, such as in the Middle East, had gained more and more economic power. In 1973, North America experienced a fuel crisis when OPEC, the Middle Eastern organization, reduced crude oil supplies and increased prices to the rest of the world. (Energy Matters, 1998). Many of the world's current political problems continue to stem from these issues.

Obviously, it has become important to look at alternative options for energy sources. Many countries have again turned to look at biofuels as an answer. It is certainly a local renewable resource that can become a viable option. In Europe, France and Germany are actively utilizing biodiesel as an energy source. In Germany, one can purchase pure biofuel at many gas service stations. In the United States, over 200 major fleets including the Postal Service, the US Military, metropolitan transit systems and school districts now run on biodiesel fuel. (Yokayo Biofuels, 2006).

BIOBUS Project

In 2002, the Canadian government along with the *Société de Transport de Montréal* (STM) became involved in a research project called the BIOBUS project whose aim it was to look at the feasibility of using biodiesel in their fleet. (STM, 2003). Investigations aimed to compare different biodiesel blend concentrations, their effects on engine efficacy particularly with the influence of colder temperatures experienced in this part of the world and to determine their economical and environmental impact.

In Quebec, nearly 40% of all greenhouse gas emissions come from the transportation sector. A city bus can carry the same number of passengers as can 50 cars and, under regular circumstances, pollute up to 18 times less! If the use of biodiesel fuel could be shown to further reduce the environmental load, imagine the advantages! (STM, 2003).

The BIOBUS project was able to demonstrate that biodiesel could continually supply an urban transit fleet even when temperatures plummeted down to -30 degrees Celsius. In addition, it was determined that the 155 buses that took part in the STM project had helped to reduce carbon dioxide emissions by roughly 1,300 tons. By extrapolation, it was estimated that annual emissions would be reduced by 42,000 tons if all Quebec urban transit authorities used 20% biodiesel blends as fuel. Across Canada, this reduction was estimated to be 171,000 tons! This obviously makes biodiesel a prime alternative fuel for public transport. (STM, 2003)

Benefits of Biodiesel

The major reduction in greenhouse gas emissions from the use of biodiesel fuels comes from the life cycle of the fuel source itself and not necessarily from its reduction in tail gate emissions. In the collection of vegetable oils from naturally grown plants, recycling used frying

oils or rendering animal waste products, the manufacturing of pure biofuel produces 60 to 100 percent fewer greenhouse gas emissions compared with that of petroleum diesel. (Canada, 2007).

Many food and animal waste products that now end up in our landfill sites decompose naturally to produce methane gas which also contributes negatively to climate change. By diverting these products into biodiesel instead, we can further impact the environment in a positive way. (EIA, 2006).

Biodiesel is composed of 11 percent of oxygen by mass which when added to petroleum diesel, allows it to burn more efficiently. (STM, 2003). In addition, biodiesel has mild solvent properties and is thus considered to be a *clean* fuel. These factors allow biodiesel to help reduce the emissions of fine particulates and unburned hydrocarbons into the air, some of which have been associated with cancer-causing properties. (Canada, 2007).

Biodiesel fuel usage is a viable option that can be implemented without significant delay into existing diesel engines and using existing fuel transportation and delivery systems. This could certainly have important impacts in the fields of public transportation and the trucking industry.

Drawbacks

As with any relatively new movement, there are drawbacks. Of major consideration is the fact that the vast majority of privately-owned vehicles have engines that are designed only for use of petroleum fuels. Further research regarding the adaptation of these engines to allow for the use of blended fuels is required. In addition, and probably more importantly, is the requirement of education to the public regarding the advantages of using biofuels. Promoting the use of public transportation fueled by biodiesel would certainly help reduce greenhouse emissions.

However, most car drivers are not ready to give up the comforts and flexibility associated with the use of their cars so that governments would need to actively provide interesting incentives for them to do so.

Consider the possibility that societies and governing bodies actively embrace the use of biodiesel fuels, there would then soon likely be a problem of supply and demand. Resources would need to gear up in order to effectively divert currently discarded waste products from our landfills and to produce raw materials from our farm lands and forests. On one hand, a direction towards utilizing our renewable resources may in turn create new industries and reduce our disposal costs. On the other hand, expertise and foresight would be required to keep the system in balance. Farmers and the lands they tend to are obviously essential to the production of our foodstuffs for our consumption. Diverting these resources for the production of biodiesel raw materials would be unsound and could drive up the cost of food. (Gristmill, 2007). Our forests and natural landscapes need to be preserved as well so that mass forestry projects would require strict regulation. Altogether, environmental, economic and sociological factors would require an overall coordinated and balanced approach.

Conclusion

Overall, it is clear that biodiesel is an advantageous, cost-effective, environmentally-friendly fuel alternative. The fact that all societies and countries can tap into locally available resources and thereby help to reduce their dependency upon other nations for important energy materials is significant. By employing the use of biodiesels, greenhouse gas emissions have been shown to be measurably reduced. In doing so, we can also recycle waste products that might otherwise end up in landfill sites. The impact of all of this on a global scale makes the

incorporation of biodiesel fuels into our lives essential and an idea whose time has come.

Together, we can save the world, one drop at a time!

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