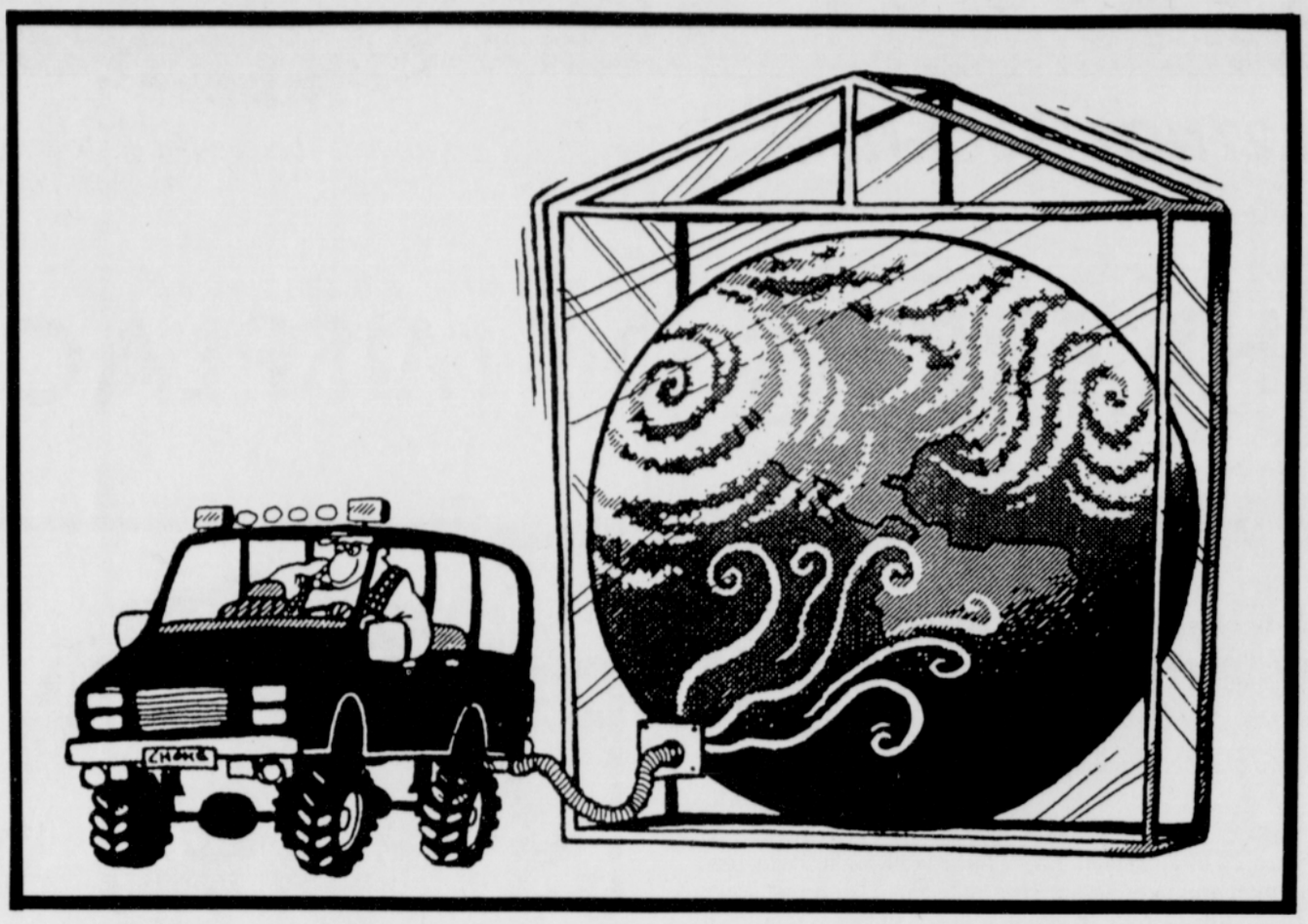
BIODIESEL A SIMPLE SOLUTION TO A COMPLEX PROBLEM



RAESIDE

BY JONNIE DUNNE

Biodiesel is a renewable, clean burning fuel derived from vegetable oils that can be used in virtually any diesel engine. It has been successfully road tested for millions of miles and has recently received increasing attention as oil resources become scarce. In 1912, Rudolf Diesel, inventor of the diesel engine, predicted this recent interest, stating, "The use of vegetable oils for engine fuels may seem insignificant today, but such oils may become, in the course of time, as important as petroleum." While Diesel foresaw and promoted the economic need for vegetable oils, he could never have predicted the urgent need for environmental stewardship we face a hundred years later. All around the world, health concerns such as cancer are becoming urgent, while global climate change threatens various environmental processes. When compared to traditional diesel fuels, the properties of biodiesel show promise to reduce many of these health issues, and the use of biodiesel can decrease the environmental harm associated with petroleum use.

The physical properties of biodiesel alone are attractive when compared to petrodiesel (the common term for traditional diesel fuel). Biodiesel is vastly safer to handle than petrodiesel; it has a flashpoint of 320 degrees Fahrenheit, compared to 143 degrees for standard diesel. This means that biodiesel will not ignite as easily as petrodiesel, and is actually classified as a non-flammable liquid by the Occupational Safety & Health Administration. This property protects all those who come in contact with biodiesel; those who produce it, those who transport and sell it, and those who use it. The same cannot be said for petrodiesel. This property has made biodiesel a popular choice in public transit vehicles in which the safety of passengers is of utmost concern.

On the occasion that a user of biodiesel comes in physical contact with the product, they are again at lower risk than those handling petrodiesel. Biodiesel has been shown to be at least as biodegradable as sugar, ten times less toxic than salt, and less irritating to the skin than a 4% soap and water solution. It has also been shown that ingesting biodiesel is not harmful to lab mice, while ingesting even a small amount of petrodiesel can prove fatal. Naturally, the benign nature of the product translates into much cleaner emissions.

Biodiesel is produced only from vegetable oils and an alcohol cataylist, while petrodiesel is generally heavily processed from low quality crude oil. The result of this disparity is that emissions of biodiesel are drastically reduced when compared to petrodiesel. Studies published by organizations such as the U.S. Department of Energy and Department of Agriculture have consistently shown that carbon dioxide emissions are reduced by 78%, carbon monoxide by 50%, particulate matter by 65%, aromatic hydrocarbons by 71%, and a slight reduction in noxious oxide. All of these reductions have been shown to have very significant effects on the health of those in contact with the fumes.

Recent mutagenicity studies have shown that developing organisms exposed to biodiesel exhaust are, when compared to petrodiesel exhaust, much less likely to form mutations. This is especially important when considering the use of petrodiesel fuels in school buses. Due mostly to stress fractures in exhaust lines and poorly designed vehicles, emissions in Los Angeles school buses have been found to be eight times higher than the ambient emissions around them. Biodiesel in this case cuts right to the root of a very significant concern — preventing health problems in children that may appear later in life as a result of early mutations. A host of other health issues associated with diesel emissions are recognized in the Clean Air Act, in which biodiesel is the only alternative fuel recognized as being compliant in reducing the threats.

Perhaps the greatest health risk associated with petrodiesel is cancer. Cancer claims millions of lives each year, and biodiesel has shown the potential to reduce these deaths. The Environmental Protection Agency has reported that the 65% decrease in particulate emissions results in a 94% decrease in the risk of cancer from biodiesel fumes. Other dangerous chemicals found in petrodiesel fumes such as sulfur are responsible for increasing cancer threats. Due to the organic nature of biodiesel versus the mineral nature of petrodiesel, some of these agents are completely eliminated. While this reduction of cancer and other health risks is undoubtedly impressive, biodiesel affects the environment much more significantly, which in turn improves human life much more effectively.

Diesel fuels are used in a wide range of applications, in the sea, on land, underground or in the sky, in urban and rural settings. Everywhere diesel engines are used, fumes are pumped into the environment, profoundly affecting the Earth. In addition to the fumes, the extraction and production of fossil fuels in general has proved to be disastrous. It was John Muir, the famous conservationist, who wrote, "When we try to pick out anything by itself, we find it hitched to everything else in the universe." This is especially so when considering the effects of oil use.Oil has been one of the most commonly used substances in the world since the late 1880s, and the aggregate damage caused by its use over these years requires immediate attention. While some of the damage is simply irreversible, the use of biodiesel can significantly reduce the ecological impact of the systems used today, and allow natural systems to repair themselves in the future.

The most visible effects of petrodiesel use can be seen on land around the world. Overland transportation is the most common use of diesel fuels, and the fuel itself is commonly extracted from and refined on land. As fossil fuels become scarce, more environmentally sensitive areas are being targeted in order to meet increasing demand in conjunction with decreasing supply. These areas, such as the Alaskan National Wildlife Reserve, may provide habitat for endangered species, but facts like these are overlooked in the name of profit. New methods are also increasingly insensitive, such as the extraction of oil from tar sands in Alberta, Canada. The oil in this area is difficult and ecologically expensive to extract. Huge tracts of land are dug up, leaving large craters in areas that were formerly migration routes for thousands of Canadian animals. The process itself involves pulling sands through the bottoms of the craters, pulverizing two tons of it, mixing it with hot water, and pumping it in huge centrifuges to separate out a single barrel of oil. The waste-water from the process is then used to flush out any of the remaining minerals.

This oil must then be refined into products consumers use, another complex system that creates even more pollution, mostly in the form of waste-water.

In contrast, biodiesel production does just the opposite. The oil used in biodiesel comes from plants, which carry out photosynthesis and convert carbon dioxide into oxygen. The farming required to do so could "help considerably in the development of agriculture of the countries which use it," according to Rudolf Diesel, and increased agriculture would mean increased carbon dioxide exchange.

The reduction of carbon dioxide in the atmosphere is incredibly important when considering the effects of petrodiesel use on land. Excessive loads of carbon dioxide in the atmosphere cause rain to become more acidic, and the effects of this phenomena known as acid rain can be devastating for certain environmentally sensitive areas. Many plants have a specific tolerance for acidity levels, and acid rain can cause incredible damage to entire ecosystems.

Acid rain also obviously affects another enormous and vastly important part of the environment, the water. Rain that has become acidic and fallen to the ground may be stored as groundwater in aquifers for an average of 40 years. While acid rain may reduce plant populations on land, it has been shown to be absolutely devastating for fish and other aquatic wildlife. John Muir's quote affirms the urgency of the situation. At the first United Nations Environment Council in Stockholm in 1972, this was kept in mind, as the council resolved to cooperate in the reduction of acid rain. One of the key strategies the UN is implementing is promoting biodiesel use.

The use of biodiesel has also been recommended as a solution to the international problem of oil spills. The biodegradeability of biodiesel has been especially well documented in the aquatic environment. Being ten times less toxic than table salt is the main factor that separates it from petrodiesel, and drastically reduces the threat of oil spills.

An excellent contemporary example is the oil spills that occurred as a result of Hurricane Katrina in 2005. Following the disaster, it was reported that 143 refineries along the Gulf Coast had spilled over 7 million gallons of oil into the ocean. Nineteen oil rigs actually broke from their supports and drifted to sensitive estuaries and deltas that line the coast. The resulting spills killed more than 700 endangered brown pelicans, and some marshes were so saturated with petroleum that igniting them was the only method that could effectively remove the oil. Had this been biodiesel, or at least a biodiesel blend, the effects would have not been as devastating. Biodiesel has been found to be readily biodegradable in the aquatic environment, and biodiesel blend triples the biodegration of diesel.

Other catastrophic oil spills, such as the *Prestige* spill in Spain, the *Sea Empress* disaster in South Wales, or the *Exxon Valdez* spill in Alaska in 1989, in which 41 million liters of oil were spilled and cleaned at a cost of $2.1 billion, would have been much easier to manage if biodiesel were used as commonly as petrodiesel. While oil spills are a serious problem that can be devastating to the immediate area, they are only temporary when compared to the prolonged and permanent problem of carbon imbalance in the oceans.

Oceans are a natural "bank" of carbon, and the effects of increased carbon levels from petrodiesel use are not immediately visible. Global oceans are referred to as a carbon sink, meaning the gigantic bodies of water absorb atmospheric carbon dioxide, a property that has greatly decreased the effects of carbon dioxide emissions. Since 1750, carbon dioxide levels have increased by 30%, from 275 parts per million, to 365 today, 65% of which is due to burning fossil fuels. However, the oceans are quickly reaching saturation, meaning they will soon no longer be able to absorb the excessive levels of carbon dioxide in the atmosphere. When this occurs, the effects of the increasing carbon dioxide will be greatly amplified, as the oceans currently take up one-quarter of atmospheric carbon.

Again, biodiesel reduces carbon dioxide emissions by 78% over petrodiesel, and the need to reduce carbon dioxide emissions is extremely urgent. This is because the rate of carbon exchange is extremely slow, measured in hundreds of thousands of years, due to the fact that a single dissolved carbon atom remains in the ocean for an average of more than 500 years. Carbon, being the fourth most abundant element on Earth, and the chemical that all life is based on, is very important to the healthy functioning of ocean life. The carbon cycle is integral to many important processes, the most significant of which is upwelling. Upwelling mixes nutrients in offshore waters, which supports coastal fisheries, which support estuaries, which in turn supports coastal forests, and so on.

The effects of increased carbon dioxide are much more visible in the media when they are related specifically to the atmosphere. Global climate change has received massive amounts of media attention and is incredibly well-documented, especially in respect to temperature. While climate change is a natural and cyclical phenomenon, global average temperatures have recently risen above any ever recorded; direct observation has shown the average temperature across the entire Earth has risen 1 degree Fahrenheit. This might not seem terribly drastic, but the warming is projected to increase; eight of the hottest years on record have occurred, since 1996, and the global average temperature is expected to increase 4 degrees Fahrenheit by 2050. Again, the effects of this phenomenon are well documented. The single simple factor of increasing global temperatures would likely kill off many rare and delicate plants, reducing biodiversity and weakening ecosystems. In addition to harming the environment, global warming would also be devastating to many human populations. Low-lying islands such as Tuvalu would be nearly submerged if polar ice caps were to melt due to global warming. The cause of all this devastation, a 30% increase in atmospheric carbon dioxide since the Industrial Revolution could be significantly reduced through the use of biodiesel.

This vast interconnectedness of nature is an inevitable property of life that humans must learn to understand and respect. It is a difficult concept to fully grasp, but the potential for good to harness this model is boundless. The use of biodiesel in place of petrodiesel immediately affects those who come in contact with it, providing safety and reducing fatal health risks, and drastically reduces the global environmental harm that is caused by burning fossil fuels. Problems such as global warming are generally beyond the scope of our own perception, but through examination of the characteristics of biodiesel, it is obvious that many of the urgent health and environmental problems we face today are greatly mitigated by the simple choice of using biodiesel.

Johnnie Dunne is a 2006 graduate of Astoria High School. He and fellow graduate Sydney Lane have produced biodiesel for a senior physics class and have contracted to partially fuel the Astoria Trolley and two shuttle buses, which they estimate will have carried 100,000 people by summer's end. Johnnie will attend Willamette University in the fall, and plans to major in environmental sciences.