

The annual NYWEA Student Paper Competition is held during the Annual Meeting in New York City. University students from around the state are invited to present their projects during the University Forum session. The following is the winning project from the 2007 competition.

Veggie Car Promotes Use of Alternative Fuels

by Eric Spargimino

The Manhattan College Veggie Car Project started as an independent study course for two environmental engineering undergraduates in the spring of 2006. The goal of the course was to modify and successfully run an existing vehicle on an alternative fuel: particularly, vegetable oil. To start, the project raised nearly \$7,000 to purchase the car and equipment necessary for the conversion. Only a diesel-powered car would accept such a conversion. By the end of their senior years at Manhattan College, the car and all parts necessary were purchased. While one of the students left after graduating, the other stayed at Manhattan College for a master's degree in environmental engineering so that the rest of the project fell to him – in other words, me. Over several weekends during the summer, the car was successfully converted in my driveway in New Jersey. Since then many things have been fixed and added to ensure the car runs properly, so it can be a reliable, consistent “lab on wheels.”



Photo courtesy of Eric Spargimino

Conversion in progress

In the past 18 months, the Veggie Car project has evolved from a conceptual idea to a fully functional 1974 Mercedes-Benz 240D that runs on used vegetable oil. The car has been driven all over New York, New Jersey and Connecticut to promote environmental issues and the environmental engineering profession. Although the car does not represent necessarily new or groundbreaking technology, the project was used as a tool to increase awareness about growing environmental concerns and the use of alternative fuels.

Once the car was converted, a cheap source of waste vegetable oil had to be found. Just like many wastewater treatment plants, restaurants pay to have their fats, oils, and grease removed. With this in mind, the food service department at Manhattan College was negotiated with to pay a small fee to remove their waste vegetable oil (WVO) for use in the Veggie Car. The payment has been used to sup-

plement some of the costs to maintain the car and conduct experiments on its efficiency.

The oil is stored in a 55 gallon (208 L) drum inside the College's engineering building. Before entering the barrel, the waste oil is passed through a 200 micron screen at the top. This process takes out large solid particles like french fries or any food particles left from the fryers. Once a month the barrel is heated to approximately 140 degrees for 45 minutes to evaporate any moisture in the pre-screened oil. As any mechanic will tell you, moisture is an enemy to any combustion engine. Once done, the oil can sit until needed. Prior to pumping the oil into the gas tank of the car, it must pass through a pressurized 40 micron bag filter. When appearing at schools to talk to children about the project, the filter is described as a three-foot tall sock. After pumping over 50 gallons of oil through my first filter since starting the project, it still does not need to be replaced. The rate at which the filter will have to be replaced is reliant on the quality of the incoming waste oil. The oil could by-pass the initial screening saving some time, but the useful longevity of the bag filter would be significantly reduced.

Test Results

To date, the Veggie Car has been driven more than 1000 miles (1609 km) on WVO. As the car promotes environmental engineering and science, it has been analyzed and tested to determine how truly environmentally friendly the car is compared to a diesel operated vehicle. Every mile has been meticulously logged and the quality of the WVO exhaust has been tested and compared to that of diesel and different formulations of bio-diesel. Out of the factory, the unmodified Mercedes 240 D gets 33 mpg (53 km/L) on diesel. Running on WVO, the car now gets 34 mpg (55 km/L). The system that was installed in the car enables it to be run on either WVO or diesel simply by operating a switch on the dashboard.

A simple schematic of the changes made to the fueling and coolant systems of the vehicle can be seen on page 46. A new fuel tank was installed in the trunk, along with new fuel lines which deliver WVO to the fuel pump. Flow to the fuel pump was modified to regulate both diesel and WVO. The only observable difference between running on WVO and diesel is a slight odor of french fries coming from the exhaust. Preliminary emissions research showed that the WVO produced cleaner emissions than the diesel.

While researching and testing with the WVO, new formulations of biodiesel were tested, using the waste vegetable oil as the primary ingredient. Biodiesel does not require any conversion, and it can be used as fuel in any diesel engine. The biodiesel was comprised of WVO and methanol; however, the methanol is not free like the WVO. So the final cost per gallon for the biodiesel is estimated at 80 cents significantly better than the \$2 to \$3 per gallon charged for diesel in most parts of the country.

Detailed emission testing was done on the diesel, biodiesel, and WVO. Emissions from the WVO showed less CO (carbon monoxide), SOx (sulphur oxides), NOx (nitrogen oxides), and particulate matter (PM) than diesel. Biodiesel results showed less PM and CO than diesel, but the NOx was about 16 percent higher. Although the biodiesel proved to be a good alternative, the WVO is still cheaper per gallon and produces less harmful emissions.

A Winning Response

In February, the car was displayed at the annual New York Water Environment Association (NYWEA) conference at the Marriott

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Photo courtesy of Eric Spargimino

Eric Spargimino displaying Veggie Car at the 79th annual NYWEA conference

Marquis in New York City's Time Square. Conference attendees were surprised and pleased with the results found from the work accomplished on the Veggie Car. People from every corner of the environmental engineering profession were discussing the project and expressing a great deal of interest in the field of alternative fuels. At the University Forum for Student Papers, the Veggie Car presentation was well attended and awarded first place. Throughout the three-day conference, many people inquired about their companies becoming sponsors of the project.

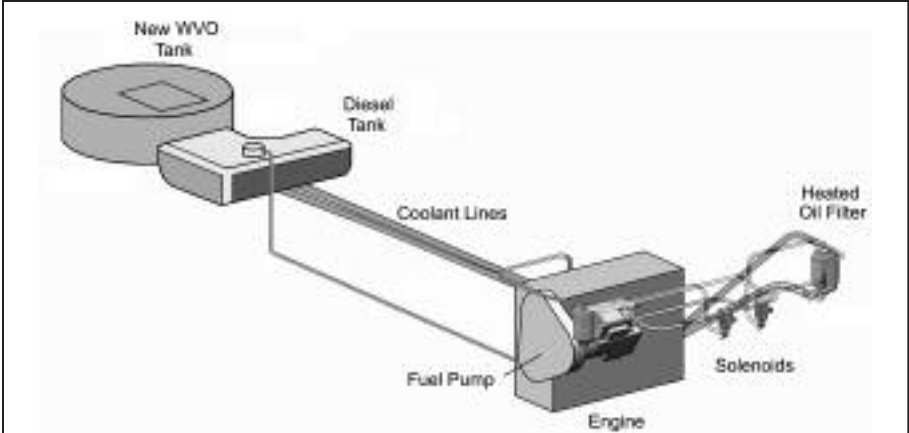
The next goal is to raise approximately \$7,000 so the car can be driven from New York City to San Diego for the Water Environment Federation's annual conference, WEFTEC® 07, in October. The

money will cover further research, necessary improvements and maintenance to the car, and expenses for the trip. People at WEF are working on supplying the Veggie Car Project with a space in the WEFTEC showroom where all current research and information can be displayed.

Environmentally-friendly technology utilizing WVO could be used as fuel for generators that help power many wastewater treatment plants around the United States. This could save operators millions of dollars on fuel and will produce less-harmful emissions that will help decrease the overall industrial pollution on the planet. There are other technologies that may be even more efficient — this is just one possibility that hopefully opens people's eyes to the growing need for alternative fuels.

Eric Spargimino is a graduate student studying environmental engineering at Manhattan College. He was awarded First Place in NYWEA's annual Student University Paper Competition and was presented the \$600 prize at NYWEA's 79th Annual Meeting held in New York City, February 4-6, 2007. If interested in sponsoring the WEFTEC trip or if you have any questions, please contact him at: espargimino.student@manhattan.edu.

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Conversion System Schematic

The original diesel lines and fuel tank are labeled above. The engine is represented by a grey rectangle. Attached to it is the original fuel pump that pulls the diesel and waste vegetable oil (WVO) from the tanks to the engine. The oil filter is a heat jacketed filter used as a final cleaning before the WVO enters the fuel pump. Two solenoids (magnetic valves) shown, direct flow to and from the fuel pump. They are operated by a three-position switch inside the car that chooses fuel to be pumped from the new WVO tank, the original diesel tank, or diesel can be pumped through the WVO lines to purge them of old oil.

The coolant lines shown coming from the WVO tank to the heated oil filter bring hot coolant from the engine to the new tank where it circulates through a copper coil to keep the WVO warm. For heat transfer efficiency, the new WVO fuel line is inside of the larger diameter coolant line, until it gets to the final filter.

The entire Veggie Car Project was made possible by the many sponsors listed below. It will continue to advance with the continued support of companies and people like these.

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