SCITEC Biofuels Extended Design Project ’08-‘09

Project Description

SCITEC teachers and students will generate refine and use two different types of biofuel in this project. The generation, refining and application of these fuels will be integrated into the curriculum of multiple classes across multiple schools, all working together to create a cooperative final product: usable stores of biofuel.

Biodiesel

Biodiesel is generated from vegetable oil or grease through a two or three step chemical separation process. This process can be undertaken without an advanced knowledge of chemistry, but does involve some chemicals that demand stringent safety requirements and laboratory techniques that require care in their execution. Biodiesel will be generated by students in introductory chemistry classes in one or more sending schools. Biodiesel can be used in cars with standard diesel engines, which will be supplied by the Auto Tech students at CATC. The efficiency of various fuel sources can be determined using measuring equipment at Central Maine Community College, and biodiesel produced by student groups can be measured against the ASTM standard D 6751 to assess its purity against a market-accepted standard.

Ethanol

Ethanol is produced through a two-step process beginning with any of a wide variety of organic waste products. The initial step in the process involves fermentation to produce ethanol and byproducts. Students and teachers at the CATC will research, design and perform this stage of the process. The second step involves distillation of this mixture to separate out usable ethanol. Students and teachers in chemistry classes at sending schools will design and perform this stage of the process using the products created by CATC students. Both of these processes must be refined to produce effectively working models that can accommodate a variety of product grades and original source materials. The generated ethanol can be burned in a modified engine. Students and teachers collaborating between CATC and its sending schools will convert an engine to run on the ethanol generated as an end-stage product of this process. These students and teachers will use this converted engine on a testbed to evaluate the effectiveness of their conversion and the efficiency of the fuel product produced during the process.

Design Elements/Parameters

In generating biodiesel, students will need to evaluate source materials and design an effective process for generating biodiesel from vegetable oil received from a variety of suppliers. Students will evaluate the product (and thus the process’ effectiveness) through the efficiency of the fuel when burned in a test vehicle. They may also have the opportunity to have their fuel tested to compare it to ASTM standards.

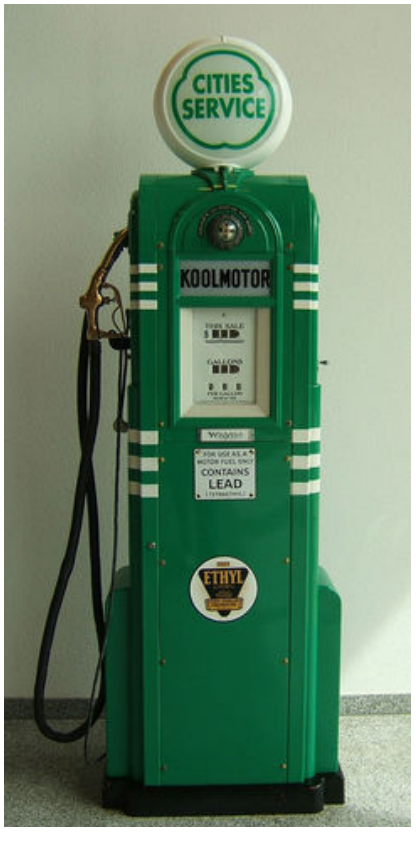
In generating ethanol, individual students or student groups will be required to identify a viable waste source for use in ethanol production, and to use this source as the feedstock of a fermentation process to generate ethanol. The efficiency of their production can be measured through rough means as simple as the specific gravity of the product and a comparison of the mass of feedstock to the mass of yield.

In purifying ethanol through distillation, students will be required to design a clear process for evaluating the input material, adjusting distillation parameters accordingly and evaluating the products of the distillation process. Students will create a written process that could be used by a technician to produce ethanol of a designated grade from an arbitrary input solution.

In converting an engine for use with ethanol, students will be required to evaluate the existing engine and necessary conversions and to measure and evaluate its efficiency before conversion and after conversion. Students will be expected to make modifications to the converted engine to increase its efficiency once running on the generated ethanol.

Timeline

Students at CATC will generate ethanol via fermentation in the Fall, and pass the products to sending school chemistry classes. Students in sending school chemistry classes will distill the ethanol in the winter and collect the product to pass to the Auto Tech students at CATC. CATC Auto Tech students will perform the engine conversion in the Fall and winter, and will test the engine using the produced ethanol.



Students and teachers already involved

Biodiesel—Cindy Fylstra's chemistry classes at Cony HS will generate biodiesel from vegetable oil for use in this project. Shawn Schultz's classes and Tim Deblois' classes will investigate the efficiency of an engine running on various biodiesel blends from the products created in the chemistry classes. Shawn and Tim's classes will also convert a vehicle to run on pure vegetable oil.

Ethanol—Luci Levesque's Biotechnology class at CATC will be determining the organic waste sources and designing and performing the fermentation process. Cindy Fylstra's chemistry class at Cony HS, among others, will be distilling the products of this fermentation process. Tim DeBlois and Dan Palmer's classes from the Automotive Technology department at CATC, together with Shawn Schultz's casses at Monmouth Academy, will convert an engine for ethanol operation, test its efficiency and modify the converted engine for improvement.

Opportunities for involvement

- Interested chemistry classes from sending schools can generate their own biodiesel from vegetable oil for use in this project. These classes will have the opportunity to send their product to CATC for use in the test vehicle, for efficiency measurement and for potential testing against the ASTM standard.
- Interested biology classes can arrange to visit the CATC biotechnology class to learn more about the fermentation process and learn how they might perform it on their own. Any biology classes generating ethanol through this or similar processes can pass their materials on to a participating chemistry class for distillation.
- Classes interested in vehicle or engine thermodynamics, fuel efficiencies or the conversion process can arrange to visit the CATC Auto Tech class or the CMCC efficiency measurement station. These visits would be especially effective when done when engines or tests are being run using the visiting students' generated fuels.
- Students and teachers participating in any of these aspects are also invited to the student green design fair at CATC on May 5, 2009, to show their work and see the work of others.
- Opportunities for workshops or trips to university labs are planned during the year. Teachers interested in learning more about the process and technology involved in biodiesel can attend these to learn about the issues and processes in more depth.