PROCESSING AND ENVIRONMENTAL CATALYSIS

CLEAN ENERGY TECHNOLOGIES

SUPERCETANE TECHNOLOGY

Natural Resources Canada (NRCan) has developed a new process to convert waste vegetable oils and greases, animal tallow and other high lipid waste products into a renewable, high cetane diesel fuel blending stock called 'SuperCetane'. By raising the cetane content in diesel fuel, engine pollutant emissions are reduced and fuel economy improves.

Discovered in the 1980's at the Saskatchewan Research Council and now being developed by researchers at NRCan's CETC-Ottawa laboratories, SuperCetane could replace nitrate based cetane additives to increase diesel performance.

Process

The CETC-Ottawa process adapts conventional petroleum refinery technology operating under proprietary conditions, to generate its product. Several reactions occur in the process, including: hydrocracking (breaking apart of large triglyceride molecules), hydrotreating (removal of oxygen), and hydrogenation (saturation of double bonds). A conventional commercial refinery hydrotreating catalyst is used in the process and hydrogen is the only other input.

A number of renewable feedstocks have been successfully processed in CETC-Ottawa's hydrotreating reactor systems including canola oil, soya oil, yellow grease, animal tallow and tall oil (a by-product of the kraft pulping process). CETC-Ottawa has also constructed a semi-pilot (700-mL) tubular reactor system and a larger scale process development unit (PDU) that are being used to optimize process parameters and to produce large volumes of product for performance and exhaust emission tests. To date, several successful tests have been conducted in both units.

Product

The product generated by CETC-Ottawa's process is a hydrocarbon liquid, which can be distilled into 3 fractions: naphtha, middle distillate and waxy residues. The middle distillate, which makes up most of the product, is the SuperCetane. It has a cetane number (a measure of ignition quality) of around 100 – which is comparable to commercial cetane additives. The specific gravity of SuperCetane is similar to regular diesel while its viscosity is similar to biodiesel. It is 97% biodegradable as compared to 45% for regular diesel.

The cetane number increases linearly with the concentration of SuperCetane, unlike commercial additives, whose impacts are limited above a certain concentration. Further, when SuperCetane is blended with commercial additives, the cetane value of the final blend is improved synergistically. Fuel economy savings are an added benefit of SuperCetane – in a six-month test program using a fleet of Canada Post delivery vans operating in Vancouver, Canada, fuel economy savings of 8% were achieved.

Automated reactor system used for producing cetane enhancer (SuperCetane)

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Emissions Reductions

Combustion and emission tests have been performed on CETC-Ottawa's SuperCetane by ORTECH in Toronto, Canada and by the Environmental Technology Centre (ETC), Environment Canada in Ottawa, Canada. The CETC-Ottawa product and commercial cetane additives displayed comparable gaseous emission reductions of total hydrocarbons, NO_x, particulates and carbon monoxide. Emission reductions were found to be due in large part to improved combustion characteristics. As expected, the higher emission reductions occurred when the CETC-Ottawa SuperCetane was added to lower grade diesel fuel (cetane numbers below 40). As such, CETC-Ottawa's SuperCetane may prove most valuable as a blending stock for lower quality diesels.

Life cycle analysis indicated a reduction in greenhouse gas emissions of up to 23% with a blend of 20% SuperCetane in diesel fuel.

Conversion of restaurant grease (left) to SuperCetane (right)

The middle distillate (SuperCetane) is the primary liquid product of the technology and product yields range from 70% - 80% for yellow grease and tallow. With its long, straight chain hydrocarbon molecules, the CETC-Ottawa SuperCetane resembles conventional diesel fuel when analyzed by GC/MS and is miscible in all proportions with diesel fuel. In the most recent tests, the sulphur content was less than 10 ppm thus meeting the upcoming diesel fuel specifications.

Opportunities

CETC-Ottawa has recently completed a project with Ottawa-based Advanced Engine Technology Ltd. (AET) to determine whether the addition small amounts of SuperCetane and biodiesel to oil sands diesel can improve the quality and exhaust emissions of the fuel. Results indicate that fuel blending reduces particulate matter and nitrogen oxides exhaust emissions and that this reduction improves with increasing concentration of SuperCetane.

Under a contract from CETC-Ottawa, Calgary-based C.J. Wheeler Process Consultant Inc. recently completed an engineering and economic feasibility study for the construction and operation of a commercial plant to convert biomass-derived oils (including vegetable oils and yellow grease) to SuperCetane and a highly paraffinic lubricant basestock (wax).

There are many other interesting commercial applications for the CETC-Ottawa SuperCetane that are currently being investigated:

- As an additive to B20 bio-diesel to reduce NO_x emissions.
- As an additive to low-grade middle distillates such as those derived from oil sands.
- As a waste disposal option for the rendering industry.

Advantages of the CETC-Ottawa SuperCetane Process

- Produces a high yield of SuperCetane product (up to 93% in vol.) with a high cetane number (about 100), low sulphur content and characteristics similar to premium diesel.
- Reduces emissions of engine pollutants.
- Has the ability to process a wide variety of fatty feedstocks.
- Produces useable "hydrocarbon" co-products that are well suited to conventional refinery streams.
- Uses existing technology and refinery hardware and has limited technical risk.
- Is relatively low cost.

Your Invitation to Work with Us

We are interested in collaborating with you. Please contact the Business Office to discuss your particular needs.

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