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ADVANCED BIOFUELS USING OZONE MEDIATED TECHNOLOGY

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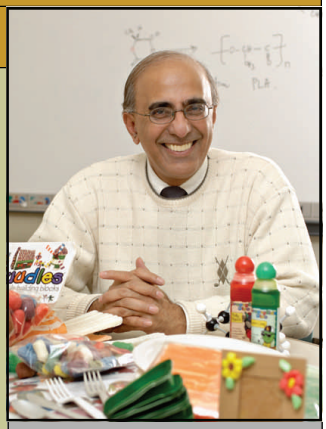

The presence of double bonds (unsaturation) in fatty acid methyl esters (FAME) of vegetable oils like soybean and the relatively high average molecular weights (MW) affect the thermo-oxidative stability, flow and compatibility of biodiesel compared with a petroleum-based diesel.

This project targets the production of new, advanced biofuels with enhanced thermal and oxidative stability, improved low temperature properties, low viscosity, and high volatility. This is achieved by reacting the double bonds in the fatty acid esters with ozone, followed by an in situ base catalyzed transformation of the intermediate ozonide to form esters by reaction with an alcohol. Preliminary data indicate that the oxidative stability of the new esters and di-esters product mixture is drastically improved once the double bonds are eliminated. As a result the thermal stability in air and, even more so at elevated temperatures, is greatly improved. Furthermore, the lower molecular weight mixture has similar viscosity and volatility to peteroleum Diesel #2 fuel. It is further expected that the low MW fragments will act to lower the cloud point and pour point. Hence, it is anticipated that our biofuel will resolve issues related to filter plugging, injector failure and overall problems with fuel economy, emission and power loss. Furthermore, the ozonation process enriches the oxygen content making the product suitable as fuel oxygenates which should improve fuel economy and reduced harmful air emission. These new biofuels are expected to be non-toxic and readily biodegrade in the environment. The use of higher molecular weight alcohols in our catalytic ozonation process will produce a higher viscosity mixture of esters and di-esters, which are potentially useful as lubricants.

Successful completion of the project will result in the design and engineering of a new, one step, and continuous ozone mediated process technology to transform fatty acid methyl esters of vegetable oils to biofuel compositions with enhanced thermal and oxidative stability, improved low temperature properties, low viscosity, and high volatility. These new biofuels would overcome the limitations of current biofuels such as filter plugging, injector failure and overall problems of fuel economy, emission and power loss. The planned process technology should further yield oxygen enriched value-added products suitable as fuel oxygenators and bio-based lubricants.

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