COMPANY: Plant-Based Coolants

Archer Daniels Midland (ADM)

PROBLEM

Using Plant-based coolants to replace GHG-intensive petroleum-coolants

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The use of coolant (propylene glycol) in our engines and machinery is a significant contributor to greenhouse gas due to its highly energy-intensive manufacturing process. *The manufacturing of propylene glycol is highly energy intensive*.* Coca-Cola companies use a great deal of coolant:

- Big engines can contain 20-30 gallons of propylene glycol.
- Other equipment and like HVAC chillers can hold far greater amounts as a heat/cool transfer fluid.

DESCRIPTION OF PRACTICE: RUNNING ON PLANT BASED COOLANT

Plant-based coolant (propylene glycol) can be used instead of the energy-intensive petroleum-based coolant to reduce the related greenhouse gas emissions by 61%.

What is Plant-based coolant?

Plant-based coolant is derived from soybeans or canola. The process involves crushing, de-hulling, conditioning, flaking and extraction crude vegetable oil from soybean or canola seeds. This vegetable oil is further processed into refined oil. The refined oil is then transformed through a trans-esterification process into crude biodiesel and crude glycerin (by-product). Glycerin is further processed through evaporation and distillation steps into glycerin. Glycerin is further processed into propylene glycol. The propylene glycol is further distilled into an industrial-grade or a USP-specification-grade propylene glycol. The process of changing glycerol to propylene glycol is a simple chemical reaction that uses no environmentally harmful chemicals and uses only water for solvent; thus minimizing risk of harm to the environment.(*Chemical process illustrated below.) The solid catalyst used in the process has a long life and, when exhausted, the metals can be reclaimed and recycled rather than sent to a landfill.

RESULTS

Renewable products and fewer greenhouse gas emissions

The estimated emissions from plant-based coolant (Propylene Glycol) are less than half of the emission of petroleum-based coolant (propylene glycol). The overall greenhouse gas emissions for this plant-based coolant are 3.24 kg CO2eq per kg propylene glycol. The environmental performance of plant-based coolant when benchmarked against the petroleum-based route for propylene glycol production was of 8.23 kg CO2eq per/kg propylene glycol. When comparing the plant-based process to the petroleum-based process, there is a 61% reduction in GHG emissions.

COST

Based upon ChemSystem's analysis, the cost of plant propylene glycol should be competitive at the current cost of production. Their analysis indicates the ability to identify plant-based propylene glycols that can provide a cost savings:

The cost of production for propylene glycol made from crude biodiesel-based glycerin is compared to conventional propylene oxide-based propylene glycol. The following cases are presented:

- Glycerin based with crude glycerin at $0.05/lb
- Glycerin based with crude glycerin at $0.17/lb
- Propylene oxide based with PO at cash cost of production
- Propylene oxide based with PO at full cost plus 10% ROI

Even at the highest recent cost of crude biodiesel glycerin, the glycerin-based product has a cost advantage over conventionally produced propylene glycol. This is the obvious reason why this concept is receiving so much interest even from Dow Chemical, one of the world's largest producers of conventional propylene glycol.

However, these cost analyses are a snapshot in time and for a more complete analysis thought must be given to other cost scenarios such as a return or at least a partial return to a more "normal" oil price scenario. In the report we look at the sensitivity of propylene glycol costs as a function of both crude glycerin prices and propylene prices.

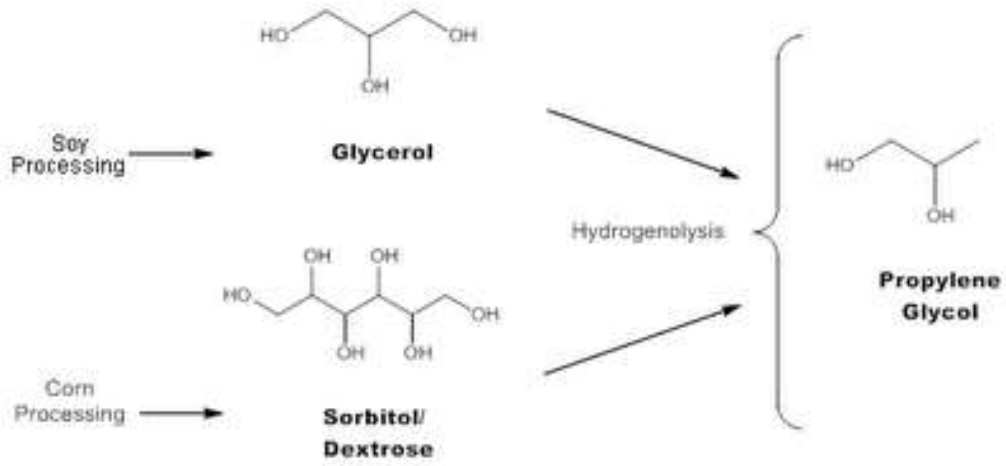
If propylene prices stay at these historic highs then the glycerin-based process has a distinct advantage. However, if oil prices abate, two factors will mitigate against the new glycerin-based processes. One is that propylene prices will fall and will cause the costs of PO-based propylene glycol to decrease as well. However, if oil prices abate, fuel prices will also fall and this will make biodiesel economics more difficult and production of biodiesel will decline. This in turn will cause biodiesel-based glycerin supply to decrease raising its price and further narrowing the cost gap or even surpass the costs of PO-based propylene glycol. These are the commercial risks inherent in any commercialization of a new process technology, but especially so with any new technology that is based on renewable resources and dependent on high oil prices to compete.

The full analysis can be seen here:
http://www.chemsystems.com/about/cs/news/items/PERP%200607S4_Glycerin.cfm

RESOURCES

Additional manufacturing information
The manufacturing of propylene glycol is highly energy intensive. Petroleum-based propylene oxide is used to produce commercial and industrial products including propylene glycols, polyether polyols, and propylene glycol ethers. It is among the most diffused chemical intermediates worldwide and its production is on the rise. Industrial production of Propylene Oxide generally involves hydro-chlorination or oxidation.

***Above referenced process**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