UOP
A Honeywell Company

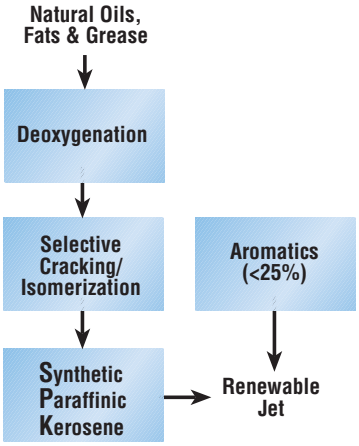
Renewable Jet Process

Renewable Energy and Chemicals

Introduction

UOP LLC, a Honeywell company, is in the final stages of developing a process to convert natural oils derived from bio feedstocks to jet aviation fuel. This process has been developed as part of a DARPA-funded research project. After certification, UOP expects that the resulting Synthetic Paraffinic Kerosene (SPK) product will be used directly as a blended component with petroleum-derived jet fuel or will be combined with aromatics from either a renewable or petroleum source. The resulting fuel will meet Jet A-1 or JP-8 specifications. UOP plans to offer the process for license by the second quarter of 2009.

Overview of Renewable Jet Production

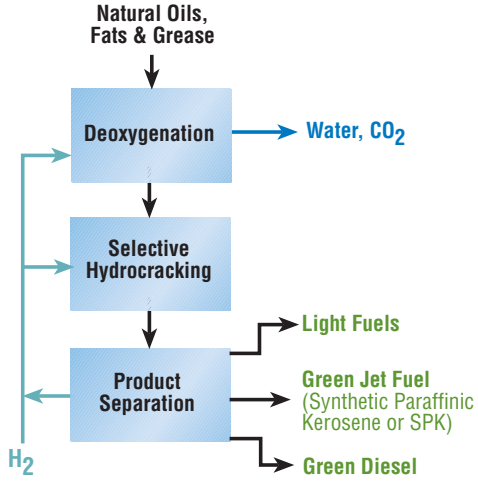


Process

The renewable jet process* is based on UOP's EcofiningTM process, which is commercially available for the production of green diesel produced from biofeedstocks. While the Ecofining unit can produce up to 15 vol-% of SPK jet fuel, as a co-product with diesel, this new process is designed to maximize the yield of SPK to 50-70 vol-%. This is achieved by optimizing the catalytic processes of deoxygenation, isomerization and selective cracking of the hydrocarbons present in natural oils and fats to yield a high quality, ultra-low sulfur jet fuel that meets Jet A-1 specifications, including freeze point of -47°C (-52.6°F) and flash point of 38°C (100°F). Co-products from this new process are diesel and naphtha range material.

* The Renewable Jet process name is not finalized

Renewable Jet Process Flow Diagram



The process can be adjusted to produce a specific freeze point of the SPK or can alternately be operated in a max-diesel mode.

Feed flexibility

The renewable jet process can convert a variety of refined natural oils and fats including edible and non-edible natural oils, tallow and algal oils. A key difference between the new jet process and the Ecofining process is the need to reduce the natural oil carbon chain lengths to the required range for jet fuel. To solve this, the renewable jet process uses a selective cracking step which reduces the natural oil C16-C18 carbon chain lengths to carbon chain lengths in the C10 to C14 range for jet fuel. UOP's development has shown that the process can process C18 oils like soy, palm and canola oils, C12 oils like coconut oil, inedible oils like jatropha and camelina and a variety of algal oils, to produce SPK fuel that meets the preliminary SPK specifications considered by ASTM.

Catalysts

The renewable jet process utilizes deoxygenation and isomerization/selective cracking catalysts which are supplied by UOP.

Product properties

The table below highlights the SPK product produced by the process, using jatropha and camelina feedstocks meets or exceeds the requirements of some of the key Jet A-1 specifications.

Analysis of Renewable Jet Samples

	Jet A-1	Jatropha	Camelina
Property	Spec	SPK	SPK
Flash point, °C	38 min	46	42
Freeze point, °C	-47	-57	-63.5
Net heat of combustion, MJ/kg)	42.8 min	44.3	44.1
JFTOT (2.5h at control temp, °C)	260 min	300	300
Filter pressure drop, mmHg	25 max	0	0
Tube deposits	<3	<1	<1
Distillation,			
10%	185 max	168.5	163
50%	report	186.0	183.5
End boiling point	340 max	248	242
Density, kg/m^3	775 - 840	749*	753*
Sulfur, ppm	-	<0.01	<0.01
Trace metals (each), ppm	-	<0.05	<0.05

* by definition SPK fuels have a lower density. However once blended with aromatics the final jet fuel meets the Jet A-1 density specification.

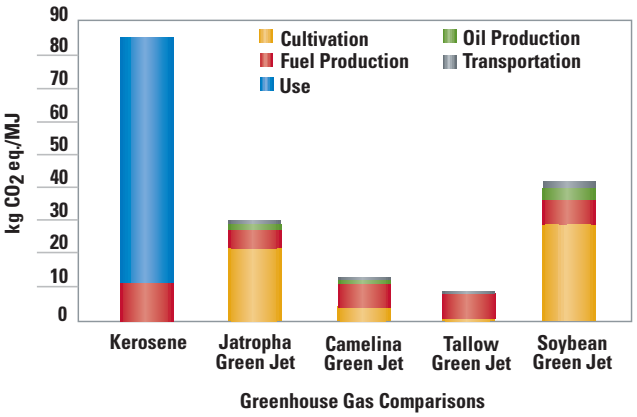
Testing and certification

UOP actively participates in the fuel qualification process for bio-derived SPK. To provide sufficient quantities of SPK for these activities UOP has worked with its partners and a toll manufacturer to produce over 6,000 gallons of SPK to date from a variety of 2nd generation bio feedstocks.

Life cycle analysis

UOP has completed a preliminary Life Cycle Analysis (LCA) for the green jet fuels produced. The results when processing camelina, jatropha, tallow and soybean based jet are compared in the figure below with the LCA of current petroleum kerosene fuel. Early results indicate that renewable jet fuels show promise as a sustainable component to petroleum kerosene.

Life Cycle Analysis of Green Jet



Technology delivery

UOP will offer licenses and basic engineering design packages of the renewable jet process to meet customer requirements, starting in 2Q09. Via our alliances with leading contractors worldwide, UOP can also provide complete project implementation services and support.

For more information

For more information, contact your local UOP representative or our Des Plaines sales office:

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