

Bio-derived Liquefaction Oil

BIOREFINING PROCESS SOURCE

Thermochemical liquefaction

DESCRIPTION

Raw liquefaction oil is a free-flowing, dark liquid that can be stored and transported, allowing decoupling of feedstock, process, and use. It is a complex mixture of oxygenated hydrocarbons, with aromatic compounds, multiple heavy and light fractions that can be refined, and essentially no sulfur.¹ It has a heating value of approximately 36MJ/kg (15,500 Btu/lb).²

Changing World Technologies³ produces a derived light liquefaction oil they call TDP-40, and it is a mixture of C20-minus Bio-derived hydrocarbons. TDP-40 has shorter chain lengths and a narrower range of chain lengths. The dominant carbon chain lengths are between 15 and 19, with only a very small portion above C-20. This difference in carbon chain lengths will cause some differences in combustion characteristics that can translate into improvements (reductions) in combustion pollutant emissions. The pour point of TDP-40 oil is -17°F. The boiling points for 75% of the components of TDP-40 oil are lower than for Cetane. This is due to the second stage of processing that breaks fatty acids into smaller hydrocarbon molecules.

REPRESENTATIVE BIOBASED PRODUCT OPPORTUNITIES

BIOBASED PRODUCT	CLASSIFICATIONS	MARKET OPPORTUNITY	MARKET SIZE
Raw bio-derived liquefaction oil	Liquid Fuel, Chemical Feedstock	Markets include refineries that will separate the different components; fuel blenders that will blend with heavy oils to make a higher value fuel oil; and boiler operations that will combust the oil to produce power.	Large
TDP-40, a refined bio-diesel from Changing World Technologies	Liquid Fuel	TDP-40 can be used as a blended fuel, a chemical feedstock, or as a stand-alone fuel to generate steam and/or power in a diesel engine. ³	Large
Refinable hydrocarbon chemicals including: cyclohexane, methylethyl benzene, toluene, cyclopropane	Solvent	Cyclohexane is used as a paint remover, solvent for lacquers and in making nylon. Methylethyl benzene is typically used in producing rubber, waxes and resins and is often blended with gasoline and other fuels. Toluene is primarily utilized as a solvent in the manufacture of explosives, dyestuffs and added to aviation fuel to improve its octane. ³	Large
Fatty Acid Oils	Pharmaceuticals, Detergents, Surfactants, Personal Care Products	Fatty acids are used in a range of applications: detergents, soaps, cleaners, stabilizers, industrial surfactants and pharmaceuticals, personal care products, lubricants and rubber products. The fatty acids produced by Changing World Technology process are primarily palmitic, stearic and oleic acids. ³	Large

REFERENCES

¹ Duncan, Donn G. Chairman, Biomass Transformation Industries LLC, Santa Fe, NM; Don H. White, Professor Emeritus, Dept. of Chemical Engineering, Univ. of Arizona, Tucson, AZ. April 11-13, 2002. Wood-Derived Crude Oil. Presentation at “SMALLWOOD 2002: Community & Economic Development Opportunities in Small Tree Utilization”. Albuquerque, NM .

² Brown, Robert C. 2003. Biorenewable Resources Engineering New Products from Agriculture. Iowa State Press, Ames IA.

³ Roberts, Michael, P.E., Gas Technology Institute, James Williams, Kvaerner Process Systems, Paul Halberstadt and Don Sanders, Renewable Environmental Solutions, LLC, and Dr. Terry Adams, Changing World Technologies. 2004. Animal Waste to Marketable Products, Natural Gas Technology Conference. <http://www.changingworldtech.com/techfr.htm> (April 16, 2004).