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SYNTHETIC FUEL

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Annotation. The article provides a variety of obtaining synthetic fuel from biological municipal waste. As well as increasing the role of various alcohols in internal combustion engines, dehydration methods for obtaining demitelethers from methanol.

Keywords: biomass, natural gas, synthetic diesel fuel, ethanol, butanol, water-carbon fuel, dimethyl ether, methyl tert-butyl ether.

Аннотация. В статье приводится разновидности получения синтетического топлива из биологических коммунальных, отходов. А также повышение роли различных спиртов в двигателях внутреннего сгорания дегидратационных методов получения демителэфиров из метанола.

Ключевые слова: биомассы, природного газа, синтетическое дизельное топливо, этанол, бутанол, водоуглеродного топлива, диметиловый эфир, метил-трет-бутиловый эфир.

Аннатация. Мақолада биологик массалар ва саноат, коммунал маиший чиқиндилардан сунъий ёнилғи турларини олиш усуллари келтирилган. Шунингдек хилма-хил спиртларни ички ёнув двигателлари учун дегидратация билан метанолдан олиш усулининг роли тобора ошиб бориши баён қилинган.

Таянч сўзлар: биомасса, табиий газ, синтетик дизел ёнилғиси, этанол, бутанол, сувуглерод ёнилғиси, диметил эфир, метил-трет-бутил эфира.

Introduction

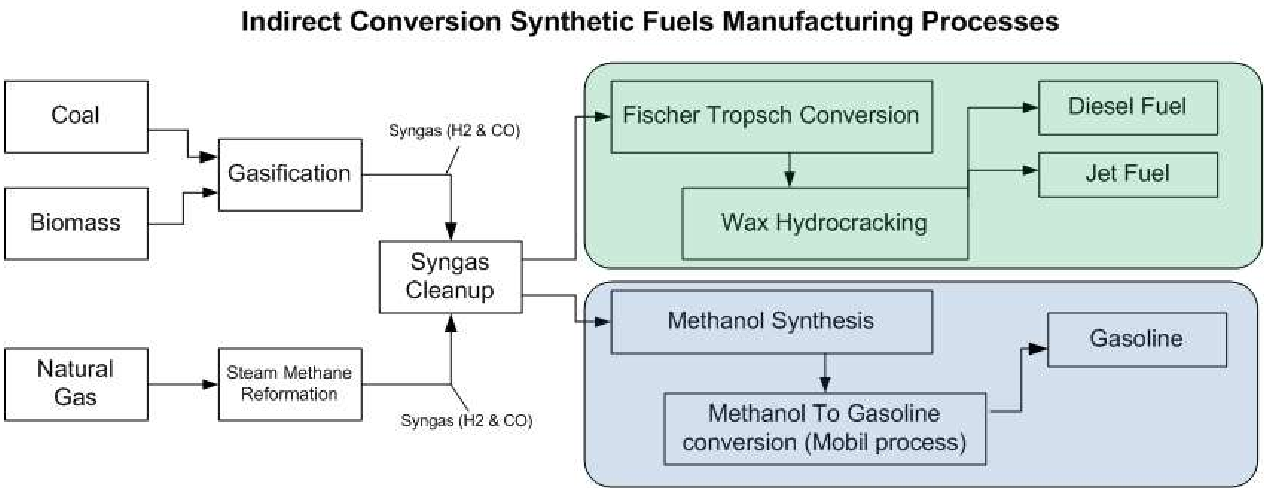
Synthetic fuel or synfuel is a liquid fuel, or sometimes gaseous fuel, obtained from either syngas, a mixture of carbon monoxide and hydrogen, or a mixture of carbon dioxide and hydrogen. The syngas could be derived from gasification of solid feedstocks such as coal or biomass or by reforming of natural gas. Alternatively a mixture of carbon dioxide from the atmosphere and green hydrogen could be used for an almost climate neutral production of synthetic fuels.Common ways for refining synthetic fuels include the Fischer–Tropsch conversion, methanol to gasoline conversion or direct coal liquefaction. As of July 2019, worldwide commercial synthetic fuels production capacity was over 240,000 barrels per day (38,000 m^3/d), with numerous new projects in construction or development, such as Carbon Engineering. Classification and principlesThe term 'synthetic fuel' or 'synfuel' has several different meanings and it may include different types of fuels. More traditional definitions, such as the definition given by the International Energy Agency, define 'synthetic fuel' or 'synfuel' as any liquid fuel obtained from coal or natural gas. In its Annual Energy Outlook 2006, the Energy Information Administration defines synthetic fuels as fuels produced from coal, natural gas, or biomass feedstocks through chemical conversion into synthetic crude and/or synthetic liquid products.[4] A number of synthetic fuel's definitions include fuels produced from biomass, and industrial and municipal waste.[5][6][7] The definition of synthetic fuel also allows oil sands and oil shale as synthetic fuel sources, and in addition to liquid fuels, synthesized gaseous fuels are also considered to be synthetic fuels:[8][9] in his 'Synthetic fuels handbook' petrochemist James G. Speight included liquid and gaseous fuels as well as clean solid fuels produced by conversion of coal, oil shale or tar sands, and various forms of biomass, although he admits that in the context of substitutes for petroleum-based fuels it has even wider meaning.

Processes

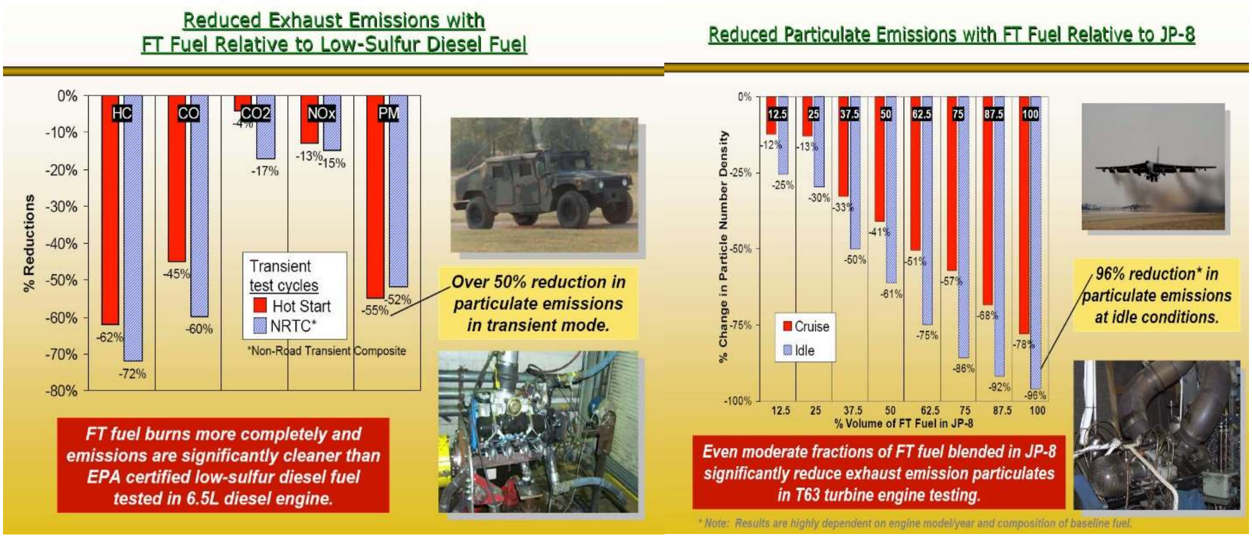
Indirect conversion Gas to liquids Indirect conversion has the widest deployment worldwide, with global production totaling around 260,000 barrels per day (41,000 m3/d), and many additional projects under active development. Indirect conversion broadly refers to a process in which biomass, coal, or natural gas is converted to a mix of hydrogen and carbon monoxide known as syngas either through gasification or steam methane reforming, and that syngas is processed into a liquid transportation fuel using one of a number of different conversion techniques depending on the desired end product.

Exhibit 1: Coal Liquefaction Technologies

Mild Pyrolysis	Single-Stage Direct Liquefaction	Two-Stage Direct Liquefaction	Co-Processing and Dry Hydrogenation	Indirect Liquefaction
- Liquids from Coal (LFC) Process – Encoal - Coal Technology Corporation - Univ. of North Dakota Energy and Environmental Center (EERC)/AMAX R&D Process - Institute of Gas Technology - Char, Oil Energy Development (COED)	- Solvent Refined Coal Processes (SRC-I and SRC-II) – Gulf Oil - Exxon Donor Solvent (EDS) Process - H-Coal Process – HRI - Imhausen High-Pressure Process -Conoco Zinc Chloride Process - Kohleoel Process – Ruhrkohle - NEDO Process	- Consol Synthetic Fuel (CSF) Process - Lummus ITSL Process - Chevron Coal Liquefaction Process (CCLP) - Kerr-McGee ITSL Work - Mitsubishi Solvolysis Process - Pyrosol Process – Saarbergwerke - Catalytic Two-Stage Liquefaction Process – DOE and HRI - Liquid Solvent Extraction (LSE) Process – British Coal - Brown Coal Liquefaction (BCL) Process – NEDO - Amoco CC-TSL Process - Supercritical Gas Extraction (SGE) Process – British Coal	- MITI Mark I and Mark II Co-Processing - Cherry P Process – Osaka Gas Co. - Solvolysis Co-Processing – Mitsubishi - Mobil Co-Processing - Pyrosol Co-Processing – Saabergwerke - Chevron Co-Processing - Lummus Crest Co-Processing - Alberta Research Council Co-Processing - CANMET Co-Processing - Rheinbraun Co-Processing - TUC Co-Processing - UOP Slurry-Catalysed Co-Processing - HTI Co-Processing	- Sasol - Rentech - Syntroleum - Mobil Methanol-to-Gasoline (MTG) Process - Mobil Methanol-to-Olefins (MTO) Process - Shell Middle Distillate Synthesis (SMOS)



The primary technologies that produce synthetic fuel from syngas are Fischer–Tropsch synthesis and the Mobil process (also known as Methanol-To-Gasoline, or MTG). In the Fischer–Tropsch process syngas reacts in the presence of a catalyst, transforming into liquid products (primarily diesel fuel and jet fuel) and potentially waxes (depending on the FT process employed). The process of producing synfuels through indirect conversion is often referred to as coal-to-liquids (CTL), gas-to-liquids (GTL) or biomass-to-liquids (BTL), depending on the initial feedstock. At least three projects (Ohio River Clean Fuels, Illinois Clean Fuels, and Rentech Natchez) are combining coal and biomass feedstocks, creating hybrid-feedstock synthetic fuels known as Coal and Biomass To Liquids (CBTL).[26] Indirect conversion process technologies can also be used to produce hydrogen, potentially for use in fuel cell vehicles, either as slipstream co-product, or as a primary output.[27] Direct conversion Direct conversion refers to processes in which coal or biomass feedstocks are converted directly into intermediate or final products, avoiding the conversion to syngas via gasification. Direct conversion processes can be broadly broken up into two different methods: Pyrolysis and carbonization, and hydrogenation.[citation needed] Hydrogenation processes See also: Bergius process One of the main methods of direct conversion of coal to liquids by hydrogenation process is the Bergius process.[28] In this process, coal is liquefied by heating in the presence of hydrogen gas (hydrogenation). These fuels, because of their high level of purity and lack of contaminants, further enable the use of advanced emissions control equipment that has been shown to virtually eliminate HC, CO, and PM emissions from diesel vehicles. In testimony before the Subcommittee on Energy and Environment of the U.S. House of Representatives, the following statement was made by a senior scientist from Rotech: F-T fuels offer numerous benefits to aviation users. The first is an immediate reduction in particulate emissions. F-T jet fuel has been shown in laboratory combusters and engines to reduce PM emissions by 96% at idle and 78% under cruise operation.



1. Using Fischer–Tropics diesel results in dramatic across the board tailpipe emissions reductions relative to conventional fuels
2. Using Fischer–Tropics jet fuels have been proven to dramatically reduce particulate and other aircraft emissions

Validation of the reduction in other turbine engine emissions is still under way. Concurrent to the PM reductions is an immediate reduction in CO2 emissions from F-T fuel. F-T fuels inherently reduce CO2 emissions because they have higher energy content per carbon content of the fuel, and the fuel is less dense than conventional jet fuel allowing aircraft to fly further on the same load of fuel. The "cleanness" of these FT synthetic fuels is further demonstrated by the fact that they are sufficiently non-toxic and environmentally benign as to be considered biodegradable. This owes primarily to the near-absence of sulfur and extremely low level of aromatics present in the fuel.[53]

Conclusions

Fundamentally, transitioning from oil to coal or natural gas for transportation fuels production is a transition from one inherently delectable geologically limited resource to another. One of the positive defining characteristics of synthetic fuels production is the ability to use multiple feedstocks (coal, gas, or biomass) to produce the same product from the same plant. In the case of hybrid BCTL plants, some facilities are already planning to use a significant biomass component alongside coal. Ultimately, given the right location with good biomass availability, and sufficiently high oil prices, synthetic fuels plants can be transitioned from coal or gas, over to a 100% biomass feedstock. This provides a path forward towards a renewable fuel source and possibly more sustainable, even if the plant originally produced fuels solely from coal, making the infrastructure forwards-compatible even if the original fossil feedstock runs out. Some synthetic fuels processes can be converted to sustainable production practices more easily than others, depending on the process equipment selected. This is an important design consideration as these facilities are planned and implemented, as additional room must be left in the plant layout to accommodate whatever future plant change requirements in terms of materials handling and gasification might be necessary to accommodate a future change in production profile.

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