



Production of Synthetic Diesel Fuel from the Gasification of Woody Biomass

Kinya Sakanishi
 Director, Biomass Technology Research Center

Biomass as Diesel Fuel

Especially in principal cities, the emission of air pollutants PM, NO_x, and SO_x from diesel engines has recently worsened and the demand has grown for the production of sulfur-free or odor-free super clean diesel fuel. Under these circumstances, research is being undertaken to find a way to produce BTL by the gasification of biomass, in the same way that FT synthetic fuels are made by converting methane-based natural gas to synthetic gas.

If compared to GTL using fossil fuels as raw material, BTL has the effect of reducing carbon dioxide, and so recently the development of BTL technology has been promoted, principally in Europe. Fig. 1 shows carbon dioxide reduction comparisons between DME, methanol, and FT synthetic light diesel oil derived from biomass.

Light diesel oil made from biomass not only shows significantly reduced levels of carbon dioxide, but also the reduction of SPM and acid-rain causing SO_x, as previously mentioned. It is also very efficient, and until fuel-cell automobiles come into wide use, is considered the best automotive fuel from the points of view of the prevention of global warming and conservation of the environment.

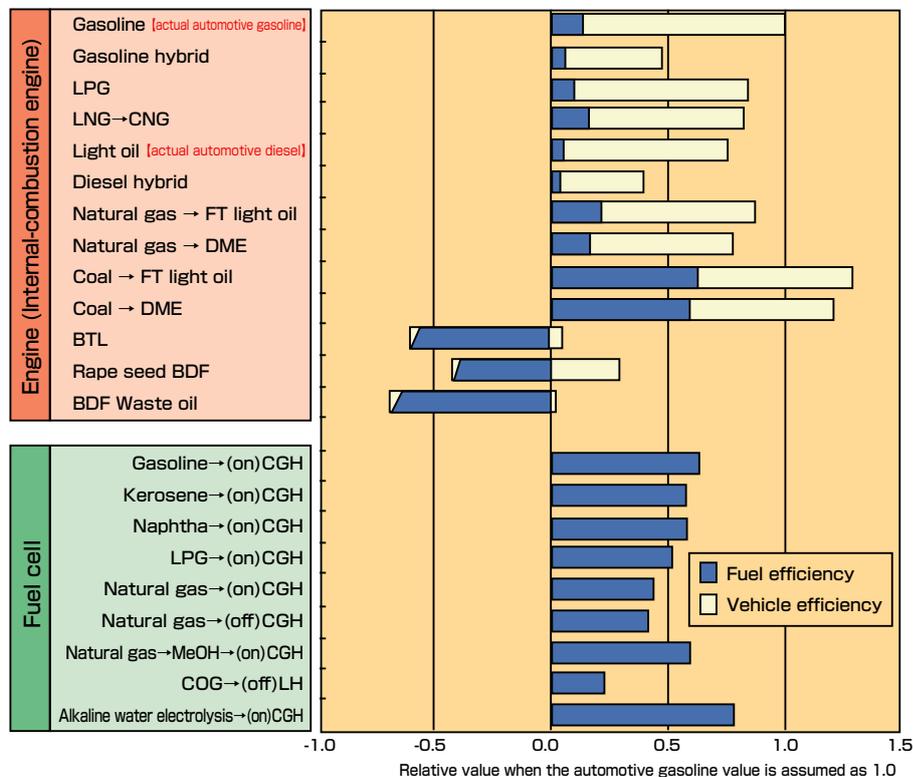


Fig. 1 : Carbon dioxide reduction effect of FT synthetic light diesel oil derived from biomass
 Calculated by assuming the vehicle efficiency of LPG, CMG and ethanol automobiles is the same as the vehicle efficiency of gasoline automobiles, and assuming the vehicle efficiency of FT light oil, DME, BDF automobiles is the same as the vehicle efficiency of light diesel oil automobiles.
 Source: TOYOTA Motor Corporation, Mizuho Information & Research Institute, Inc., November, 2004.

Production Technology and Potential of BTL and DME

A synthetic diesel fuel production technique using the FT synthesis catalytic reaction is the core technology for the production of liquid fuels from synthetic gas components. To be cost-effective

when compared to petroleum-based light diesel oil, it is considered indispensable to further develop FT synthesis by introducing new types of technologies in the future. In the case of GTL, the raw-material gas components of FT synthesis are being diversified for different technologies,

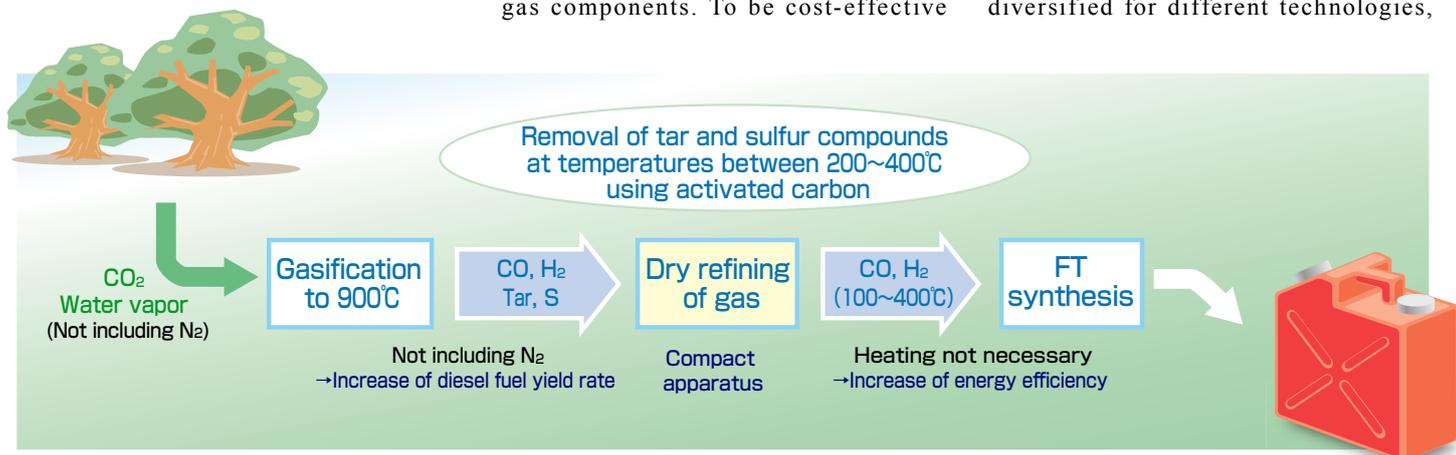


Fig.2 : Gasification, gas refining, and FT synthesis catalytic reaction directly combined with BLT system

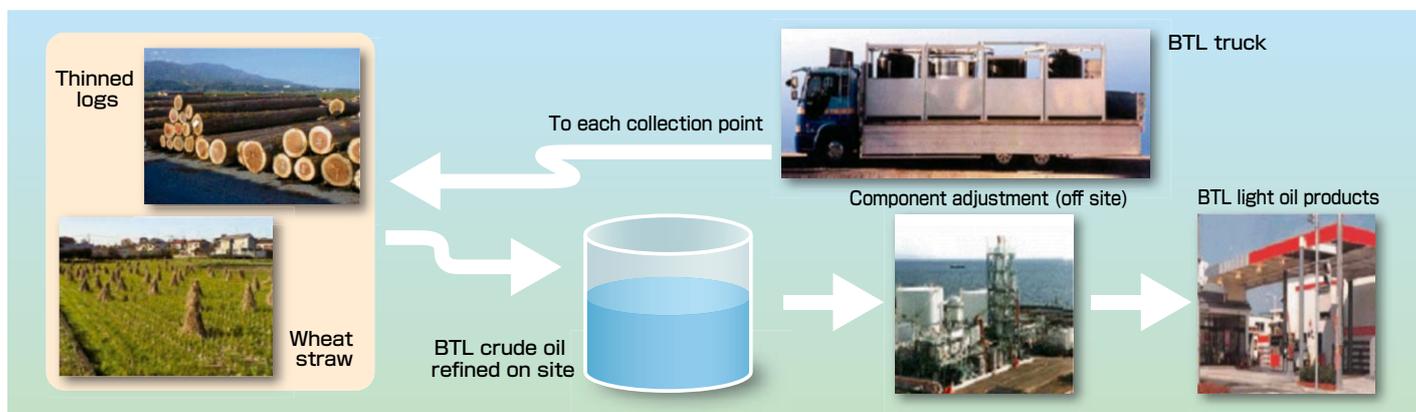


Fig.3 : Scheme of making BTL practicable

such as small to large scale natural gas fields, unprofitable natural gas fields, the gasification of biomass, and the gasification of coal. It is therefore expected that highly efficient FT synthesis technologies appropriate to the characteristics of respective raw materials will be developed.

FT technology is composed of technical fields such as catalysis development, reactor development, and plant development. Fig. 2 shows the BTL Integrated System being developed by AIST. Compared with conventional gasification, gas refining, and the FT synthesis process, this system shows merit, such as improved energy efficiency by Hot Gas Cleaning using activated carbon, and the significant increase in the yield of light diesel oil by combining directly with FT synthesis, hydrocracking, and catalytic isomerization.

DME has similar properties to LPG and is expected to become a new clean fuel that can be utilized in the public sector, transport sector, and as fuel for power generation, due to its ease of transport and storage.

DME can be produced not only from fossil resources such as coal, petroleum and natural gas, but also from synthetic gas generated by the gasification of biomass. It can contribute to the diversification of primary energy resources, the reduction of carbon dioxide emissions and due to its super clean composition (sulfur and odor-free), it is expected to become the ultra low polluting diesel fuel in the future.

DME is currently produced by a dehydration reaction of methanol on the scale of several tens of tons per day. However in order to use DME as a fuel, it is necessary to produce it on a larger scale and at a lower cost. The raw material, methanol, can also be produced from synthetic gas, and so the development of a technique is being sought to produce DME directly from synthetic gas instead of from methanol. A DME direct synthetic reaction is very promising from the viewpoint of production cost because it is possible to obtain a higher yield rate at lower pressure if compared to a conventional methanol producing installation.

Making BTL Suitable for Practical Use

We can envisage two prototypes to make BTL practical. One is a mobile BTL truck of about 2 tons which can take a small BTL unit into mountainous areas (shown in Fig. 3), and the other is a middle/large scale BLT production plant using agricultural waste and forest product biomass readily available in large quantities.

In the former type, when the high costs due to the difficulty of collecting raw materials in Japan are calculated, an economically efficient and compact BTL unit which makes possible the production of BTL diesel fuels for “regional production, regional consumption” or a unit to co-produce gasoline and DME will be developed. In the latter type, we would like to contribute to the production of BTL synthetic diesel fuel using the large quantities of biomass from Southeast Asian countries, and to the popularization of BTL by the development and import scheme.

Explanation of terms

PM : Particulate Matter-general term for the soot discharged from diesel engines.

FT synthesis : a method developed by Fischer-Tropsch of synthesizing hydrocarbons by the catalytic reaction of synthetic gas (carbon monoxide and hydrogen).

GTL : Gas To Liquid - liquid fuels made by the FT synthesis catalytic reaction of natural gas to synthetic gas.

BTL : Biomass To Liquid - liquid fuels made by the FT synthesis catalytic reaction of synthetic gas obtained by biomass gasification.

DME : Dimethyl Ether - a new fuel with similar properties to LPG (liquefied petroleum gas, propane gas) and expected to replace diesel fuel and LPG.

LPG : Liquefied Petroleum Gas - fuels with propane as the main component.

SPM : Suspended Particulate Matter – PM of small (micrometer-order) diameter. Soot of microscopic diameter discharged by diesel engines.

Hot Gas Cleaning : the super deep dry refining of synthetic gas using an adsorbent such as activated carbon at high temperature (approximately 400°C) after gasification.