

# Carbon-neutral synthetic petroleum production technology of waste plastics

Carbon-neutral Syngas Production from Waste Plastics



<b>Patent title</b>	Method for producing diesel and gasoline high content synthetic fuel using slurry bubble tower reactor	<b>Inventor</b>	Korea Institute of Energy Research / Jeong Heon and eight more
<b>Patent application No.</b>	KR 10-2015-0144130 (2015.10.15) / 10-1776927 (2017.09.04)	<b>Authority status</b>	Registered

## Technicality

### Technology overview

The technology is a technology which gasifies pyrolysis oil produced from waste such as waste plastics and waste wood and converts a produced syngas into a liquid fuel such as diesel oil and a jet aircraft fuel, which are carbon-neutral. An optimum process is provided to enable efficient production of a synthetic fuel with increased diesel or gasoline contents by reacting a synthesis gas and a catalyst in a slurry bubble column reactor (SBCR), which is mainly applied to a low-temperature Fisher-Tropsch (FT) reaction.

### Development background and problem to be solved

- The technology is a technology which utilizes a coal liquefaction technology developed to gasify a coal and produce oil. The technology is a technology for environmentally-friendly producing carbon-neutral synthetic petroleum in an environmentally-friendly way by gasifying waste pyrolysis oil by a coal gasifier and directly converting the same into diesel and gasoline.

### Excellence and discrimination of technology

#### Excellence of technology

- The environmentally-friendly waste processing technology generates almost zero pollutants by converting waste plastics and waste wood into synthetic petroleum and generating electricity from an off-gas by a gas engine.
- The design and production operations of a scale required for commercial-grade waste processing facilities are immediately possible, and the developed small and medium-sized liquefaction technology is unique.
- Due to the high flexibility of a catalyst used in a liquefaction process, the composition of an injected gas and a process of impurity treatment are simplified to lower the overall investment costs and minimize the operating costs.
- Stable conversion of pyrolysis oil to a syngas is possible, and wasted resources are minimized by reducing the generation of wax.

#### Discrimination of technology

- Costs can be reduced by producing diesel and gasoline at the temperature and pressure lower than those of an existing high-temperature FT.
- The initial investment costs are low due to the improvement of the performance of a reactor and a catalyst and the process simplification, and the operation costs are reduced due to an easy operation.
- Energy efficiency is enhanced by generating electricity from an off-gas remaining after a liquefaction process (FT reaction) of waste plastics and biomass.
- Environmentally-friendly properties are ensured as there is almost no emission of pollutants other than carbon dioxide, and a carbon-neutral fuel produced from waste enables decarbonization of airplane and ship fuels.



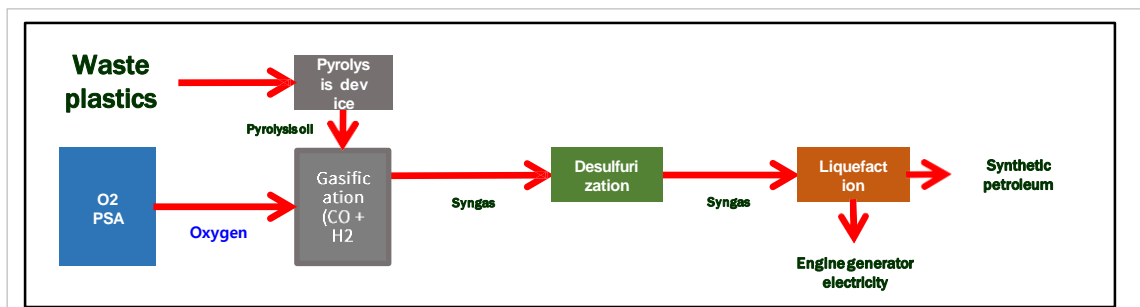
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## Carbon-neutral Synfuel Production from Waste Plastics

### Implementation method

According to the present invention,

- A syngas produced by gasifying low-grade oil produced by the thermal decomposition of waste is supplied to a slurry bubble column reactor, and the temperature is adjusted from 290 degrees to 300 degrees to perform an FT reaction.
- During an FT reaction, in order to increase the yield of diesel and gasoline, an Fe-based catalyst composed of Fe-Cu-K-SiO<sub>2</sub> is used to produce diesel of maximum 35% and gasoline of 15%, and wax of at least 5% among a total product.



Picture 1 Synthetic oil production process

### Degree of technology completion (TRL)

Degree of technology completion: TRL7 (quasi-commercial product development stage)

TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Technical principle presentation	Technology concept setting	Technology concept verification	Lab Scale prototype development	Implementation environment application experiment	Full Scale prototype development	Quasi-commercial product development	Commercial product development	Commercial product implementation

## Utilization

### Utilization field and applied product

#### Utilization field

- Conversion of waste plastics into environmentally-friendly fuels
- Waste oil upgrade
- Biomass fuel conversion
- Conversion of waste wood into fuels



Picture 2 Biomass power generator

#### Applied product

- Carbon-neutral diesel and jet aircraft fuel
- Petrochemical product
- Waste processing process
- Waste plastics power generator



Picture 3 Waste plastics power generator

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## Carbon-neutral Synfuel Production from Waste Plastics

### Technology trend

- A commercially available synthetic petroleum production technology has not yet been developed in Korea, and overseas, South Africa and China have large-scale liquefaction technologies, but there are few small and medium-sized synthetic petroleum technologies applicable to waste.
- The technology possessed by the Korea Institute of Energy Research enables the construction of small and medium-sized liquefaction plants. Pre-processing and post-processing are simplified so that investment costs can be reduced and economical feasibility can be ensured.

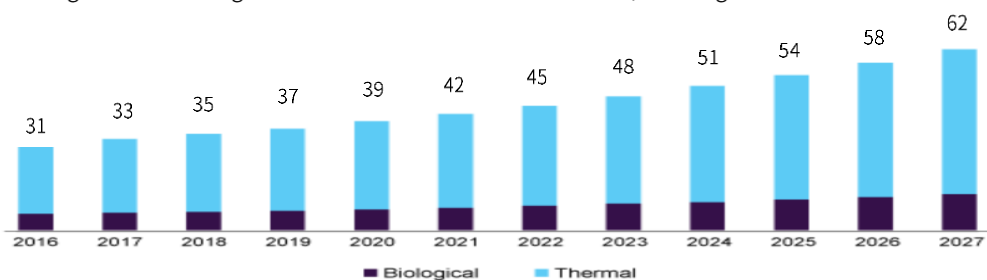
### Family patent status

Application nation	Application No. (Application date) / Registration No.	Title of the invention
KOR	KR 10-2015-0144130 (2015.10.15) / 10-1776927 (2017.09.04)	Method for producing diesel and gasoline high content synthetic fuel using slurry bubble tower reactor
KOR/RSA	KR 10-2017-0079499 (2017.06.23) / 10-1847549 (2018.04.04) RSA 2017/07393 (2019.01.30)	Method for producing liquid or solid hydrocarbon from synthesis gas through Fischer-Tropsch synthesis reaction that does not perform separate reduction pretreatment for catalyst activation
Mongolia	4472 (2016.11.03)	System for producing hydrocarbon compound using Fischer-Tropsch synthesis
US	9,533,292 (2017.01.03)	Method for producing iron-carbide/carbon nanocomposite catalyst for high-temperature Fischer-Tropsch synthesis reaction including potassium and catalyst therefrom, method for producing liquid hydrocarbon using iron-carbide/carbon nanocomposite catalyst, and liquid hydrocarbon therefrom
US	9,789,472 (2017.10.17)	Method for producing iron-based catalyst and iron-based catalyst produced thereby

## Market prospect

### Target market size and prospect


The demand for waste environmentally-friendly carbon-neutral fuel production plants is expected to be 1,000 or more units worldwide, and the market is expected to reach KRW 50 trillion on the basis of KRW 50 billion per unit. In the case of Waste to Energy (WTE) for producing energy from waste, the market size was USD 31 billion in 2019, and is expected to grow at an average annual rate of 7.4% from 2020 to 2027, reaching USD 62 billion in 2027.



**Table 1** Waste energy plant market size forecast

<Data: Grand View Research>

### Technology transfer query

 두호특허법인 / (주) 두호기술경영 <small>DooHo IP Law Firm / DooHo Tech. &amp; Mgt. Inc.</small>	<b>Person in charge</b>	Kyuhyeong LIM
	<b>Contact</b>	070-4333-8021
	<b>Email</b>	khlim@doohopat.co.kr

### Technology transfer process

