WASTE PLASTICS
CHEMICAL RECYCLING
BY GASIFICATION

To Achieve a Sustainable Society

JGC JGC GROUP
Promotion of Plastic Recycling has been one of a global issue.

**IDENTIFYING THE PROBLEM**

**World Demand for Plastics and Current State of Recycling**

- It is estimated that by 2050, the world demand for plastics will be tripled from the 2015’s.
- There is an estimation that the weight of plastics in the ocean will exceed total weight of fish living in the ocean by 2050, if the present trend continues.*
- Significant increase in amount of the plastics for recycling is highly required.

In addition to Material Recycling, promote Chemical Recycling

Significant improvement in the plastic recycling rate is required worldwide*. While making maximum use of material recycling, it is also required to promote chemical recycling that can be applied to waste plastic which is difficult to recycle, such as "mixed plastic" and "contaminated plastic".

* "A European Strategy for plastics in a circular economy: By 2020, all plastic packaging placed on the EU market is to be either reusable or recyclable.

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**Chemical Recycles promoted by JGC Group**

- **DTP Process** (Methanol to Olefins)
  - Process Co-developed with Mitsubishi Chemical Corporation
  - "DTP: Dominant Technology for Propylene Production"

- **ETB Process** (Ethanol to Butadiene)
  - Under Development

- **EUP**
  - Ebara Ube Process

- **Polyester Chemical Recycling Process** (Forming Monomers)
  - **Polyester Fibers**
  - **Waste Plastics**

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**Chemical Recycling**

- Applicable to a wide range of Waste Plastics
  - Good tolerance for Impurities and Uncleaness
- Production of Virgin Plastic equal to one from Fossil Resources is possible.

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**Upcycle without Emission of Waste Plastic**

**Waste Plastic**

- **Virgin Plastic**
- **Plastic Products**

**Material Recycling**

- Recycling can be accomplished with simple facility only
- Recycling can only be applied for limited types of waste plastic.

**Thermal Recycling**

- Simple Incineration, Landfill Disposal

**Other Process**

- **Waste Plastics**
- **Plastic Bottles**
- **Waste Tires**

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**Chemical Recycling by Gasification**

- **Virgin Plastic**
- **Processing**

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**Plastic Production and Recycling Forecast**

- **Material and Chemical Recycling**

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**Waste Plastic Reborn as Virgin Plastic!**

We Propose Realization of a Upcycle

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**Vision by JGC**
EUP, Realizing a Waste Plastic Recycling Society

Chemical Recycling
by Gasification

Enabling the local production of Hydrogen for local consumption.

Enable to produce wide variety of plastic products to meet the expectation of Extended Producer Responsibility.

Applicable to mixed plastics.

Features of EUP

- High pressure operation (10 barg) promotes chemical synthesis
- Achieving high gas conversion rate by high temperature operation
- No dioxin generation

EUP is the first and only Gasification Chemical Recycling Process which has long-term commercial operation track record.

**EUP Co., Ltd.**
- Location: Ube City, Yamaguchi Prefecture
- Processing Capacity: 10 Tons/Day
- Operation Record: 2001 – 2008

**Showa Denko K.K.**
- Location: Kawasaki City, Kanagawa Prefecture
- Processing Capacity: 100 Tons/Day
- Operation Record: 2003 – Present

Expertise in Engineering and Operation of EUP

There is a reason for JGC Group leading the promotion of EUP Process. Superior track record and knowledge in every detail of Gasification Chemical Plants

- Experiences in gasification projects for various types of feed materials
- Deep knowledge, specifically to the gasification process
- High reliable plants enabled by outstanding system integration ability
- Support total plant control and plant automation

As a Licensor/Contractor, the JGC Group contributes to the promotion of EUP, the Gasification Chemical Recycling Technology

EUP was jointly developed by EBARA CORPORATION (transferred this business to Ebara Environmental Plant in 2009) and UBE INDUSTRIES LTD. This process produces syngas from waste plastic using partial oxidation with oxygen and steam. Syngas can be utilized for production of ammonia, olefins, and etc.

This EUP is applied for a gasification facility at Showa Denko's Kawasaki Plant which is continuously running from 2003. This is the only technology for gasification chemical recycling in the world with a long-term track record of commercial operation.

Pre-treatment

Gasification

- Low Temperature Gasifier (800°C~840°C)
- High Temperature Gasifier (1200°C~1500°C)

Crusher

Molding Machine

Oxygen, Steam

Syngas

Coal

Ammonia, Ethylene, Propylene, etc.

GTL Plant

Sarawak, Malaysia
The first commercial plant in the world to produce middle distillates of petroleum products processing natural gas as a feed.

IGCC*(Coal) Plant

Hiroshima, Japan
The first CO2 separation and recovery type oxygen-blown IGCC(coal) plant in Japan.

IGCC(Residual Oil) Plant

Kanagawa, Japan
The first commercial IGCC plant in Japan.

*IGCC: Integrated Gasification Combined Cycle

Rubber Products

Chemicals (Ammonia, Ethylene, Propylene, etc.)

Fuel Cell Vehicles (FCV)

Power generation

Plastic Collection

Gasification

Chemical Synthesis

Rubber

Plastic Products

Chemicals

Plastic Wastes

Various Products

Pre-treatment

Gasification

Plastic Waste

Oxygen, Steam

Molded Plastic

Scrubber

Non-combustible

Low Temperature Gasifier

(600°C~800°C)

High Temperature Gasifier

(1300°C~1500°C)

Oxygen, Steam

Chemical Plant

Chemicals

Ammonia, Ethylene, Propylene, etc.

H2

CO2

CO

Plastic Wastes

Gasification

Chemical Synthesis

Rubber

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PROPOSAL

Creating a New Value from Waste Plastic through Gasification Chemical Recycling

Applicable Proposal

1. Produce Sustainable Plastic Products

It is possible to expand an EUP Gasification Chemical Recycling facility utilizing existing chemical plant. Waste plastic becomes an alternative raw material, which contributes to saving of Crude Oil and Fossil Fuels.

Production of locally produced hydrogen for local consumption in the “Smart City”

We will construct Hydrogen Production facility by EUP from scratch. For required local hydrogen production source for local consumption, we will accomplish stable hydrogen supply which contributes to the demand for a higher self-sufficiency rate.

2. Provide Solutions for the Establishment and Operation

Our Business Planning Support will accelerate you to accomplish by including study of stable supply source, and support of partnering with Off-takers of the final product.

License Design

As the EUP licenser/contractor, we can coordinate with the process development company and can design optimized gasification plant applying past project experiences.

O&M Service

Utilizing the data gained from the long-term commercial operation of the Showa Denko plant, we can provide after-sales service by supporting operation and maintenance.

License of the Process

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Initiatives of the JGC Group to Achieve a Sustainable and Environmentally Friendly Society

The JGC Group recognizes protecting nature and achieving harmony with the environment through our business activities as an important task. We are making efforts to protect the Earth’s environment, such as building LNG plants which have an extremely small environmental impact, developing technology for the recycling of plastics, and promoting the spread of renewable energy.