

# The Mitsubishi Chemical Group's Circular Economy Initiatives Prospects for Building a Sustainable Recycling System —Business transformation toward a circulating society with an eye on post- COVID-19, such as a system for collecting used acrylic sneeze guard—

The Mitsubishi Chemical Group, Japan's largest chemical company, has been working for more than 10 years to promote the realization of a circulating society without the concept of waste. In this letter, we would like to introduce some cases of the recycling of various materials that we are working on. In particular, we will delve into the efforts to date and future prospects for the recycling of acrylic resin, which is also used in sneeze guard, which have become a common sight in the city due to the COVID-19 pandemic.

## The Mitsubishi Chemical Group's Recycling Cases Contributing to the SDGs



### **1. Efforts to recycle acrylic resin**

We are developing chemical recycling technology to collect used acrylic resin products and produce recycled products with the same quality as conventional acrylic resin. In June 2021, we built a recycling facility for demonstration experiments. Here, we would like to introduce an overview of the demonstration experiment and future prospects.

Acrylic sneeze guard made of acrylic resin are expected to be discarded in large quantities after the COVID-19 pandemic ends. With regard to acrylic resin, which society is increasingly demanding be recycled, our group is conducting various demonstration experiments aimed at commercializing chemical recycling.



### **2. Efforts to convert plastic to oil jointly with ENEOS**

At our Ibaraki Plant, we will start a joint plastic-to-oil conversion business with ENEOS Corporation. We will start to tackle the problem of waste plastic at Japan's largest chemical recycling facility, which is currently under construction.



### **3. Full-scale entry into the carbon fiber recycling business**

Carbon fiber significantly contributes to the weight reduction of mobility in general, including automobiles. We are working to deploy a business model in Japan and Europe that enables us to consistently implement the manufacturing, collection, and recycling of carbon fiber products, as well as to develop applications for recycled carbon fiber.

\*Some images presented in this document are for illustration purposes only.

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# Mitsubishi Chemical Group's Recycling Cases Contributing to the SDGs —Efforts to Recycle Acrylic Resin—

## 1. Efforts to recycle acrylic resin

### ◆ Highly convenient acrylic resin and possibility of chemical recycling

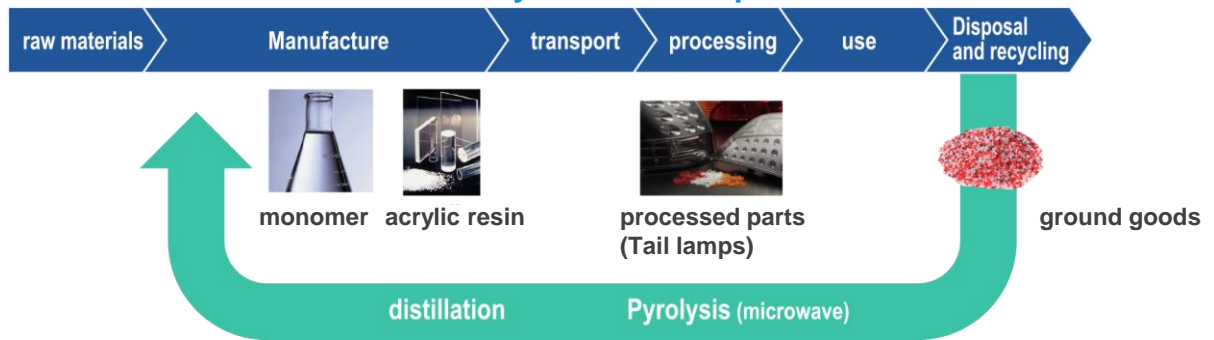
Acrylic resin is a plastic with excellent transparency and weather resistance, and is widely used for automobile tail lamps, signboards, aquarium tanks, paints, building materials, etc., and global demand is about 2.4 million tons. Our group is a global top manufacturer of acrylic resin with manufacturing bases all over the world, and it is also conducting pioneering research and development on recycling.

As the movement toward carbon neutrality becomes more active around the world, there is a demand for sustainable materials with low carbon dioxide emissions. Our group is promoting research and development to explore the possibility of chemical recycling, which collects and reuses used acrylic resin.

\*Chemical recycling of acrylic resin: Used acrylic resin to be decomposed by heating, etc., refined, and returned to its raw material, methyl methacrylate (MMA), for reuse.



### Conceptual diagram of the chemical recycling and recovery system for acrylic resin in Japan



### ◆ Commencement of demonstration experiments for chemical recycling of acrylic resin

In June 2021, we jointly developed with Microwave Chemical Co., Ltd., a partner in the study of acrylic resin recycling technology, and built a new demonstration facility at its Osaka Plant. Furthermore, we are conducting demonstration experiments in cooperation with Honda Motor Co., Ltd., a major Japanese automobile manufacturer. Tail lamps made of acrylic resin are to be collected from end-of-life vehicles, thermally decomposed using microwaves and refined, and returned to raw materials. We are verifying whether acrylic resin made of the reused raw materials can be used again as a material for tail lamps without problems. At present, it has been confirmed that acrylic resin manufactured using chemical recycling technology maintains the same level of performance as conventional products, including transparency.

In addition, we expect to reduce carbon dioxide emissions in the manufacturing process of chemically recycled products by about 70% compared to conventional products. This technology will not only reduce the amount of acrylic resin waste, but also reduce carbon dioxide emissions during manufacturing, which can greatly contribute to the reduction of environmental impact.



The sheet on the left is a conventional product, and the sheet on the right is a recycled product. Both have the same level of transparency.



A facility for demonstration of chemical recycling

## Mitsubishi Chemical Group's Recycling Cases Contributing to the SDGs —Efforts to Recycle Acrylic Resin—

### ◆ Background and demand for full-scale operation of chemical recycling

In the past, our group had been conducting research and development to recycle acrylic resin offcuts generated in-house, but the project was discontinued due to cost and other reasons. However, in view of the growing interest in environmentally friendly materials in recent years and the possible mass disposal of droplet-blocking panels, the establishment of acrylic resin recycling technology has been strongly demanded from society, so we have resumed research and development of the recycling technology.

In fact, there is an increasing demand for recycled materials that can significantly reduce carbon dioxide emissions from automobile manufacturers and electronics manufacturers. Moreover, inquiries regarding the recycling of collected products are increasing from businesses that handle waste. We are working to build an open business model in the future that will collect and recycle a wide range of used acrylic resin products, such as droplet-blocking panels and cosmetic containers, in addition to the automobile parts that are currently undergoing demonstration experiments.

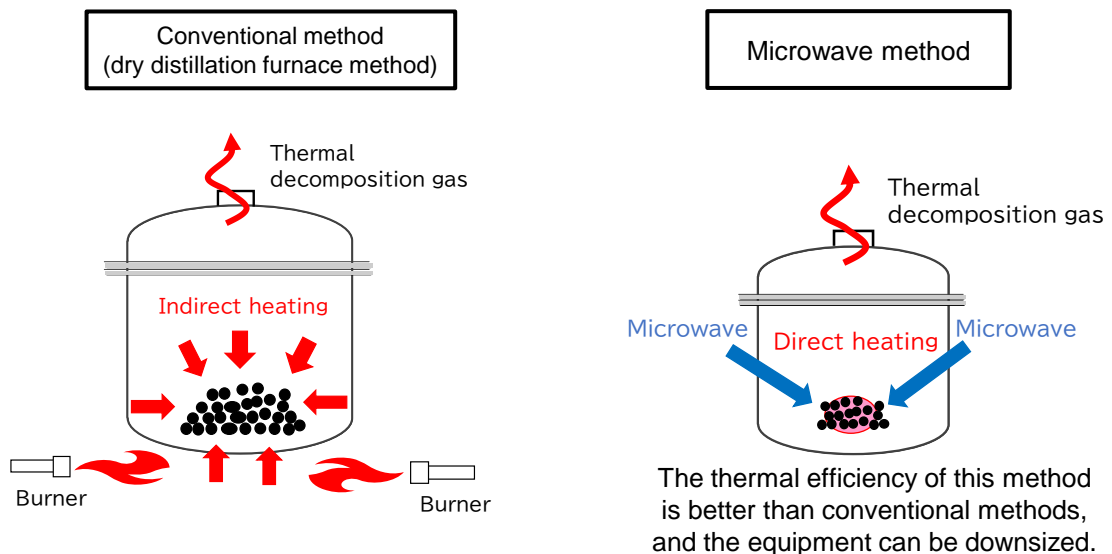


Acrylic resin is used in various scenes in our lives  
(Left: Sneeze guard in a restaurant, Right: Signboards)

### ◆ Chemical recycling using microwaves

Thermal decomposition technology using microwaves, jointly developed with Microwave Chemical, has been a breakthrough in the efficient recycling of acrylic resin. This has the same mechanism as a microwave oven, in which efficient thermal decomposition is realized by using microwaves with wavelengths that acrylic resin absorbs. It is expected that this method will become mainstream in the future, as it reduces CO<sub>2</sub> emissions during recycling compared to conventional methods. Our chemical recycling of acrylic resin using microwaves is the **world's first** such use of the technology.

Our group, which was among the first to focus on acrylic resin recycling ahead of other companies, will enter the acrylic resin chemical recycling business on a full-scale after the ongoing demonstration experiments. We are advancing research not only in Japan but also in the UK, and are accelerating global efforts to realize a circular economy.

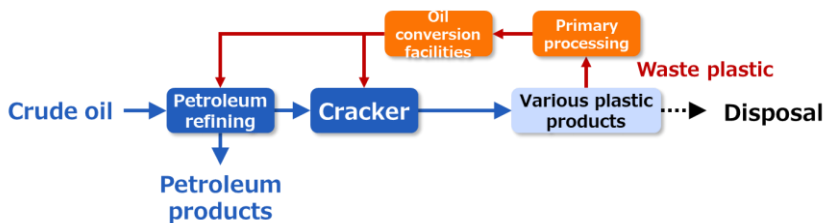


# Mitsubishi Chemical Group's Recycling Cases Contributing to the SDGs —Recycling of plastic and carbon fiber—

## 2. Construction of the largest plastic chemical recycling facility in Japan

Our group has been working with ENEOS Corporation to start a plastic-to-oil conversion (\*) business from 2021. This project aims to chemically liquefy collected waste plastics to reuse them as raw materials. It will enable us to recycle even a mixture of multiple types of plastics, and obtain recycled products with the same quality as brand - new products. Currently, we are constructing a chemical recycling facility with an annual processing capacity of 20,000 tons, which is the largest in Japan on a commercial basis, and we are aiming to complete construction of the chemical recycling facility in FY2023. The problem of waste plastics has become a global issue, and as a business that manufactures plastics, we will contribute to the formation of a recycling-oriented society.

\*A chemical recycling method that hydrothermally decomposes waste plastic to produce oil



Assumed flow diagram of waste plastic recycling



Construction of a chemical recycling facility at the Ibaraki Plant is in progress.

## 3. Realizing the recycling of carbon fiber, which has been difficult until now, and aiming for a circular economy from a new perspective

As the shift from gasoline vehicles to electric vehicles accelerates toward the realization of carbon neutrality, it is essential to reduce the weight of the vehicle body more than gasoline vehicles in order to extend the driving range of electric vehicles equipped with heavy batteries. Now, carbon fiber, which is stronger than steel and lighter than aluminum, has been attracting attention, and its use in automotive parts has been increasing.

Our group considers it essential to establish a carbon fiber supply chain that takes account of sustainability, and it is also focusing on the carbon fiber recycling business. In addition to introducing a recycling facility in Japan, we are accelerating our efforts in Europe by acquiring a company which is operating a recycling business. We are proposing a total solution including product recycling to our customers through establishing a chain from the production of carbon fiber raw materials to recycling and utilizing the recycled products as raw materials again in our group.

In addition to automobiles, carbon fiber is also widely used in sports equipment. For example, in windsurfing the boards and masts are made of carbon fiber. Our group and the Japan Windsurfing Association have started working together to collect and recycle equipment damaged during use.

- Examples of recycled carbon fiber that we are working on



Efforts to recycle windsurfing equipment have also begun.



Joint development with Boeing Company of aircraft interior materials using recycled carbon fiber is in progress.