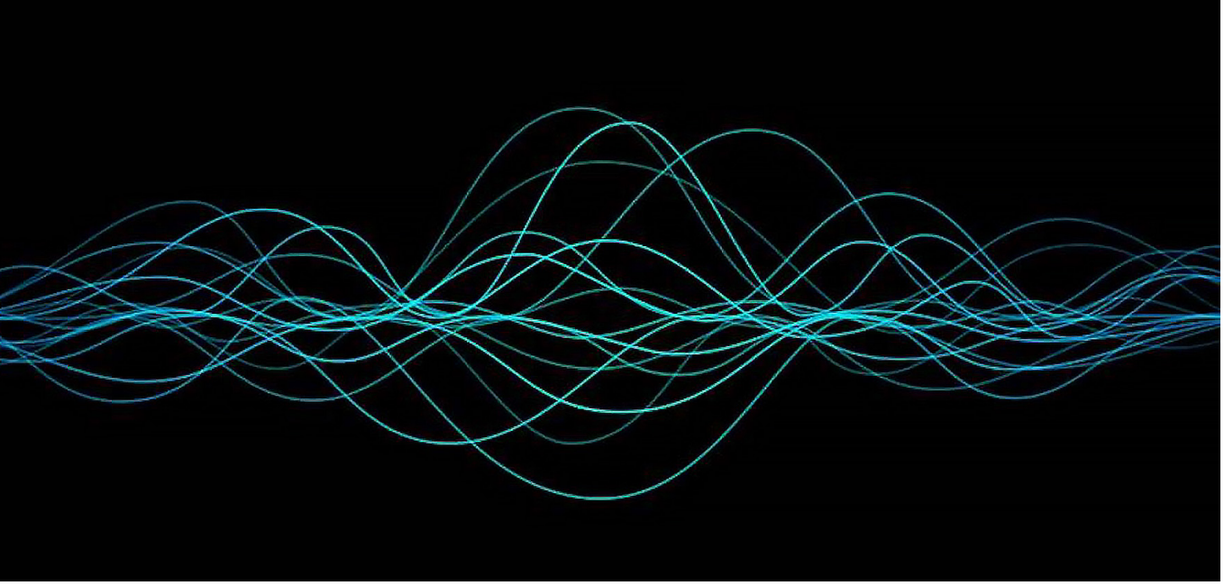


THE MICROWAVE TECHNOLOGY TURNING THE

CHEMICAL INDUSTRY GREEN

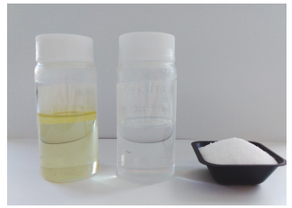
Chemical products that are essential in today's manufacturing require huge amounts of energy to produce. Now, an ambitious new startup company, Microwave Chemical Co., Ltd., has built the world's first chemical mass production plant that uses microwaves, leading the way in the green transformation (GX) of the chemical industry.

The world's first microwave chemical mass production plant was completed in 2014.

In today's world, chemically derived products such as plastics and synthetic fibers are indispensable to manufacturing in a wide variety of fields. The chemical reactions that are used in their production often require heating at high temperatures. Consequently, the chemical industry consumes a lot of energy, accounting for about 30% of the entire industrial sector's total energy consumption. The chemical industry is also a big CO_2 emitter, making the green transformation (GX) an urgent issue.

Founded in 2007, Microwave Chemical Co., Ltd. is a startup company that brings innovation to production processes in the chemical industry. By more accurately controlling the same technologies as those used in microwave ovens, the company aims to bring about the GX of chemical manufacturing processes.

Conventionally, substances within a chemical reactor—an enclosed container where chemical reactions take place—are heated through steam or other means. With this method, heat is transferred indirectly from an external heat source through the reactor to the substance inside, so it takes time for the whole substance to be heated. In contrast, microwaves transmit heat directly to the substance at the molecular level, doing so quickly and at a uniform temperature, targeting only the intended subject and nothing else. Since the microwave method can create chemical reactions more efficiently, it is possible to save energy and reduce the size of equipment.



PlaWave

Top: PlaWave's demonstration facility. Left: Decomposed oil (left), recovered styrene monomer (center), and recycled polystyrene (right) were all chemically recycled using PlaWave's small pilot unit.

Companies introducing this method have successfully reduced their energy consumption by up to 70%.

The use of microwaves on an industrial scale has previously been considered impossible due to the difficulty of controlling microwaves. However, through long-term research, Microwave Chemical has established unique technologies in its reaction system design to find the optimum frequency and amount of energy input by measuring the degree to which various reactants absorb microwaves, as well as its reactor design to ensure that microwaves work both safely and efficiently without leakage, thereby paving the way for their industrial use. The company began shipping chemically derived products produced using the microwave process in 2012, and in 2014 completed the world's first microwave chemical mass production plant.

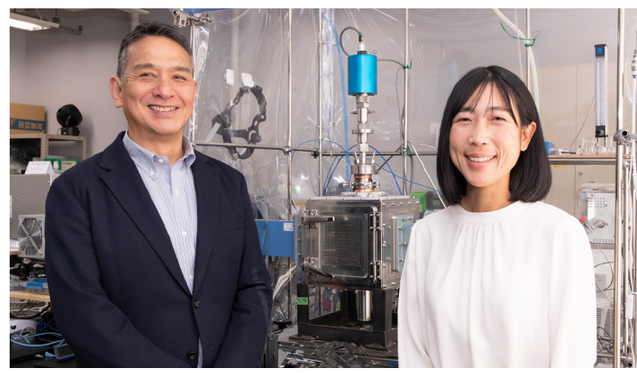
Besides joint projects with chemical manufacturers, the company has also been collaborating with companies in an assortment of fields, such as steel, glass, and pharmaceuticals. "Just as there are huge platform providers in the IT field, at Microwave Chemical we aim to be a platform provider for manufacturing technologies. This is something that has become one of our strengths. The more problems we solve for customers, the more technology we accumulate, and the more we can solve problems that were previously unsolvable, thereby creating a virtuous cycle," said co-founder and CEO YOSHINO Iwao.

One of the platforms provided by Microwave Chemical that is attracting attention is PlaWave, a chemical recycling technology platform that uses microwaves in the chemical recycling process to decompose used plastics at high temperatures and return them to oil and chemical raw materials for reuse. Being a solid material, plastic is difficult to heat efficiently using conventional methods, as these involve indirect heating using hot air, but microwaves are well suited to the task since they can transmit energy directly. Microwave Chemical is now carrying out demonstrations of its PlaWave concept with multiple companies, mainly chemical manufacturers, with the aim of commercializing chemical recycling.

"The Japanese government's 2020 pledge to be carbon neutral by 2050 was a huge tailwind for our company. Manufacturing technology such as ours is Japan's strength, which is why we want to make every effort to put it into practice moving forward," said OKUNAKA Mao, a spokesperson for Microwave Chemical.

"I believe that our technology can contribute to carbon neutrality in a plethora of areas. For example, in the case of electric vehicles, not only do microwaves reduce carbon emissions during the manufacturing process but they also keep down power consumption in the process of dissolving and smelting lithium—the battery material—from ore," stated Yoshino.

Benefiting from the versatility of microwaves, which can save energy in all kinds of heat treatment processes, Microwave Chemical aims to apply its technology not only to the field of chemical manufacturing, but to many others too.



YOSHINO Iwao (left), CEO of Microwave Chemical Co., Ltd., and OKUNAKA Mao (right), the company's public relations manager.