

CCU Using CO₂ Recycling Artificial Limestone

TOPICS

The Sumitomo Osaka Cement Group views the heavy volume of CO₂ primarily emitted from cement plants as a resource, and, as part of its carbon capture and utilization (CCU) efforts to reduce emissions, we are engaged in the development of pilot-scale manufacturing test technology aimed at commercializing CO₂ recycling artificial limestone. The resultant CO₂ recycling artificial limestone is utilized as a firing raw material or extender in the production of carbon-recycled cement (CRC), in addition to which we are also advancing research and development to utilize it as a raw material for various products in collaboration with other industries. In this section, we showcase the initiatives undertaken at our pilot-scale manufacturing test facility for CO₂ recycling artificial limestone, which commenced operations in April 2025, along with research findings on the practical application of CO₂ recycling artificial limestone across numerous industrial sectors.

Pilot-Scale Manufacturing Test Facility for CO₂ Recycling Artificial Limestone at Our Tochigi Plant Site



Exterior and interior views of the pilot-scale recycled CO₂ artificial limestone manufacturing test facility at the Tochigi Plant

Target mineral sequestration effect of CO₂ recycling artificial limestone:

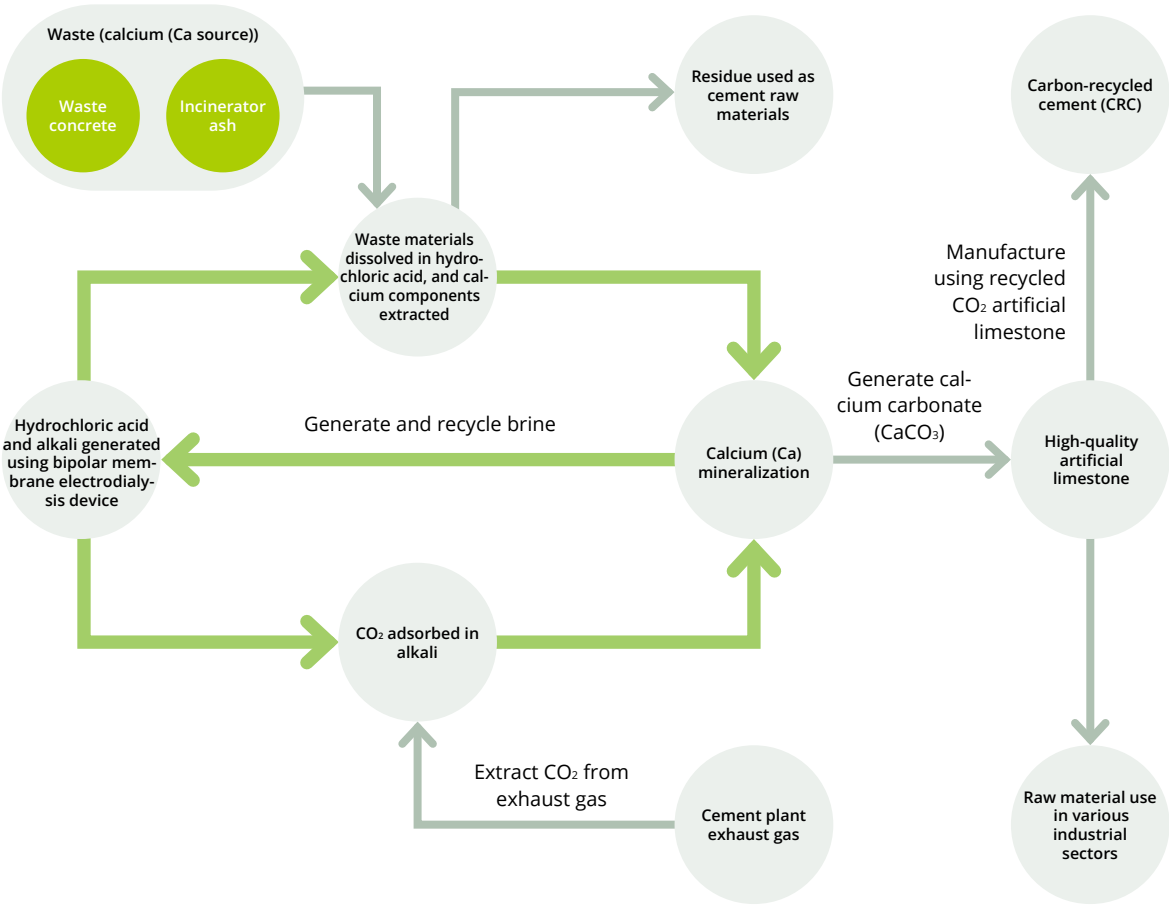
420 kg-CO₂/ton

Since 2022, we have been engaged in research and development aimed at the commercialization of CO₂ recycling artificial limestone as part of the “Establishment of Carbonation Chlorination Technology Using Diverse Calcium Sources” project (JPNP21023). This project is part of the NEDO (New Energy and Industrial Technology Development Organization) Green Innovation Fund's “Development of Concrete Manufacturing Technology Using CO₂” initiative. In this initiative, CO₂ contained in exhaust gases from cement plants is reacted with calcium extracted from externally collected waste to produce CO₂ recycling artificial limestone, which sequesters CO₂ within the minerals. We are developing technologies to use CO₂ recycling artificial limestone as a raw material in a variety of fields, including cement and concrete. This technology is the world's first “dual recycling” technology that recycles both calcium extracted from waste and CO₂ from cement plant exhaust gas. This contributes both to extended lifespans for landfill sites through waste recycling and to the reduction of CO₂ emissions.

Limestone is the primary raw material used in cement production, and CO₂ makes up nearly half of its mass. Consequently, the decarbonation reaction during the cement manufacturing process generates process-related CO₂ that originates from the limestone. This accounts for approximately 60% of the CO₂ emitted during cement manufacturing. The benefit of using CO₂ recycling artificial limestone is that it sequesters CO₂ from the exhaust gases emitted by the cement plants during the production process, at a rate of approximately 420 kilograms per ton, allowing the CO₂ to be fixed semi-permanently within the minerals.

Calcium carbonate (CaCO₃), the main component of limestone, is widely used not only as a raw material for cement and concrete but also as an extender in many industrial fields to improve physical properties. Replacing conventional limestone and synthetic calcium carbonate with the CO₂ recycling artificial limestone we have developed can reduce natural resource consumption and help cut CO₂ emissions thanks to its highly efficient mineral sequestration. The pilot-scale manufacturing test facility for CO₂ recycling artificial limestone, which began operations at our Tochigi Plant (Sano City, Tochigi Prefecture) site in April 2025, was built to verify the research results obtained from our previous bench-scale production tests in a scaled-up environment and to gain insights for the design of mass-production equipment. This facility has an annual production capacity of 270 tons, approximately 10 times that of our bench-scale manufacturing test facility (Taisho Ward, Osaka City). It produces CO₂ recycling artificial limestone by extracting calcium from diverse waste materials such as collected general incineration ash, and utilizes CO₂ from the exhaust gases emitted by the Tochigi Plant. Additionally, a portion of the residue remaining after calcium extraction is used as an alternative raw material for cement at our Tochigi Plant. At this pilot-scale facility, we will establish more efficient operating methods and conduct various demonstration tests, as well as advance technological development with the objective of applying this technology practically in society from fiscal 2030 onward.

Manufacturing Process for CO₂ Recycling Artificial Limestone



Conceptual diagram of the CO₂ recycling artificial limestone business →P.53

Development of Rubber Products Using Recycled CO₂ Artificial Limestone



Rubber rollers using CO₂ recycling artificial limestone (exhibited at the Sumitomo Pavilion, Expo 2025 Osaka Kansai)

In collaboration with Sumitomo Rubber Industries, Ltd., we have successfully developed rubber rollers for office automation equipment using CO₂ recycling artificial limestone. This marks the first joint product development initiative within the Sumitomo Group utilizing CO₂ recycling artificial limestone. By using a synthetic rubber compound made using CO₂ recycling artificial limestone in place of traditional limestone, the CO₂ is minerally sequestered, and it is estimated that universal application in all rubber rollers for office automation equipment produced by Sumitomo Rubber Industries would result in an annual CO₂ reduction of approximately 36 tons. Because CO₂ recycling artificial limestone intrinsically fixes CO₂, simply mixing it in as an extender acts as an advanced and highly efficient CCU mechanism. Going forward, Sumitomo Osaka Cement and Sumitomo Rubber Industries will accelerate development toward employing CO₂ recycling artificial limestone in automotive tires and a range of other rubber products.

TOPICS

► Development of Composite Polypropylene Resin Using CO₂ Recycling Artificial Limestone

Sumitomo Osaka Cement, in conjunction with Nissen Polytech Co., Ltd., has developed a composite polypropylene resin utilizing recycled CO₂ artificial limestone. This is the world's first composite polypropylene resin that uses recycled CO₂ artificial limestone as a raw material in place of natural limestone. We are also applying CO₂ recycling artificial limestone—made by recycling used plasterboard from construction waste—as a filler material for soft polypropylene resin used in clear document folders and similar products. Looking ahead, the two companies will continue to boost development toward applying CO₂ recycling artificial limestone to resins other than composite polypropylene resin, as well as to a variety of other products.



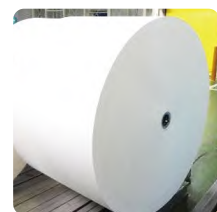
Composite polypropylene resin pellets



Clear document folders made of composite polypropylene resin

► Development of Paper Using CO₂ Recycling Artificial Limestone

Together with Oji F-Tex Co., Ltd. and Fukoku Paper Co., Ltd., we have developed "LOCABO Paper® (Low Carbon Paper)," a paper made from CO₂ recycling artificial limestone. This product is the world's first paper developed based on Oji F-Tex's premium printing paper (Gulliver Series) in which the raw material filler has been partially replaced with CO₂ recycling artificial limestone. LOCABO Paper® has the same strength as existing specialty papers and has passed printability tests. Going forward, the three companies will continue to explore ways to expand the application of CO₂ recycling artificial limestone, as well as technologies for stable supply of this product and its business development.



Low-carbon paper rolls



Low-carbon paper

► Development and Successful Test Construction of "Next-Generation Low-Carbon Semi-Flexible Pavement" that Uses Recycled CO₂ Materials and Combines CO₂ Emissions Reduction with Carbon Removal

Using CO₂ recycling artificial limestone, as well as carbon-recycled cement, which uses CO₂ recycling artificial limestone as an extender, we have developed a next-generation low-carbon semi-flexible pavement that combines two types of climate change mitigation measures, "CO₂ emissions reduction" and "carbon removal," in cooperation with NIPPO CORPORATION. We have successfully completed test construction and are now close to commercialization. Semi-flexible pavement is pavement with cement milk permeated into the voids of the asphalt. It has excellent plastic deformation resistance and is used in areas where vehicles frequently stop and start, such as near intersections and bus terminals, and where the road surface is susceptible to damage from heavy loads and neglect. A significant reduction in CO₂ emissions is expected for semi-flexible pavements that use cement-based materials with a high CO₂ fixation potential.



Roadway using next-generation low-carbon semi-flexible pavement

► Application of CO₂ Recycling Artificial Limestone at Expo 2025 Osaka Kansai



Edging blocks made with CO₂ recycling artificial limestone

* RITE: Research Institute of Innovative Technology for the Earth

As an environmental solutions company, we are committed to developing innovative carbon offset technologies in the cement and concrete sectors. For Expo 2025 Osaka Kansai, the "Expo 2025 Green Vision" was formulated to create an exposition that takes into consideration decarbonization and recycling, based on the concept that "Our lives are connected to each other, supported by the universe, the seas and the earth as our vessels."

We support this vision and have supplied low-carbon precast concrete products using CO₂ recycling artificial limestone for the Sumitomo Pavilion building at Expo 2025 Osaka Kansai and for the road paving of the RITE* "Future Forest" constructed for the Expo. Additionally, the official Sumitomo Pavilion merchandise sold at the Expo site included memo pads and postcards fabricated from LOCABO Paper (Low Carbon Paper), that was made from CO₂ recycling artificial limestone and developed in collaboration with Oji F-Tex Co., Ltd. and Fukoku Paper Co., Ltd., as well as clear document folders made from composite polypropylene resin that incorporates CO₂ recycling artificial limestone, which was developed in collaboration with Nissen Polytech Co., Ltd. The recycled CO₂ artificial limestone used in these products was produced at our bench-scale manufacturing test facility in Taisho Ward, Osaka City, and was generated from calcium and CO₂ contained in waste plasterboard and other such materials.



Sumitomo Pavilion merchandise made with CO₂ recycling artificial limestone (above: notepads; below: polypropylene document folders)

► Development of the World's First Road Marking Paint Using CO₂ Recycling Artificial Limestone

In collaboration with KICTEC Inc., we have developed a road marking paint that uses CO₂ recycling artificial limestone. This new road marking paint is a product in which the extender has been partially replaced with CO₂ recycling artificial limestone during manufacturing, which results in mineral sequestration of CO₂. The minerally sequestered CO₂ is not released into the atmosphere and remains semi-permanently fixed even after the product has deteriorated or is naturally worn out after use. The use of CO₂ recycling artificial limestone results in color development, durability and other performance features on a par with products made from natural limestone, thus enabling the reduction of CO₂ emissions in the road sector. We are conducting demonstration tests of this product on the access route to Expo 2025 Osaka Kansai, and will further explore its use as road marking paint as we pursue market deployment, with the aim of contributing to society-wide carbon neutrality.



Applying road marking paint made from CO₂ recycling artificial limestone