



Pioneering carbon capture with Rohrdorfer Zement

Klaus Baerenthaler, Vice President Carbon Capture at ANDRITZ, explains how Europe's first carbon capture plant in the cement industry demonstrates that CO₂ can become a resource and not a burden.

The Global Cement and Concrete Association (GCCA) reports that the cement industry contributes around 7 to 8% of global man-made CO₂ emissions. That means curbing the CO₂ emissions resulting from cement production will make a crucial difference in helping the world achieve its net-zero objectives to limit global temperature rise. ANDRITZ is set to play a key role in helping the cement industry achieve this target by deploying our carbon capture and storage (CCS) technology that is already proven in other industries.

In a pioneering project, ANDRITZ was the engineering, procurement and construction (EPC) contractor for a pilot project to develop Europe's first carbon capture plant in the cement industry. The plant has been constructed for Rohrdorfer Zement at its Rohrdorf site, near Rosenheim in Germany. This site was already a focus for major developments in decarbonization. In fact, in 2022 it was producing cement with 45% less CO₂ than in 1990 by optimizing cement types and fuel use. This approach can achieve a maximum reduction in CO₂ emissions of around 65%. The remaining 35% must be eliminated by carbon capture.



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LIQUID AMINE PROCESS

ANDRITZ has deployed a liquid amine process for the pilot plant. This technology is currently the most mature and commercially viable approach for large-scale applications. It uses amines - organic compounds derived from ammonia (NH_3) – to “scrub” the CO_2 from the flue gas. At lower temperatures the amines bind to CO_2 and absorb it. When heated they desorb it to yield close to pure carbon dioxide. There are two advantages to the amine process. First, it offers a high removal rate – up to 95% is a good practical value. Second, it produces a high purity CO_2 product – up to 99% without purification.

Our team has carried out extensive testing on the amine process and further tests are planned to optimize it for application in both the cement industry and other types of industrial plant. Gathering detailed operational information to do this is a key aim for the Rohrdorf project.

One specific area for optimization is the amine solution, our “secret sauce” for the process. Modifying its composition can enhance both the energy efficiency of the plant and the longevity of the solution. The liquid amine process is not the only carbon capture technology being developed by ANDRITZ, as we are also looking at dry membrane technology. However, currently this only offers a clear advantage at moderate CO_2 capture efficiencies (typically between 50 and 70%), with a product purity of around 95%.

DEVELOPING CARBON DIOXIDE AS A POTENTIAL ASSET

Helmut Leibinger, head of Rohrdorfer Zement’s net zero emissions team, says there are two main drivers for the investment in the carbon capture pilot project:

“Currently, we enjoy free status under the emission trade system (ETS). That means we have a free allocation of certificates for the carbon dioxide we leak into the atmosphere. But this is being phased out, so it will be prohibitively expensive for this to continue. Our aim therefore, is to find a way to decarbonize our production by 2038. We saw the potential for carbon capture from ANDRITZ’s previous experience in other industries, but we were not yet ready for a full-scale project, especially as we felt that we couldn’t just “copy and paste” from say the oil and gas industry. Our need was to carry out a proof of concept to verify the technical, qualitative and economic conditions for CO_2 capture and conversion in the cement industry.”

“Furthermore, our industry needs to start seeing the potential of carbon dioxide as a valuable asset rather than a problem that has to be disposed of. This project is demonstrating how it can be transformed into methanol, ethylene or formic acid, becoming a starting material for many products that are currently derived from petrochemicals.”

PILOT PLANT NOW PRODUCING FORMIC ACID

The pilot plant started operation in the fall of 2022 and is currently capturing more than 2 tonnes of CO_2 a day. After drying and purification, the CO_2 is compressed at 60 to 80 bar and stored in gas bottles.

The gas produced is close to food-grade. This opens future possibilities for Rohrdorfer to supply the food and beverage industry, such as for carbonization of drinks.



Right now the captured CO₂ is used to produce around 1800 liters (l) of formic acid a day. This is supplied to chemical plants in the region, serving as the basis for products such as cleaning agents, disinfectants or deicing agents. Furthermore, formic acid can be used as a reagent to activate cements with a low clinker content.

FUTURE EXPANSION

Over the next two to three years, the pilot plant will continue running to help refine and optimize the liquid amine process and examine its long-term stability. This is in preparation for the next expansion stage of the facility to capture 48 tonnes of CO₂ a day. Rohrdorfer's ultimate plan is to develop a plant that can recover 100% of the site's CO₂ emissions from cement production - 1,500 tonnes per day.

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