New crushing method saves water and energy in mines and produces better raw materials for batteries

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The operating principle of the new CCC method. Credit: Niina Paasovaara

A new type of crushing method gives ores time to react and break down
along the natural boundaries of different minerals during slower compression. In a new study, the application of this method for crushing and dry beneficiation of graphite yielded promising results. The development of the mining sector is now strongly oriented towards sustainable solutions.

Continuously compressing crushing (CCC) method aims to separate valuable minerals from non-valuable minerals more cleanly by exploiting the grain boundaries and micro-cracks of different minerals.

Traditionally, graphite has been processed using wet grinding, a water- and energy-intensive process. A study published in Minerals Engineering presents the application of CCC for graphite processing, which promises revolutionary savings in water and energy use.

CCC was for the first time tested on natural ore samples in a study by the University of Oulu and involving the University of Eastern Finland and the South-Eastern Finland University of Applied Sciences (Xamk).

"With the growing demand for high-quality graphite in lithium-ion battery production, the potential of the CCC method of producing coarse grained graphite flakes is particularly important. Coarse grained graphite flakes are highly sought after in various industrial applications due to their excellent quality and purity.

"This new advance will support the green transition and the development of electric vehicles, for example," says Professor Shenghong Yang of the Oulu Mining School at the University of Oulu.
Laboratory-scale CCC crusher at Oulu Mining School. Credit: Niina Paasovaara
"An important advantage of CCC over conventional methods is that no water is needed, so the method is completely water-free, which reduces the negative environmental impact," says Niina Paasovaara, doctoral researcher at the University of Oulu.

"In addition, it was already proven in the 1950s that slow compression is the most energy-efficient way to break the ore material, so it is surprising that the method we are refining now has not been adopted earlier."

Traditionally, rock is chipped as finely as possible, which easily leads to overgrinding of particles, makes further processing difficult and produces a lot of harmful dust. The new method produces a rougher and cleaner crushing product with a larger surface area, which in many ways facilitates the next steps of the beneficiation of valuable minerals.

"Developing graphite crushing technology is a step towards a more sustainable mining sector. In the future, the water and energy-saving crushing method will be tested for other types of ore containing critical raw materials.

"There is still a long way to go before the new crushing method can be applied on an industrial scale. It is also important to train new professionals for the mining industry that is facing a constant labor shortage," Professor Yang says.

"In further research, we will focus on further proving the energy efficiency at different stages of the crushing process," Paasovaara says. The method is also linked to ongoing green chemistry research, which uses new green flotation chemicals to concentrate valuable minerals, in collaboration with the School of Pharmacy at the University of Eastern Finland.
"The aim is to make the whole process of crushing, grinding and beneficiation of ore minerals water and energy efficient, and less waste producing. Together with the new flotation chemicals, the CCC method will ensure the cleanliness of green energy transition in the whole ore beneficiation process," Paasovaara says.


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