ACTIVATED LIMESTONE

LEVANDE HAV AB

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WHAT IS ACTIVATED LIMESTONE?

Activated limestone is a newly developed material derived from marl, a byproduct of limestone quarries, with a calcium carbonate ($CaCO_3$) content exceeding 90%. Activated limestone can bind phosphorus in waterbodies and its uptake is more than 500 times higher than that of the original marl.

Activated limestone has the ability to bind phosphorus in waterbodies.

This helps reduce eutrophication.

Activated limestone is spread as particles at the surface of water-bodies, whereafter they settle to the seafloor to bind phosphate into the sediment. This process reduces the availability of phosphorus in the water, which in its turn reduces algal and plant growth.

FIGHTING FOR THE BALTIC SEA

Many waterbodies, among them the Baltic Sea, suffer from eutrophication, which means an increase in the supply of organic matter to the ecosystem through nutrient enrichment. Excessive input of especially phosphorus and nitrogen to the waterbodies enhances the growth of phytoplankton, leading to reduced light conditions in the water, oxygen depletion at the seafloor, and a cascade of other ecosystem changes.

94%

Approximately 94 % of the Baltic Sea was assessed as eutrophied in 2016–2021 according to the integrated status assessment of HELCOM. Many other inland seas and lakes have similar eutrophication problems, too.

HOW DOES ACTIVATED LIMESTONE WORK?

Limestone is a sedimentary rock primarily composed of calcium carbonate ($CaCO_3$). When heating limestone in a kiln, carbon dioxide (CO_2) drives off and calcium oxide (CaO) is left behind. This process is called calcination. Activated limestone is the product of an incomplete calcination process and consists of a mixture of calcium carbonate and calcium oxide.

When an activated limestone particle comes in contact with water, calcium oxide dissolves and forms calcium (Ca^{2+}) and hydroxide (OH^-) ions. This leaves behind pores in the calcium carbonate particle, which itself is insoluble. If these pores are large enough, the calcium carbonate particle cracks into smaller particles leading to a much larger total surface area.

Since the reaction between activated limestone and phosphorus is a surface reaction, a large surface area is desirable for binding phosphorus in waterbodies.

Phosphorus sorbs on the surface of calcium carbonate. Since the particle cracks in the sediment and forms many microparticles, the surface for sorption is large and the uptake effective. These calcium carbonate – phosphorus compounds stay in the sediment and can become buried within the sea floor. This can result in long-term storage of phosphorus in the sediments, effectively removing it from active circulation in the water column.

BENEFITS OF ACTIVATED LIMESTONE

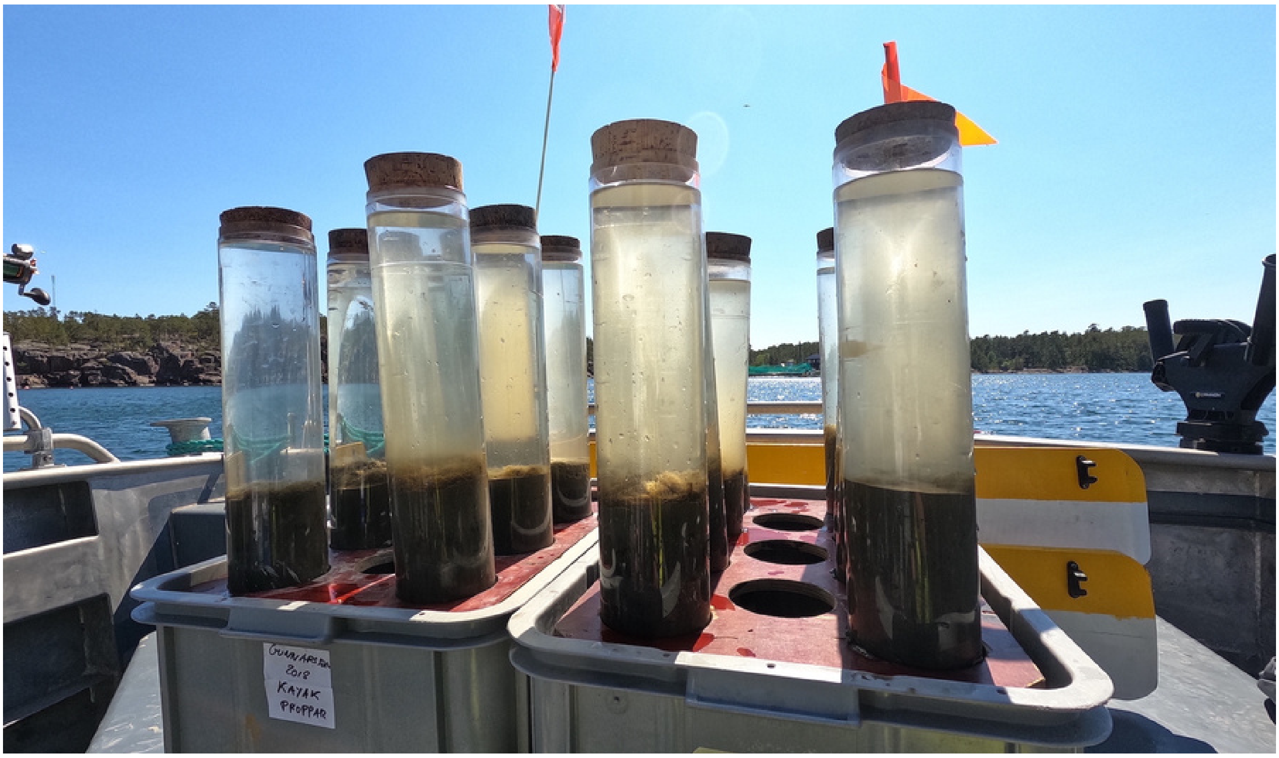
Activated limestone can be relatively cost-effective compared to some advanced technologies and engineering solutions to help mitigate eutrophication. Adding activated limestone to water is also a straightforward process. It is spread as particles on the surface of the waterbody, sinks down to the bottom, where it binds phosphorus into the bottom sediment.

Activated limestone can be applied into water using equipment like spreaders as well as helicopters or drones, making it a comparatively quick process.

It can also be strategically applied to specific areas within a water body, such as near nutrient source points or in anoxic zones, i.e. where there is no oxygen.

Yet another advantage is that with activated limestone you can reach dead bottoms at different depths by using different particle sizes. Large particles sink faster than small ones and can therefore reach deeper.

As a naturally occurring material inducing chemical reactions that mimic certain natural processes, activated limestone can be seen as a more natural approach compared to some chemical treatments.



SAFETY & SUSTAINABILITY

Like any chemical treatment, there are considerations for safety and potential environmental impacts. Adding activated limestone to water can increase the pH, making the water more alkaline, but we have not seen this in the field tests. The amount of activated limestone added to the water should be carefully calculated based on the chemistry of the water, pH, and the desired treatment goals.

The calcium carbonate – phosphorus compounds settle in the sediment at the bottom of the waterbody. This can affect sediment quality and potentially alter the habitat for bottom-dwelling organisms. Thus, monitoring the long-term effects of the treatments is essential.

Using activated limestone in a waterbody to bind phosphorus is generally not detrimental to the ecosystem, and plants and animals continue to live in these areas.

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Calcination, the process of heating limestone to produce activated limestone, requires significant energy input. The sustainability of the process depends on the energy sources used. Using renewable energy can significantly reduce the carbon footprint of the manufacturing process. Calcination also releases carbon dioxide (CO_2) as a byproduct. The extent of CO_2 emissions depends on the energy source used and the efficiency of the process. Efforts to capture and mitigate CO_2 emissions can improve the sustainability of the manufacturing process of activated limestone.

Heidelberg Materials Cement Sverige, the producer of our activated limestone, has been able to continuously reduce its CO_2 emissions since 2018. As part of the company's continuous efforts on improving carbon capture and storage (CCS), its Slite plant in Gotland is currently undergoing a process of becoming the world's first carbon-neutral cement plant.

ABOUT THE COMPANY

Levande Hav Ab is a spin-off company from Stockholm University. Our CEO Dr. Eva Björkman has been studying the use of activated limestone to bind phosphorus since 2012. The company Levande Hav was founded in 2020 to take this innovation from the laboratory into use in real aquatic environments, to help fight eutrophication.

We want to decrease the eutrophication and the toxic summer blooms in the Baltic Sea by using our sorbent activated limestone and adding it to the dead sea floors, where the sorbent binds phosphate to the sediment.

LEVANDE HAV

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