Binding phosphorus into Baltic Sea sediment with activated limestone

POLICY BRIEF

July 2019

ESA Copernicus Sentinel Data & USGS/NASA
www.syke.fi/tarkka

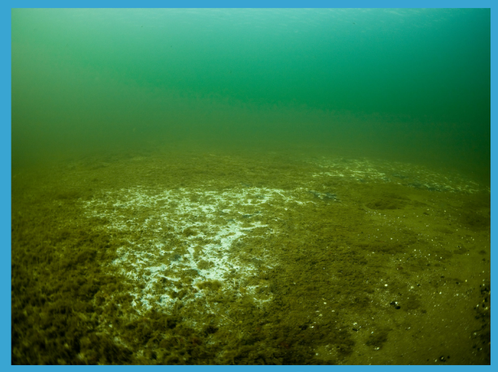

Photo: Jukka Nurminen

Photo: Eva Björkman

Photo: Tara Jaakkola

INTRODUCTION

TOO HIGH concentrations of nutrient elements (nitrogen, N and phosphorus, P) in the sea may cause excessive production of organic matter, a process called eutrophication. The most detrimental symptoms of eutrophication are algae blooms and bottom water oxygen depletion.

Due to eutrophication, large areas of bottom sediments in the Baltic Sea are covered by water containing no or very little dissolved oxygen. As no animals can survive without oxygen, such areas are often referred to as ‘dead zones’, and the expansion of dead zones pose a major threat to biodiversity in open and coastal areas of the Baltic. Furthermore, the capacity of sediments to bind P is impaired in low oxygen conditions, P-flow from sediment is increased which in turn further aggravates eutrophication. The magnitude of this so-called "internal load" has already been estimated to exceed the external P load to the Baltic sea.

THE SEABASED project included the first field tests with a newly developed calcium (Ca) based P sorbent which is intended to lower the release of P from dead zone sediments. The sorbent is produced by heat treatment of limestone pebbles (marl) by a method developed by scientists at Stockholm University. Prior to the SEABASED project, promising results from laboratory studies were available, but the sorbent had not yet been tested in field conditions.

SEABASED
SEABASED MEASURES IN
BALTIC SEA NUTRIENT MANAGEMENT

PILOT ACTIVITIES IN FINLAND AND SWEDEN

Sorbent tested in field scale setup

FOUR FIELD TRIALS (pilots) were conducted in Sweden and Finland. Two of the pilots were aimed to lower the concentration of P in the water column of semi-enclosed bays by adding the sorbent to the sediment. These trials were also performed to test the technical feasibility of spreading the sorbent by helicopter over relatively large areas.

THE TWO remaining trials were focused on changes in sediment parameters due to the sorbent, as well as the influence of field conditions on the sorbent.

The results of the field trials are presented in the final report (available at www.seabasedmeasures.eu).

Photos: Tara Jaakkola

CONCLUSIONS AND RECOMMENDATIONS

Key findings in the project

THE SPREADING of the sorbent by helicopter worked as planned and the sorbent did not cause any negative environmental effects in the studied areas.

THE SORBENT was shown to bind P in field conditions but to a lesser degree than anticipated from results in the laboratory. Yet no sustained decreases in P concentrations in the water column of studied bays were detected. Thus, the sorbent clearly has potential but further development of the large-scale production method of the sorbent is recommended to increase its P-binding capacity. To quantify and further demonstrate the sorbents' capacity to bind P in natural conditions, this development work is recommended to include controlled small-scale experiments with sediment combined with additional coastal applications

THE PILOTS INCLUDED ambitious sampling programs and the collected data allow for well-grounded and scientific-based evaluation of the tested measure to improve environmental conditions. The collected data will also be an asset in the future development of the method. Adequate environmental monitoring should be a key feature also in future pilots and it is generally recommended to perform field trials in areas where environmental monitoring is already ongoing.

EUTROPHICATION
IN THE BALTIC SEA

The role of sediment:

1. Man-made emissions of nutrients (nitrogen N, and phosphorus P) to the Baltic Sea have increased the production of organic matter (=eutrophication). The rise in P concentrations has primarily favored certain bloom-forming cyanobacteria.

2. The eutrophication has also increased the input of organic matter to bottom sediments. Degradation of organic matter consumes oxygen and the increased supply of organic matter to sediments is therefore a driver in the development of oxygen depleted 'dead zones' in the Baltic.

3. Such restoration of the P-binding capacity of sediments in dead zones has the potential to counteract eutrophication and in the long term improve oxygen conditions, as a complement to the reduction of the external nutrient load.

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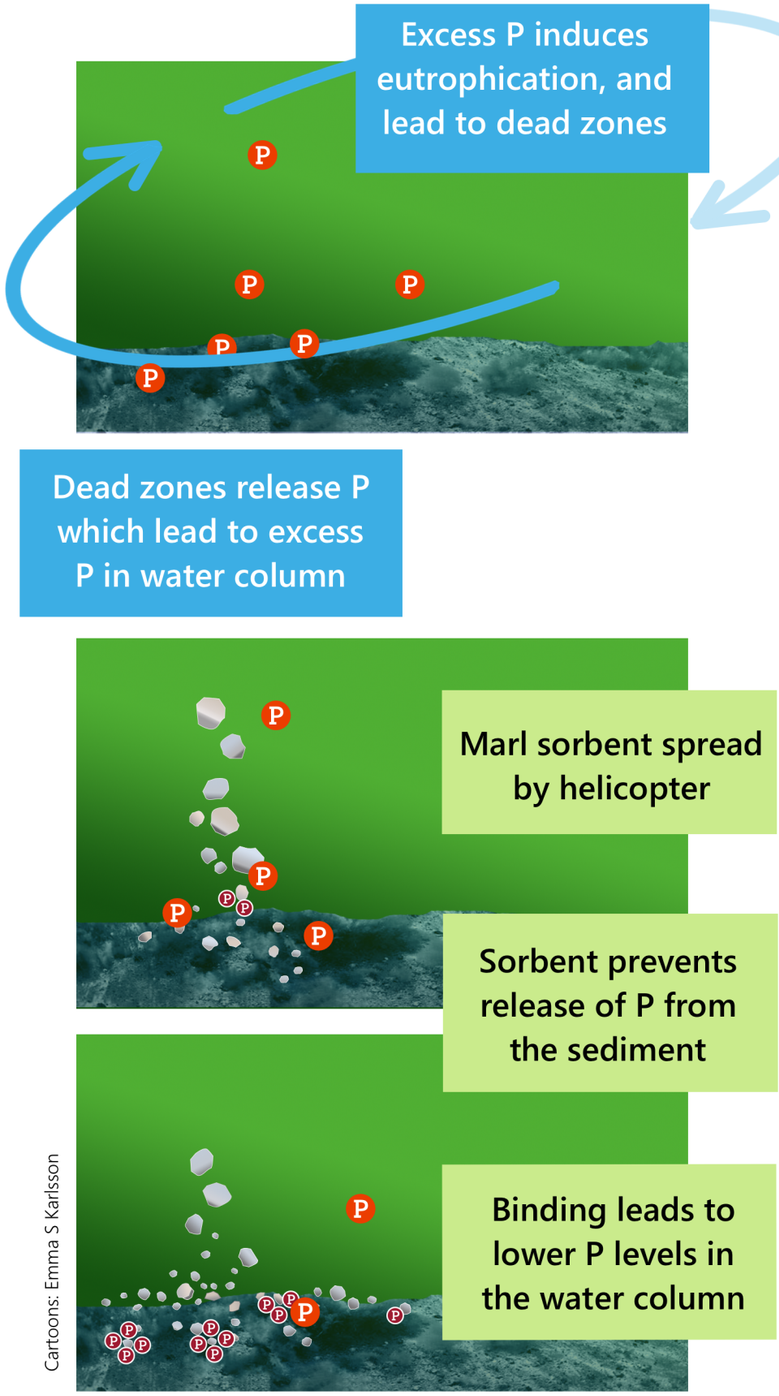

Cartoons: Emma S Karlsson

BINDING
PHOSPHORUS

The sorbent:

1. The sorbent is produced by heat treatment of a limestone-rich material called marl. The marl is a by-product of limestone excavation on the island of Gotland, Sweden.

2. The purpose of the sorbent is to increase the sediments capacity to bind P in oxygen depleted areas and to thereby lower P-levels in the water column.

3. As a complement to nutrient emission cuts of external nutrient sources, such restoration of the P binding capacity of sediments in dead zones has potential to counteract eutrophication and on longer terms improve oxygen conditions.

Layout: SEABASED project and Emma S. Karlsson, Niras

For further information
Eva Björkman, Levande Hav AB,
eva@levande-hav.se

EUROPEAN UNION
European Regional Development Fund
Interreg Central Baltic
SEABASED
SEABASED MEASURES IN BALTIC SEA NUTRIENT MANAGEMENT
Centre for Economic Development, Transport and the Environment
LÄNSSTYRELSEN ÖSTERGÖTLAND
Stockholm University
John Nurminen Foundation