Future Offshore Substructures

Innovation and Vision

Founding and Supporters:

- Det Energiteknologiske Udviklings- og Demonstrationsprogram, https://www.eudp.dk/en
- The Velux Foundations, https://veluxfoundations.dk/en
- Resen Waves, https://www.resenwaves.com/

An IDEA developed at AALBORG UNIVERSITY

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https://www.en.build.aau.dk/

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- *Facilitate large scale implementation of offshore renewable energies*
- *Sustainable material for offshore and coastal engineering applications*
- *Disruptive: scour protection, ecosystem enhancement, allocation of surplus generated power - ALL IN ONE SOLUTION*

Innovation

The cathodic protection (CP) induced by a current through the steel cathode, initiates electrochemical reactions precipitating both aragonite ($CaCO_3$) and brucite ($Mg(OH)_2$), referred to as calcareous material.

This process can be tuned to obtain a hard and resistant material. As long as an electric current is applied, the calcareous material will grow thicker in time, and will feature physical-chemical properties very similar to coral reef materials. Because the cathode on which the precipitation takes place can be of any shape and size, it is possible to design it at wish.

What if we could use the excess generation from offshore renewable energies to power one substructure that protects the seabed from scour while improving marine ecosystems?

Why?

European targets to reach 40 GW of ocean energy and other emerging technologies by 2050, need the implementation of innovative solutions promoting sustainable materials and circular economy at sea.

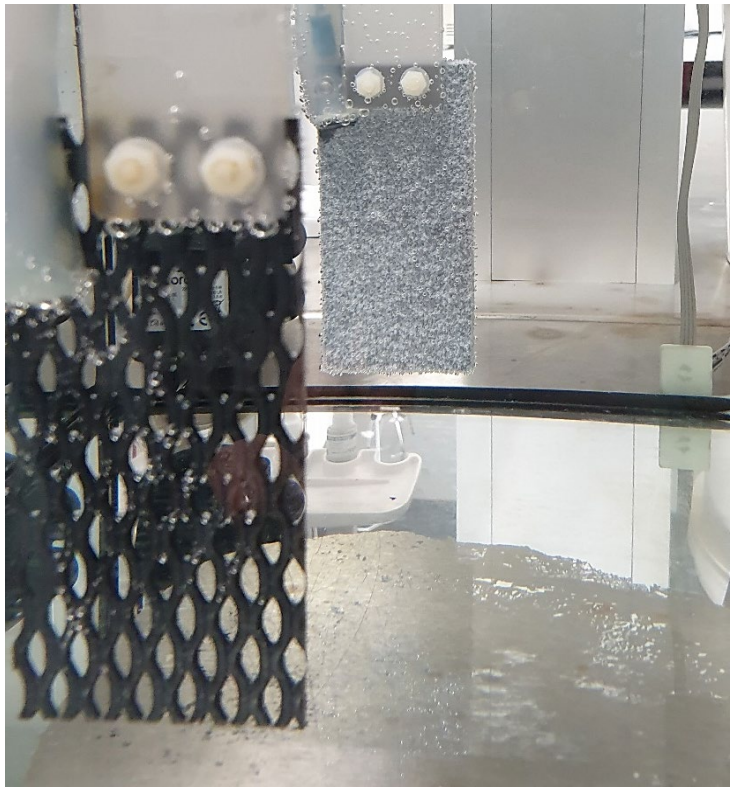
Offshore wind energy capacity will increase greatly and consequently the need for offshore constructions and substructures. Many projects are trying to find the most suitable way to undertake this green-transition, with the least impact on the marine environment.

One system could be engineered, to use the excess energy from the renewable energy farm, in order to lower the cost of the material and provide relief to the grid when it will reach full capacity. The induced mineral deposition would produce a thick and strong calcareous deposit around the metal frame, adding mass, providing habitat for marine life and protecting the seabed from scour.

Vision

In the case of ResenWaves, for each device installed rated 3kW, 50 kg of steel designed as wished are placed on the bottom of the sea over the foundations and seabed hub. The steel will be electrified with direct very low current, for a total energy consumption of 215 kWh/y, corresponding to 1-2% of the total energy produced (average expected power production of 1.8 kW in the Danish West coast).

The same concept design can be applied to **offshore wind** and **energy islands**.



Cathode
50 kg rebar steel, circa 280 m total length
Anode
0,5 sqm, DSA material
Output current
0.2 A
Output Voltage
1.2-2.5 V
Density of the calcareous material
1.6 – 2.0 g/cm3
Mineral composition
50% brucite, 44% Aragonite, 6% Calcite
Compression strength of the calcareous deposit
2-4kN

Coastal protection structures have been built virtually in the same way for hundreds of years.... Should we not dream of more advanced ways complimenting our improved understanding of marine environments?