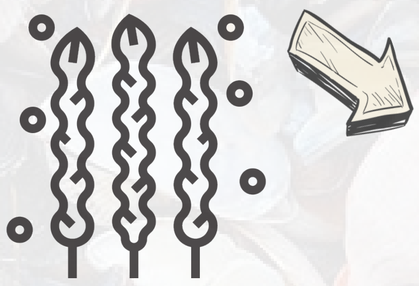
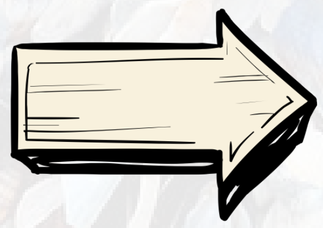
3D Printing with Mussel Shell Waste



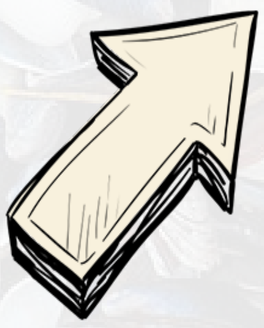
Material

The mussel shell waste from Zeeland is grinded into powder and combined with sodium alginate (which is made from algae). When adding water, a biobased paste arises which is suitable for 3D printing.

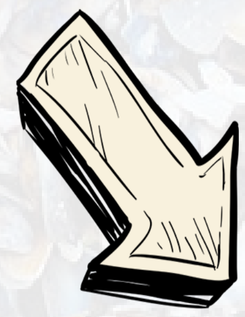


Print

There are multiple 3D printing companies in Zeeland. Since this is also where mussel shells are discarded, the whole loop can be made in Zeeland (local manufacturing). For this project an adapted Ultimaker 2+ extended was used, combined with a Stoneflower paste extruder.



In this thesis, additive manufacturing and mussel shell alginate material is combined to create parametrically designed plant-specific planters. By adjusting the parameters to the plants needs, plant growth can be increased. Parameters change the amount of water and nutrients the plant receives, the amount of oxygen and light on the roots, and the needed dimensions for the root system. The inner pot is made out of dissolvable mussel shell alginate paste, which releases nutrients. When the inner pot is dissolved, the plant has more space to grow in the outer pot, making repotting unnecesarry, The planters are designed for people with limited time or skills to care for their plants.

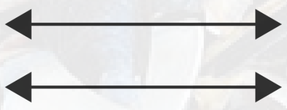


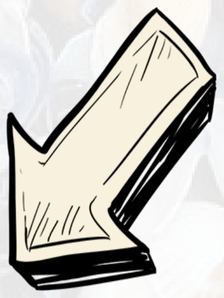
Recycle

After use, the planters can be recycled. By grinding the planter into powder, new AM material can be created. Since the powder already contains both mussel shell and sodium alginate, only water needs to be added.

Cross-link

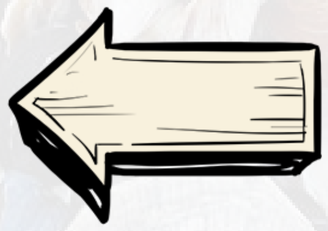
Sodium alginate has as unique property that it can be cross-linked. By submerging the print in a calcium chloride solution, the material structure changes, making the material water-resistant. By cross-linking the outer pot, we can make sure it does not dissolve. The inner pot does not get cross-linked, so it dissolves and provides nutrients.





Reverse cross link

After use, the outer pot is reversibly cross-linked with an EDTA solution, making the outer pot water soluble again. Now, when adding water in the ‘material step’, the sodium alginate that is present in the recycled powder will dissolve, meaning it does not have to be added again.



Use

Each plant needs a unique care. In this thesis a prototype for the Orchid Phalaenopsis was made. This Orchid needs special care; it grows better when both air and illumination gets to the plants roots. Therefore, the Phalaenopsis planter has big holes in the inner and outer pot. Such a design suits AM and would be difficult to make with conventional production methods.

Master Thesis Edwin van Tongeren

13-03-2020

IPD

Committee Zjenja Doubrovski
Mariet Sauerwein

TU Delft

Faculty of Industrial Design Engineering

Delft University of Technology