DEVELOPING MARINE BIODEGRADABLE PLASTIC FOR ECOSYSTEM RESTORATION

MNEXT MATERIALS & ENERGY X TRANSITION

Mechanical, thermal and rheological testing of PHA compounds for injection molding

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Introduction

A much promising way of marine ecosystem restoration is the **B**iodegradable **E**lement for **S**tarting **E**cosystems. This product is coproduced by Rodenburg Bioplastics[1] and made from Solanyl. Solanyl is a starch-based bioplastic which biodegradates in marine environments in about 20 years. The goal of this project is to make a bioplastic made from PHA which has comparable tensile and flow properties to Solanyl. PHA biodegrades in only 5 years in marine environments.

Figure 1 BESE-element providing shelter for a growing mussel bank Rodenburg bioplastics[1]

Methodology

In chronological order, 4 series have been made. S1 tests the influence of **different PHAc/PHAa** ratios. When the right ratio was made (determined with MFI and tensile tests), **thermoplastic starch** was added in the S2 series to reduce costs. After determination of the maximum amount of starch that could be added, the S3 series was made, introducing compound B to the polymer. Compound B is a **nucleating agent** that also increases the tensile strength of the plastic. After deterging the right amount of compound B in the plastic via tensile tests and MFI, **plasticizers** were added to increase the flow of the polymer. Because the mold of the BESE Element is such a difficult system, the viscosity of the plastic needs to be as low as possible.

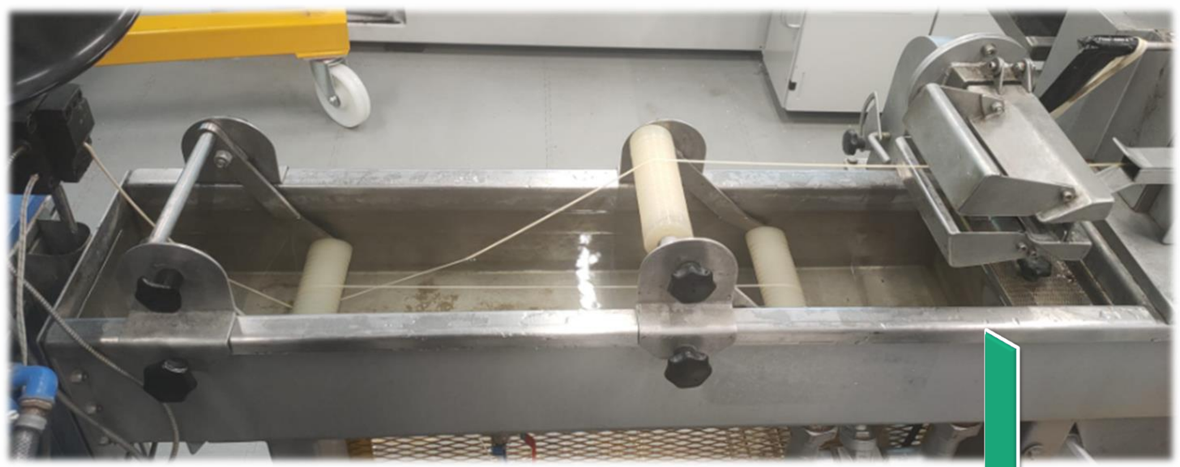

Figure 2: Compounder with PHA filament for PHA granulate

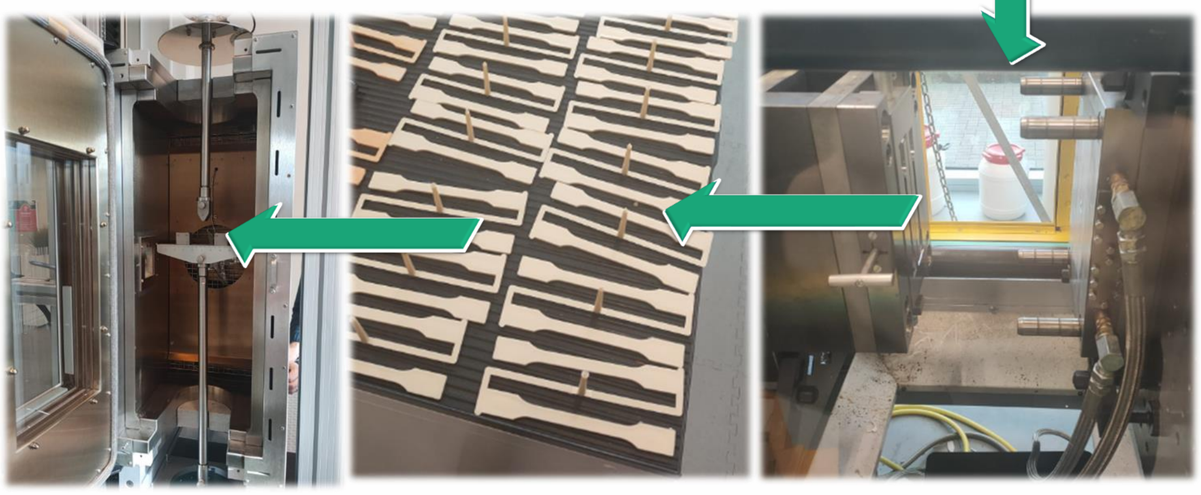

Figure 3: the process of injection molding PHA tensile bars and testing tensile bars

Results

Tensile properties have been obtained for the different series. The black lines represent the Solanyl reference and its 80% range. As to be seen in figure 4 the tensile properties rise when starch (in the S2 series) is added in comparison to the virgin PHA blends (S1). The tensile properties also rise when the nucleating agent (S3) is added. Finally, when the plasticizers were added, the tensile properties dropped beneath the 80% range.

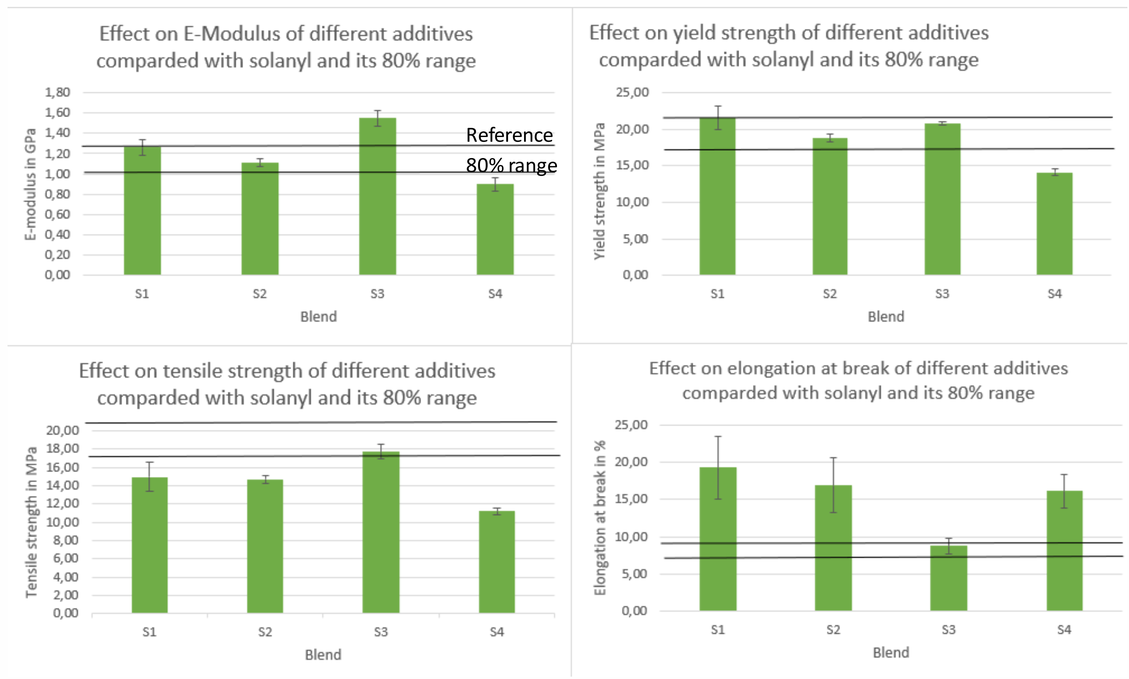

Figure 4: Tensile properties of the PHA blends. The black bars represent the measured Solanyl reference and the 80% range, which serves as a minimum of the PHA blends.

MFI tests (showcased in figure 5) were done at 180°C, and the S2 series almost doubles the MFI compared to the S1 series. Compound B, disturbs the MFI, brings it back to below the S1 series. After adding plasticizers, the MFI of S4 is not nearly as great as Solanyl, but that is because Solanyl is normally measured at 170°C.

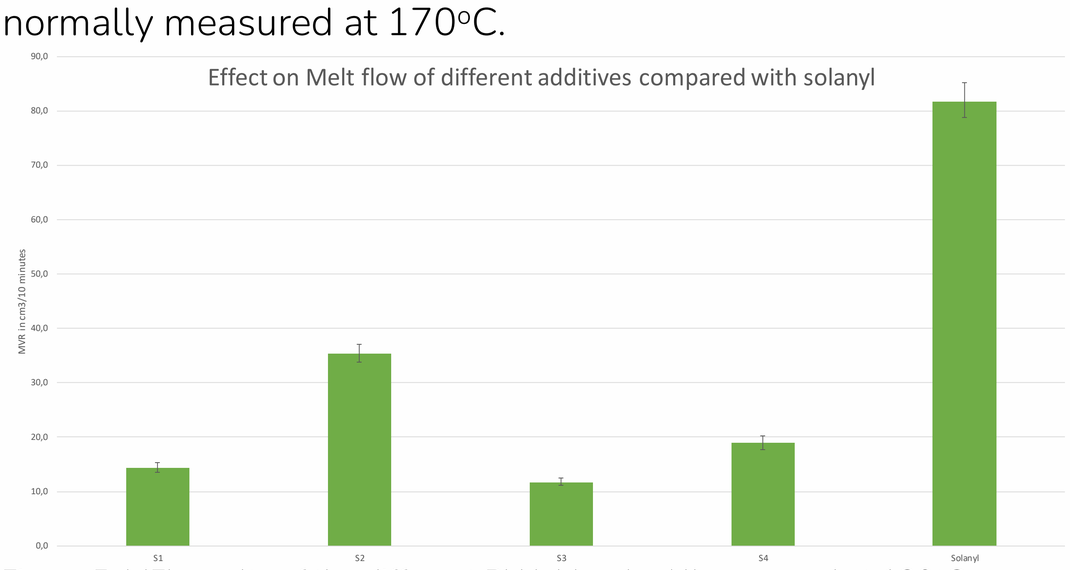

Figure 5: MFI results of the different PHA blends. All measured at 180°C.

Conclusion

An injection moldable plastic has been developed, which is stable at 80°C. Although it is much weaker than Solanyl. PHAc is in a to low concentration in the end product, to increase the melt flow index and the tensile properties, a higher concentration PHAc is recommended.

References

1. *BIODEGRADABLE 3D-STRUCTURE FOR ECOSYSTEM RESTORATION – MADE FROM POTATO WASTE, BIOPOLYMERS.COM*
2. *BESE_FACTSHEET K. DIDDEREN ET AL, WWW.BESEPORDUCTS.COM*