

4. Technical e-NEWSLETTER

Demonstrative pilot line for BioTHOP

PLANTING POTS production

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As a part of the LIFE BioTHOP project, the Slovenian Tool and Die Development Center - TECOS is establishing a pilot line for medium-series production of biodegradable planting pots, based on bioplastic matrices and wasted hop fibres.

The mould for injection moulding processing has been designed and manufactured already in the first year of the project activities.

Currently, however, we are focusing on selecting a suitable material formulation that will meet all the requirements of the horticultural sector.

Through the first generation of biocomposite materials development, led by our project partner Tecnopackaging from Zaragoza, Spain, we tested a composite blend of polylactic acid (PLA), hop fibres (20 wt.%) and special additives that were added to improve the processability and flexibility. The testing samples with this material formulation were too brittle in structure and cracked under applied hand pressure. This material composition is certainly not optimal in terms of the end application use, so we and our partners set additional technological and operational requirements for biocomposite materials in terms of improved flexibility and adjusted proportion of hop waste fibres.

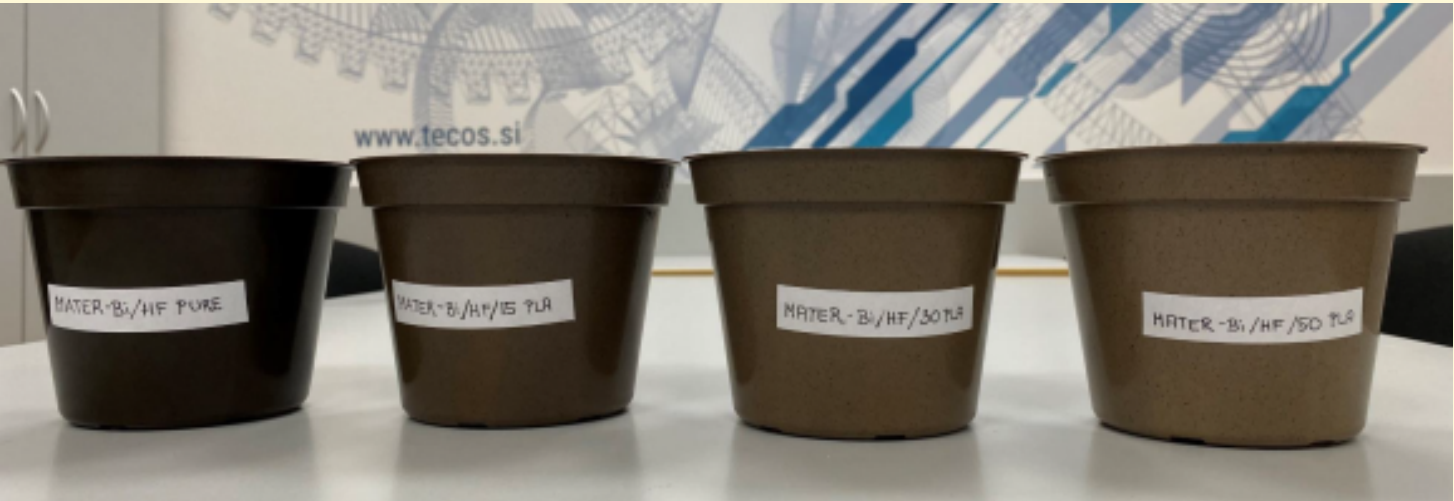
The second generation of BioTHOP materials has been established on thermoplastic starch biopolymer (TPS) with a hop fibre content of 20 and 30% by weight. Test series were successfully performed for masterbatch formulations mixed with polylactic acid (Table 1).

MIXING TPS AND HOP FIBERS BASED MASTERBATCH IN A RATIO OF 80/20 wt.% WITH PURE PLA			
MATERIAL DESIGNATION	TPS	PLA	HOP FIBRES (HF)
BioTHOP 30	60%	25%	15%
BioTHOP 25	50%	37.5%	12.5%
BioTHOP 20	40%	50%	10%

MIXING TPS AND HOP FIBERS BASED MASTERBATCH IN A RATIO OF 70/30 wt.% WITH PURE PLA			
MATERIAL DESIGNATION	TPS	PLA	VLAKNA HMELJEVINE (HF)
BioTHOP 10	23.3%	66.7%	10%
BioTHOP 15	35%	50%	15%
BioTHOP 17,5	40.8%	41.7%	17.5%
BioTHOP 20	46.7%	33.3%	20%
BioTHOP 25	58.3%	16.7%	25%

Tabel 1: Composite blends of masterbatch TPS/HF after mixing with PLA

By adding pure PLA granulate into the masterbatch compound we were able to ensure the appropriate viscosity of composite melt for the successful filling of thin-walled pots and automated injection molding process. The best results in terms of flexibility and process settings were achieved with the material composition BioTHOP 25 in the case of mixing TPS/HF - 80/20 masterbatch and BioTHOP 15-20 in the case of mixing TPS/HF - 70/30 masterbatch with pure PLA.



For the third generation of BioTHOP composite materials, we worked on a special material composition based on biodegradable polymer PBS and hop fibres of 30 and 40 wt.% contents. The supplied material compounds were initially processed in their original composition, but due to technological limitations of the injection moulding machine (exceeded maximum injection pressures) and aesthetic deformations on the finished products (unfilled / flashed pots or product remaining on the ejection side of the tool), we soon realised that also in this case the addition of pure PLA granulate is required. Composite compositions for PBS-based materials in final weight fractions are shown in Table 2.

MIXING PBS AND HOP FIBERS BASED MASTERBATCH IN A RATIO OF 70/30 wt.% WITH PURE PLA			
MATERIAL DESIGNATION	PBS	PLA	HOP FIBRES (HF)
BioTHOP 15 (bioPBS)	35%	50%	15%
BioTHOP 20 (bioPBS)	46.7%	33.3%	20%
BioTHOP 25 (bioPBS)	58.3%	16.7%	25%
BioTHOP 30 (bioPBS)	70 %	0 %	30%

MIXING PBS AND HOP FIBERS BASED MASTERBATCH IN A RATIO OF 60/40 wt.% WITH PURE PLA			
MATERIAL DESIGNATION	PBS	PLA	HOP FIBRES (HF)
BioTHOP 10 (bioPBS)	25%	75%	10%
BioTHOP 15 (bioPBS)	22.5%	62.5%	15%
BioTHOP 20 (bioPBS)	30%	50%	20%
BioTHOP 25 (bioPBS)	37.5%	37.5%	25%
BioTHOP 30 (bioPBS)	45%	25%	30%

Tabel 2: Composite blends of masterbach PBS/HF after mixing with PLA

The processability was acceptable for formulations BioTHOP 10 and BioTHOP 15 of both masterbatch compositions. Only with these mixtures were we able to ensure an automatically controlled injection process, pressures within tolerance limits and surface aesthetics of the final products.



Masterbatch compositions based on TPS or PBS with a suitable weight content of hop fibers and pure PLA granulate are therefore optimal for the targeted technological processing - injection moulding. However, if we take into account also the key requirements of end users, which is a sufficient flexibility of pots, then the material composition of BioTHOP15 in the ratio of TPS/PLA/HF - 50/35/15 wt.% is certainly the best choice. In the continuation of the project, we will test the pilot serial production of pots based on thermoplastic starch and waste hop fibres in proportion of 15 to 20%. In parallel, we are conducting also a biodegradability study to confirm that pots are in accordance with standard EN: 13432, which will represent a basis for obtaining a certificate for industrial compostability of final products.

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