ELLIPSE – Valorising Pulp and Paper Residues

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Biochemical Technologies

The **ELLIPSE project** aims to transform industrial residues into valuable bioproducts by co-processing heterogeneous waste streams. This approach addresses waste from slaughterhouses, the pulp and paper industry, dairy industry sludge, and glycerol, converting them into polyhydroxyalkanoates (PHAs) and bio-based fertilisers (BBFs) for agricultural and personal care applications. An overview of the project activities is given in Fig. 1.

In this context, BEST aims to convert pulp and paper waste streams to volatile fatty acids (VFAs) that can then be used to produce PHAs. After selecting suitable waste streams and defining a suitable pre-treatment, an acidogenic fermentation is conducted, where microorganisms convert the organic material to VFAs. This process will be optimised regarding the VFA composition and concentration. The project started in May 2023 and during the first year, the consortium focused on characterising and selecting suitable waste streams, testing pre-treatment methods and conducted acidogenic fermentation pre-trials for VFA production.

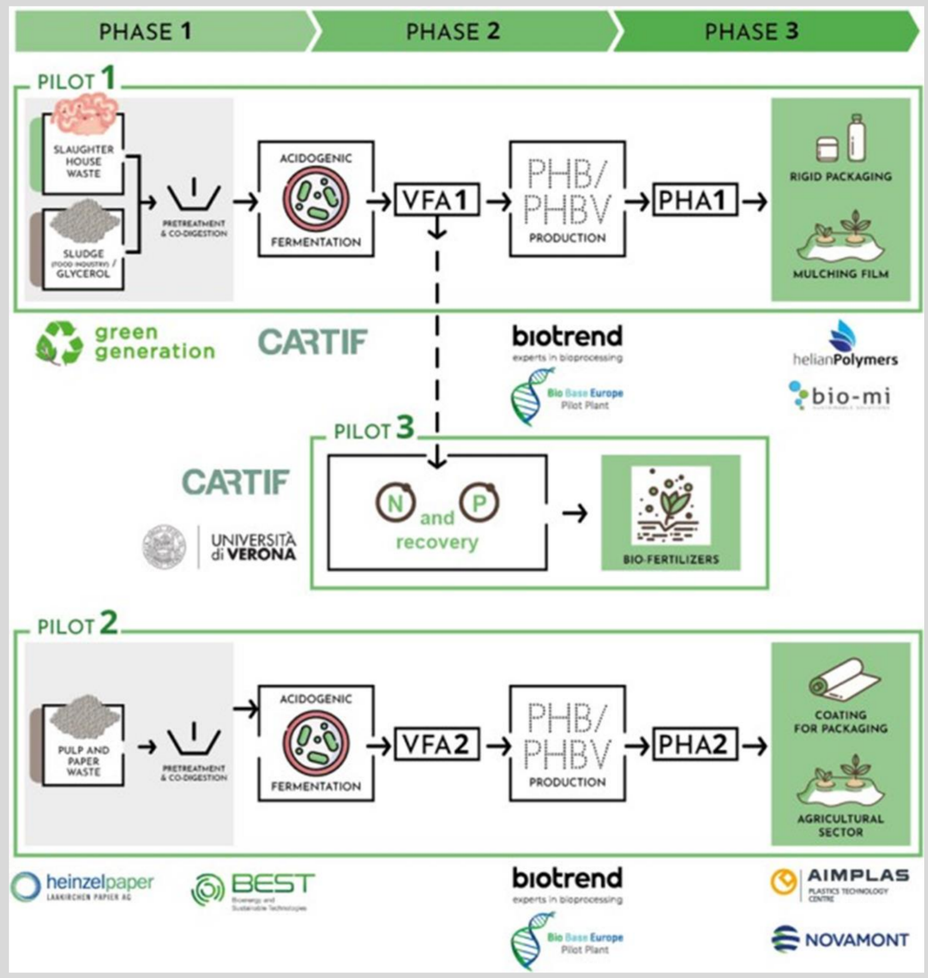

Fig. 1: ELLIPSE project: Overview of activities

Pre-treatments

As a first step towards valorising the selected pulp and paper residues, pre-treatment methods were tested on their suitability for the process. The aim was to make the components of the residues better available for microorganisms involved in VFA fermentation.

The chosen methods were mechanical (mixing), chemical (acid & base) and physical (heat) treatment, see Fig. 2. Additionally, treatment with heat and acid was combined.

The suitability of the pre-treatments was determined by the change in soluble Chemical Oxygen Demand (sCOD) as indicator for the easily available organics. The biggest increase in sCOD was achieved by heat treatment.

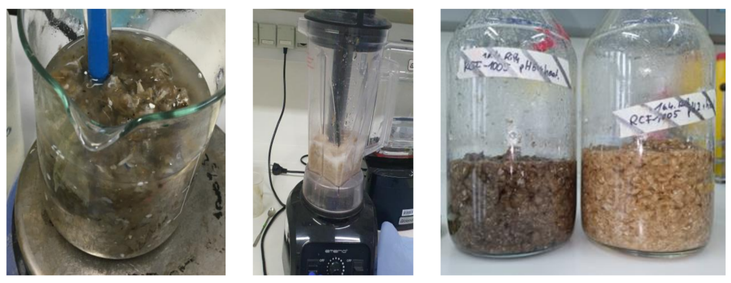

Fig. 2: Pre-treatment of waste streams. Left: Acid addition. Middle: Mixing. Right: Heat treatment.

Pre-trials acidification

At lab scale (200 mL), pre-trials were conducted to test the fermentation of untreated and pre-treated residues. They were mixed with a microbial consortium from a biogas plant and fermented under anaerobic conditions at 37 °C for 21 days. Daily analysis of VFAs, pH and produced gas volume was performed to monitor the process.

The setup and the results of the VFA analysis of the best performing residue is shown in Fig. 3. An increase in propionic, acetic and butyric acid was observed. The VFA concentration was more than doubled.

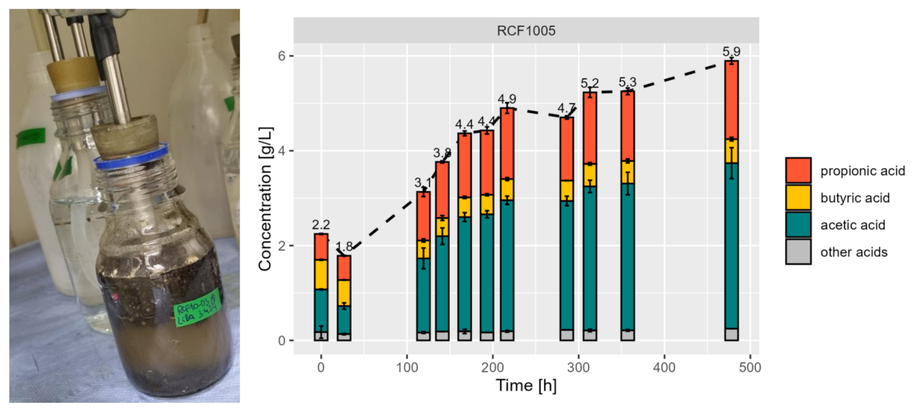

Fig. 3: Left: Setup of acidification pre-trials. Right: Concentration of volatile fatty acids during acidification trial.

Scale up: 1 m³ pilot reactor

A continuously stirred tank reactor (CSTR, 1 m³, see Fig. 4) was assembled and is currently being tested. Using this pilot reactor, the acidogenic fermentation will be scaled up and bigger volumes of VFA-rich streams will be produced from pulp and paper residues. These will be converted to PHAs in a consecutive fermentation.

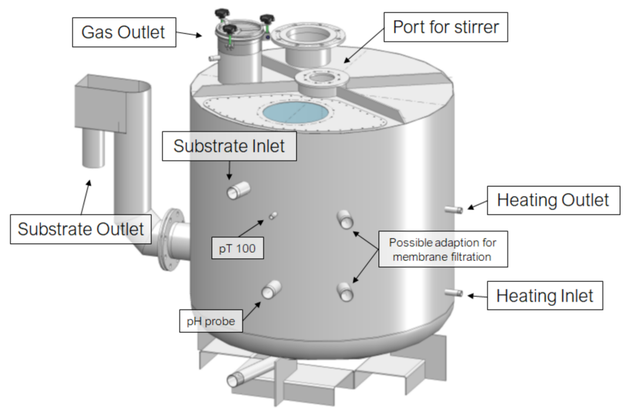

Fig. 4: Pilot reactor for scale-up of acidogenic fermentation (CSTR, 1 m³).

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