



DEVELOPMENT AND PILOT PRODUCTION OF SUSTAINABLE BIO-BINDER SYSTEMS FOR WOOD-BASED PANELS

Deliverable 1.3

Feedstocks from Vegetable Oil-based Bio-refineries, Pre- treatments

Due Date: 31/08/2019

Submission Date: 23/08/2019

Dissemination Level: CO

Lead beneficiary: Fraunhofer

Main contact: Dr.-Ing. Susanne Zibek, susanne.zibek@igb.fraunhofer.de

Other contributors Fabian Haitz, Fabian.haitz@igb.fraunhofer.de

Thomas Luchsinger, Thomas_Luchsinger@Cargill.com

...

Project acronym: SUSBIND

Project Number: 792063

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No. 792063.



1 Publishable summary

Modern bio-refineries, already present in Europe, are able to deliver large volumes of cost competitive renewable and “clean” feedstocks. Particularly, starch-based bio-refineries and the vegetable oil-based bio-refineries deliver products which can be used as feedstock for wood board binders. The selection of feedstock from these factories is meaningful not only with regard to the expected volume and price but also because it addresses the declining demand in Europe of carbohydrate and lipids for human consumption.

The preselection of the most suitable feedstock from vegetable oil-based bio-refineries is based on criteria reflecting:

- I. Sustainability
- II. Technical suitability
- III. Economic considerations

The economic factors price and availability were applied as a filter to perform a preselection of potential feedstocks to be further evaluated in detail regarding their technical suitability and their environmental impact. Furthermore, the fatty acid composition of potential vegetable oils was considered. These considerations resulted in the reduction of the range of potential feedstocks to four main candidates:

- soybean oil
- rapeseed oil
- sunflower oil
- linseed oil

These oils may require pre-treatment and further modification to facilitate novel biocatalytic functionalization to increase reactivity for application in the SUSBIND binder system. Especially, the application of novel enzyme-based technologies for region/stereo-selective oxy-functionalization, as to be developed within SUSBIND in work package 3, requires the utilization of free fatty acids or fatty acid methyl esters as substrate.

As a result, different enzyme-based pre-treatment methods were investigated in SUSBIND to modify above-mentioned potential feedstocks. These modification methods include enzymatic hydrolysis, enzymatic transesterification and treatment with aqueous H₂O₂-solution. Products obtained as result of these pre-treatments are different vegetable oil-based derivatives, namely free fatty acids (FFA) from enzymatic hydrolysis, fatty acid methyl esters (FAME) from transesterification and vegetable oil-based epoxy derivatives from treatment with H₂O₂. FFA and FAME are delivered to partners in WP3 as substrate for novel biocatalytic oxy-functionalization steps.

Suitable enzymes and process conditions were identified for each of the modification options. All selected vegetable oils were converted efficiently. During enzymatic hydrolysis 85 to 95% of triglycerides were converted to free fatty acids within less than 48 h of incubation. Similar conversion was obtained during enzymatic transesterification of different vegetable oils. Treatment of vegetable oil-based derivatives with H₂O₂ and a suitable lipase resulted in epoxide yields in the range of 85 to 95% depending on the feedstock. Furthermore, it was possible to show, that refined as well as crude vegetable oils can be applied without significant loss in enzyme performance within a single reaction cycle. This demonstrates that enzyme-based

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No. 792063.