

BIOFOAMBARK - Bark valorisation into insulating foams and bioenergy

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Softwood bark from European forest species is a major by-product of the forest products industry with low added value because bark is mainly burnt for energy purposes. The core objective of the BIOFOAMBARK project was the development of high-value insulating rigid foams based on bark tannins from selected European softwood species.

New, formaldehyde-free tannin-based foam formulations with glyoxal were successfully developed for two pine bark tannins (*Pinus radiata* and *Pinus pinaster*) and one spruce bark tannin (*Picea abies*). The foam properties were competitive with conventional insulating foams. Empirical knowledge on control of foam morphologies and properties was created. At tannin purity > 80 % the formulations are transferable between each other. In this connection curing kinetics and structure/property relationships were established. With hydroxypropylated pine tannin (HPT) a new tannin derivative and tuneable building block for bio-based foams and polymers was introduced and characterized.

The tannin extraction with hot water from Norway spruce bark was optimized and conducted at pilot scale. Crude tannin purification by the combination of enzymatic treatment and ultrafiltration showed potential but practical challenges remain to be overcome.

The cradle-to-grave life cycle analysis revealed that the production of electricity and diesel requirements for tannin extraction, debarking at sawmill and forest machines as well as the chemicals for foam production and emissions during foaming at lab-scale had the biggest environmental impact. The gasification of tannin-based foams and syngas conversion into bioenergy led to environmental benefits. In this connection the feasibility of tannin-based foam gasification into syngas could be demonstrated.

There were indications that tannin-based foams have lower environmental impacts compared to conventional foams. Tannin-based foams show potential for Green Premium prices. However the high estimated costs for the production of crude tannin indicate that multiple optimisations (cascade use, bark biorefinery) will be necessary to be competitive with other insulating foams.

The BIOFOAMBARK project produced a high number of new findings. However for the introduction of tannin-based foams on the market further research, development and upscaling by academia and industry will be necessary.

