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Application of a High Pressure Biorefinery Cascade for Creating Added Value on Jatropha Presscake and Shells

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BioM^P („Biomass high pressure") stands for the TUHH spin off initiative in using 30 years of competences in high pressure technologies for the sustainable conversion/fractionation of biomass to bulk chemicals and industrial building block molecules. The High Pressure Biorefinery Cascade (Figure) allows the full use of any kind of biomass as material resource, especially agricultural residues. In the given scenario dealing with Jatropha (*jatropha curcas* shells and seed press cake) from agricultural co-operatives in Ghana, the conversion in a sequence of at least two high pressure operation steps has been investigated: supercritical carbon dioxide extraction and pressurized liquid hot water hydrolysis.
Jatropha seeds are rich in oils and proteins (approx 30 % w/w each, whereas the press cake contains yet 8 % residual oil), the shells however contain up to 60-70 % lignin and 20 % Cellulose/Hemicellulose. The above mentioned side products from bio-diesel industries (presscake and shells) are conventionally only used for thermal conversion, as the fruit is considered as toxic and thus non-applicable for food and feed.
The process cascade for Jatropha allowed to approach to the zero waste goal for agricultural products. In the first step, by means of supercritical fluids extraction, the residual oil fraction was completely yielded at pressures around 300-400 bar, theoretical description was given via the Diffusion-Desorption-Dispersion approach. During the subsequent alkali extraction in 0,06 mol/L NaOH, the proteins of the defatted press cake were yielded and precipitated, which allows the casting of sustainable bio-polymer films. In the final liquid hot water/enzymatic hydrolysis cascade, shells and presscake residue can be treated in the same aqueous fixed bed with optionally increasing temperatures. Applying the enzymatic approach, hemicellulose, cellulose and lignin can be isolated from each other. The lignin production distinguishes from other approaches like the Organosolv or Kraft process by maintaining the products original molecular structure and consequently low VOC emission. Therefore this lignin is an interesting source for subsequent implementations in the adhesive, aerogel, pharmaceutical, polymer and consumer industry.