A CIRCULAR ECONOMY PARADIGM FOR TOTAL WASTE TEXTILE REFINING

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ABSTRACT

The paper presents the new circular economy paradigm featuring the first total textile chemical recycling process developed in the course of the H2020 European research project RESYNTEX. The process development follows several process modelling and process integration stages making use of conventional and new process optimization tools. Energy and water integration play an important role in the design procedure but emphasis is given to the extended application of Industrial Symbiosis practices to reach the desired sustainability characteristics for the process. It is shown that positive cash flow is possible but still additional incentive is needed to justify the large capital expenditure.

The chemical recycling of pure fibres is already conducted commercially, but there is no real application able to recycle blend fibres other than the process of the RESYNTEX project. The Total Textile Waste Refinery (TTWR) is a new textile waste recycling and refining process being currently developed in the course of the European Horizon2020 research project RESYNTEX. The experimental concept is currently being upscaled to an integrated pilot facility that will undergo optimization and validation of the technology in an industrially relevant environment. RESYNTEX uses the complete spectrum of waste textiles as feedstock, aiming to provide a holistic response to the largely overlooked waste textile management problem. Now that TTWR is just before the phase of pilot construction, process integration technologies are currently implemented to accelerate the design solution. TTWR consists of gate links between textile materials with commodity and specialty products and chemicals. The value chain of RESYNTEX includes the feedstock that contains the entire range of textile fibres and final products including bio-ethanol, adhesives used in the wood-based panel production, PET bottles and PA-derived value-added chemicals (see Figure 1).

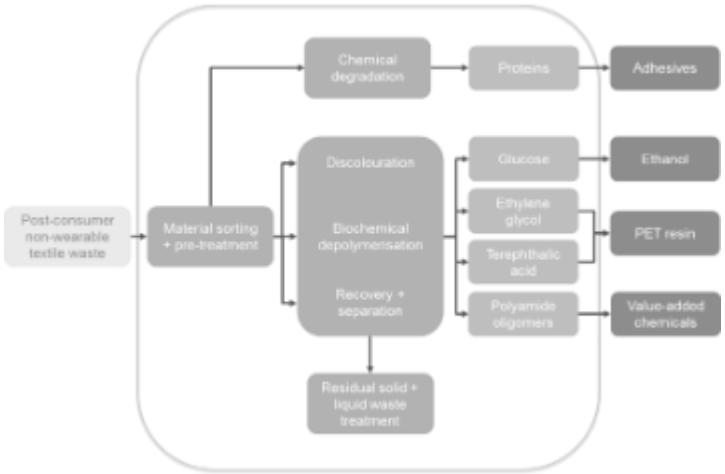

Figure 1 The RESYNTEX value chains

It is shown that centralized capacity is better but it incurs high investment costs and may restrict opportunities for symbiosis. A more sustainable business concept could be based on higher-value products. Contrary to conventional wisdom, trade-offs balance between decentralized and centralized plants not in comparing logistics vs CAPEX but primarily through the options to explore symbiosis. Upstream and downstream symbiosis is the enabler of a sustainable process by making use of lower purity chemistry upstream (low quality caustic, sulfuric acid, replacing partially hydrochloric acid, use of industrial filtrated water), and linking downstream with 2G ethanol plant or 2G lactic acid plant, also by sharing r-TAs and r-PAs with virgin plants following the paradigm of biofuels/fossil fuel mix. Producer and consumer responsibility play an important role and fee on new clothes could justify investment. Incentive set to 100 €/t of used textile (that is chemically recycled) could turn the investment attractive.