Consequential LCA in the feasibility study of integrated EFB-based dissolving pulp and furfural production

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1. Introduction –Consequential Life Cycle Assessment (cLCA) of proposed integrated dissolving pulp and furfural production from oil palm empty fruit bunches (EFB) waste has been done. This cLCA is describing an information about the consequences of changes in the level of output (consumption and disposal) of a product, including effects both inside and outside the life cycle of product [1,2]. Integrated dissolving pulp and other biorefinery products such as furfural will increase environmental performance by utilizing process waste as a raw material for another co-product.

2. Experimental – In this study, cLCA was done by following ISO 14040 methodology to evaluate environmental impact from proposed integrated dissolving pulp and furfural production. The proposed process of dissolving pulp production consists of 1) acid pre-hydrolysis; 2) soda pulping; and 3) Elementally Chlorine-Free (ECF) bleaching process steps. This cLCA study followed system expansion from oil palm plantation to dissolving pulp product and furfural co-product. Several environmental impact categories have been quantified such as acidification potential (AP), climate change (GWP100), eutrophication potential (EP), and human toxicity potential (HTP). SimaPro v8.0.5 software was used for environmental impact calculation. Input-output inventory data related to direct dissolving pulp and furfural production (foreground process) for this cLCA originates from lab-scale experiment. EcoInvent and Agri-footprint databases have been used for background data in the cLCA calculation. Functional unit in this cLCA study is 1 kg of dissolving pulp product.

3. Results and Discussion – In this study, the value of cLCA is marginal data by substituting wood with EFB as raw material for dissolving pulp production. Utilization of EFB waste to produce dissolving pulp will affect the consumption of wood for producing dissolving pulp. This consequence gave environmental impact compensation for dissolving pulp production using EFB. Additionally, co-production of furfural received compensation as a substitute material for commercial furfural production. However, further process of pre-hydrolysis liquor waste to furfural required more energy for dehydration and distillation processes. Based on cLCA approach for producing 1 kg of dissolving pulp, proposed integrated dissolving pulp and furfural production process gave 0.0133 kg SO_2 eq of AP, 2.39 kg CO_2 eq of GWP100, 0.008 kg PO_4 eq of EP, and 1.096 kg 1,4-DB eq of HTP. As comparison, 1 kg of commercial acid sulfite-based dissolving pulp production gave 0.011 kg SO_2 eq of AP, 1.85 kg CO_2 eq of GWP100, 0.005 kg PO_4 eq of EP, and 0.551 kg 1,4-DB eq of HTP.

4. Conclusions – The proposed integrated dissolving pulp and furfural production from EFB is promising process since this process can substitute wood usage and commercial furfural production with some improvement in chemical usage and co-production energy.

5. References

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