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A life cycle analysis and assessment of chemical emulsions

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ABSTRACT

This study utilises the Life Cycle Environmental Management tool, Life cycle Assessment (LCA) to compare the overall environmental impact of the life cycles of three manufactured emulsions. The emulsions - Aquapel, Hi-phase/composite (liquid/solid rosin) - fulfil a specific function as a sizing agent in the cardboard box industry within the confines of South Africa. As the origins and use of these emulsions are different, the impact assessments of each were evaluated.

Using the Simapro Impact 2002+ assessment method, the *mid-point impact categories* show the most significant impacts in descending order to be Toxicity Impacts on terrestrial ecosystems, Respiratory Inorganics, Climate Change and Non Renewable Energy resources.

It would appear that toxicity impacts on terrestrial ecosystems, is the most significant impact. Emission of respiratory inorganics followed by effluent treatment, then electricity used in the emulsion process itself has the next highest contribution in all three processes. The higher contribution to respiratory inorganics by the process using liquid rosin is due to a relatively high contribution from the production of tall oil, a relatively energy intensive process. Climate change is the third most significant contribution. Non renewable energy resources for the Aquapel process shows the highest impact because of its raw material, wax. It is also based on a non-renewable energy resource, crude-oil, whilst the raw material for the Hi-phase/composite process, rosin, is bio-based.

When comparing the three emulsion processes according to the *Impact 2002+ damage or end point impact categories* the relative contributions of the processes shows the relatively close performance of the three processes. The liquid rosin process shows slightly higher potential damages in three out of the four damage categories. The explanation for the differences between the systems follows from the explanations given for the mid-point impact categories.

The sensitivity analysis for the *Aquapel emulsion process shows* negative impacts are produced in descending order for liquid effluent in the ecosystem and human health damage categories. For electricity and paraffin wax negative impacts in the human health and climate change damage categories. The best interventions to reduce life cycle damages is to reduce water and electricity consumption and if possible to find a substitute for paraffin wax.

For the *Hi-phase/composite liquid / solid rosin emulsion process shows* negative impacts are produced in descending order for liquid effluent in the ecosystem and human health / climate change and resources damage categories respectively. The electricity and steam used in both the liquid / solid process produce negative impacts in the human health and climate change damage categories. The best interventions to reduce life cycle damages for the rosin emulsion process are to reduce water, electricity and steam consumption.