Crude Tall Oil Refining Products

Cradle-to-Gate Life Cycle Assessment

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The business of sustainability

EXECUTIVE SUMMARY

A 'cradle-to-gate' life cycle assessment (LCA) study was undertaken by Environmental Resources Management Ltd ('ERM') for Ingevity, assessing the environmental impact of its crude tall oil (CTO) distillate products. These processed pure fractions of CTO are used as a variety of intermediate products by Ingevity, for example in its asphalt and adhesive portfolios, including its WestRez®, Polyfon®, and Evotherm® lines. Products from three Ingevity refining locations were analysed: Charleston, South Carolina; DeRidder, Louisiana; and; Crossett, Arkansas (henceforth referred to as 'Charleston', 'DeRidder', and 'Crossett', respectively). The distillate products produced at each location are listed below in Table E.2.

Table E.1: CTO distillate products by refining location

Charleston	DeRidder	Crossett
DTO (226 and M28B)	TOR	TOB (3030)
TOH	TOFA	TOR
TOFA	TOH	TOFA
TOR (Rosin S and R24)	TOP	TOP
TOP	DTO	TOH
EnvaMul 200	API oil	CTOT
API oil		

In the baseline assessment, mass allocation was applied to assign a portion of the impacts from the acidulation process to black liquor soap skimmings (BLSS), and to each of the CTO distillate products by production volume. The scope of Charleston assessment includes CTO production from purchased BLSS and the distillate end products, while the other two sites only focus on the distillate end products. The functional unit (FU) encompasses the cradle-to-gate impacts of CTO distillate products at each refining location, based on 2021 data, and is defined as:

One metric ton (tonne) of specific CTO distillation product.

The main aims of the study were to inform Ingevity of the major hotpots within the CTO life cycle and to provide an updated assessment that replaces the 2013 Franklin Associates study (Franklin Associates, 2013) that covers a wider range of environmental impacts. The results will be used, directly and indirectly, in both internal and external communication in relation to the environmental performance of Ingevity's CTO distillate products.

The study has been conducted in accordance with the ISO 14040 and ISO 14044 standards (ISO, 2006a; ISO, 2006b) and in alignment with the Product Category Rules (PCR) for North American Market Pulp, Paper and Paperboard Products, Tissues and Containerboard (FPInnovations, 2017). A third party critical review was undertaken by LCA expert Michael Levy, from First Environment, Inc (USA).

Table E.2 presents the environmental performance of each CTO distillate product per production site, assessed through 10 environmental impact categories (the use of mass allocation means that all distillate products from a particular manufacturing location have the same environmental burdens). For climate change (fossil), the results ranged between 795 and 1420 kg CO2 eq/kg. Climate change (biogenic) showed negative results for each of the distillate product mixes, i.e. a net carbon capture. This is due to the carbon uptake from the softwood trees used in kraft pulp production and that remains bound up in the products. When the products are assessed over the full life cycle, this carbon would typically be re-emitted at end of life and balance out the removals at the start of the life cycle.

Table E.2: Life cycle impact assessment results (FU=1 tonne product)

Impact Category	Unit	Charleston Distillate Products	DeRidder Distillate Products	Crossett Distillate Products
Acidification	kg SO_2 equivalents	6.99	4.67	5.58
Eutrophication	kg N equivalents	1.61	1.49	1.80
Global warming - fossil	kg CO_2 equivalents	873	795	1420
Global warming – biogenic (emissions)*	kg CO_2 equivalents	3288	2115	2434
Global warming – biogenic (removals)	kg CO_2 equivalents	-6193	-5083	-5824
Ozone depletion	kg CFC-11 equivalents	1.27E-04	8.96E-05	1.57E-04
Respiratory effects	kg $PM_{2.5}$ equivalents	1.18	0.96	1.11
Smog creation	kg O_3 equivalents	126	91.6	104.1
Ecotoxicity	CTUe	1254	1498	1950
Fossil resource use	MJ surplus	1433	1150	2684

Biogenic emissions results shown are based on average carbon content per tonne of distillate mix. Detailed biogenic emissions per individual distillate product are shown in Section 5.1.

The use of CTO as a raw material input was the main hotspot for production of distillate products at each of the sites. The main hotspot for production of the CTO at the Charleston site was BLSS used. Steam and natural gas use made a relatively significant contribution to the total burdens, most substantially at the Crossett production facility. Chemicals and inbound transport of materials have a relatively small impact overall. Inbound CTO shipments transported via rail contribute more substantially than road transport, as a greater proportion of the total purchased CTO is transported by rail.

Based on these results, CTO usage (and precedent BLSS usage at the Charleston facility) are the main impact hotspots. Since consumption of these materials cannot be avoided, other process efficiencies to reduce electricity and fuel consumption should be explored in order to reduce overall environmental impacts. As coal is still used in part to produce the purchased steam at the Charleston site, expanding the sourcing of renewable energy would deliver further benefits, e.g. producing steam using only biomass. Finding more local suppliers of purchased components (i.e. BLSS, CTO, other chemicals) in order to decrease inbound transport distance could be investigated further to reduce transportation impacts. However, this is unlikely significantly to reduce the impacts.

The quality of the study could be substantially improved by expanding data collection to close the gaps mentioned throughout this report, e.g. measurement of waste flows and water usage more accurately, more consolidated and specific record-keeping at each refinery site, or seeking the environmental profile of certain raw materials with suppliers, e.g. BLSS or purchased CTO. Such improvements could be substantial and have the potential significantly to change the conclusions of the report.