EPDLA

EPDLA Life Cycle Assessment of Polymer Dispersions

EPDLA supports the European Commission's sustainable development agenda and also strives to help market participants become more sustainable. Here, data provide important indications of sustainability performance. Therefore, EPDLA has decided to update the existing average industry LCA.

On behalf of the European Polymer Dispersions and Latex Association ('EPDLA'), Quantis International conducted a Life Cycle Assessment (LCA) of the following different families of aqueous polymer dispersions:

- Styrene butadiene (SB) covering "hot and cold" processes;
- Styrene acrylate (SA);
- Pure acrylate (PA);
- Alkyds (AD);
- Polyvinyl acetate (VAH), it covers also copolymers like Vinyl acetate/Veova and Vinyl acetate / Acrylic;
- Vinyl acetate ethylene (VAE); and
- Polyurethane (PU).

The participating companies were Alberdingk Boley, Allnex, Arkema, BASF, Celanese, CH-Polymers, Covestro, Dow, DSM, EOC, EPS, Omnova, Synthomer, Trinseo, Vinavil and Wacker Chemie AG.
The main goal of the study was to understand the environmental impact of the considered polymer dispersion families better while considering also latest methodological developments from Product Environmental Footprint (PEF)[1]. Furthermore, this LCA was to provide EPDLA with state-of-the art Life Cycle Inventories (LCIs) compliant with ISO 14040+A1 and ISO 14044+A2, representing industry-average data for the aforementioned dispersion families produced in Europe.
LCIs help producers quantify the environmental impacts of their activities.
Precise data on the current environmental impacts of the production of polymer dispersions were collected from the participating companies across production sites in 11 countries and compiled over a wide perimeter.
The basis for the study was the data for the specific polymer dispersion families provided by the companies listed above. The data collection consisted of two parts: plant- and polymer dispersion family-based data.
Plant-related data on the production volumes, energy consumption, water consumption, emissions and waste have been collected. These data cover the entire plant, where also products other than the polymer dispersions under consideration might be manufactured.
In addition to the plant data, product-specific data on polymer dispersions have been collected. Data collection takes into account all the raw materials required to manufacture the

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[1] https://ec.europa.eu/jrc/en/publication/suggestions-updating-product-environmental-footprint-pef-method#:~:text=The%20Product%20Environmental%20Footprint%20(PEF)%20is%20a%20life%20cycle%20assessment,existing%20approaches%20and%20international%20standards.

considered polymer dispersion families. If not all data for the raw materials were available, they were modelled as proxies.

Some companies produce only part of the polymer dispersions. Other companies, in turn, manufacture other products in the same plant. Therefore, all plant-related data must be broken down so that only relevant dispersion-data are taken into account. For this purpose, after recording all relevant production data, all inputs and outputs were assigned by mass to the specific polymer dispersions produced by the companies. To the best knowledge, there are no high end relevant cut-offs as all known energy and material flows within the system boundaries are considered. The reason for this is because all raw materials, transport, and production needs are directly related to the production and completion of the polymer dispersion up to the factory gate.

The declared unit of the LCA is 1 kg of wet dispersion (with varying solids contents). The variances of the results are in the typical range of a Life Cycle Assessment based on industry data.

The considered impact categories refer to the specific impact categories and impact assessment methods recommended by the PEF methodology. Main focus for EPDLA relied on the following impact categories:

- Climate change – total
- Acidification
- Eutrophication
- Photochemical ozone formation
- Resources (energy)
- Resources (minerals)
- Consumptive water usage

All average results and models have been provided to the respective companies. These were then reviewed and finalized in iterations. No confidential or otherwise legally sensitive information was passed between participants, ensuring compliance with competition law.
The results represent a comprehensive and up-to-date cradle-to-gate analysis (i.e. from the raw materials to the factory gate of the polymer dispersion producer) for the production sites of the participating companies. This does thus not take into account the use phase of the downstream product (like e.g. a paint or an adhesive).
In addition, the results of the data analysis enable producers to identify key factors of environmental impact to be able to take measures to further reduce this impact where possible.
The results can be considered as representative for European polymer dispersions since the 16 companies provided data for more than 50% of the European market.

The following table gives the average value of indicators (impact & flow) for each dispersion family. The PEF 3.0 data were implemented where background data were modelled.

Table 1. Life cycle impact assessment results per kg polymer dispersion family.

	Unit	SB	SA	PA	AD	VAH	VAE	PU
Solid content	%	51	48	47	51	53	54	41
Climate change – total	kg CO_2 eq.	1.0	1.3	2.1	2.1	1.4	1.3	2.4
Acidification	mole H^+ eq.	2.0E-3	3.4E-3	8.9E-3	7.3E-3	6.0E-3	5.7E-3	5.3E-3
Eutrophication, freshwater	kg P eq.	3.2E-5	3.3E-5	9.4E-5	2.9E-4	3.9E-4	3.4E-4	7.8E-5
Photochemical ozone formation	kg NMVOC eq.	1.6E-3	2.8E-3	6.0E-3	5.5E-3	5.5E-3	4.7E-3	4.7E-3
Resources (energy)	MJ	33	36	43	29	36	36	47
Resources (minerals)	kg Sb eq.	3.4E-6	4.0E-6	6.1E-6	2.4E-5	1.9E-5	1.7E-5	3.6E-6
Consumptive water usage	m^3 world eq.	0.2	0.3	0.4	0.9	1.8	1.2	1.9

Main learnings out of the LCI study:

- The main origin of impacts are the monomers and the main raw materials (in case of dispersion polymers).
- We see that at the gate of the factory several dispersion families show quite similar impacts within the margin of variances typical for the methodology used.
- In order to consider the environmental impact of a polymer dispersion across the entire life cycle, all steps (raw materials, manufacturing, application, use phase and end of life) have to be calculated to achieve a comprehensive LCA and LCIA.
- A comprehensive LCA study needs to consider regionalised data for consumptive water use to generate meaningful information for this impact category.

Each dispersion family is used for specific applications and since the LCA data are cradle-to-gate data, they can be used for a study of downstream users. It is necessary to consider the full life cycle of an application to compare the performance of different materials and the effects of relevant life cycle parameters (as in a cradle-to-grave chemical product footprint study). Companies may use the results of the study to compare the environmental performance of their specific products that were used to create the industry average dataset of that specific product as developed in this study. Such a comparison of products with the averages considered in the study is only possible within the same specific product group, comparable parameter (e.g. solid content), same scope (cradle-to-gate), and other methodological decision, including allocation rules and where applicable generic background data.

The study was reviewed by an independent party.

The present industry average LCI data may thus serve as a good basis for a total life cycle (cradle to grave) calculation for any downstream product.

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