Additive Sustainability Footprint

LESSONS FROM PILOTING THE METHODOLOGY WITH VINYLPLUS PARTNERS

The Natural Step

INTRODUCTION

This report documents key learning outcomes from development and prototyping of the Additive Sustainability Footprint (ASF) methodology by VinylPlus. The report is provided to VinylPlus as a public summary from The Natural Step (TNS) based on direct input, observations and engagement with VinylPlus stakeholders. The report is a supplement to the documentation of the ASF methodology and results provided to participants involved in pilot projects. For further background on the scope and aims of ASF, visit *https://www.vinylplus.eu/sustainability/our-contribution-to-sustainability/additive-sustainability-footprint/*.

BACKGROUND

One of the key targets within the VinylPlus voluntary commitment for 2011-2020 was to review the use of PVC additives and move towards more sustainable additive systems (Challenge 3). As a sustainability partner to VinylPlus, The Natural Step has supported and followed industry efforts to address this commitment over a number of years. This has included initial stakeholder consultation on definitions and scope for 'sustainable use of additives', to engagement in EU initiatives on emerging tools such as the Product Environmental Footprint concept, and the co-development of criteria for additives within the VinylPlus® Product Label.

A lack of clear definitions and suitable tools to measure additive sustainability performance and to guide improvement for additive manufacturers was identified as a key issue for the PVC industry. Therefore, VinylPlus committed to develop a bespoke methodology for its members, now known as Additive Sustainability Footprint (ASF). The Natural Step's Strategic Life Cycle Assessment (SLCA) tool provided a foundation for this new approach, essentially customizing SLCA specifically for the assessment of the life cycle of additives and their application within PVC articles. The underlying principles of ASF are generically relevant to other chemicals. [1]

VinylPlus subsequently set a target to "…validate a methodology for the sustainable choice of additives in both rigid and flexible applications". To address this target, an external review of the ASF methodology was sought from academics. Presentations and workshops were also conducted to introduce the ASF methodology to VinylPlus stakeholders, two journal articles were published,[2,3,4] and two pilot projects were completed via the VinylPlus Additives Committee.

The first pilot assessment of key additives used in a generic PVC window profile using ASF commenced during 2016, involving representatives from ESPA, TEPPFA and company representatives and TNS within the VinylPlus Additives Committee. The second pilot, commencing in 2020, engaged specific Task Force set up by VinylPlus and TNS, in collaboration with ERFMI, ESPA and European Plasticisers, to validate the ASF criteria for the key additives used in a generic homogeneous PVC floor covering.

This report documents collective learning from the two pilot projects. The intention is that this learning can be used by VinylPlus as ASF is rolled out more widely for assessment fo specific additive products by companies within the PVC industry.

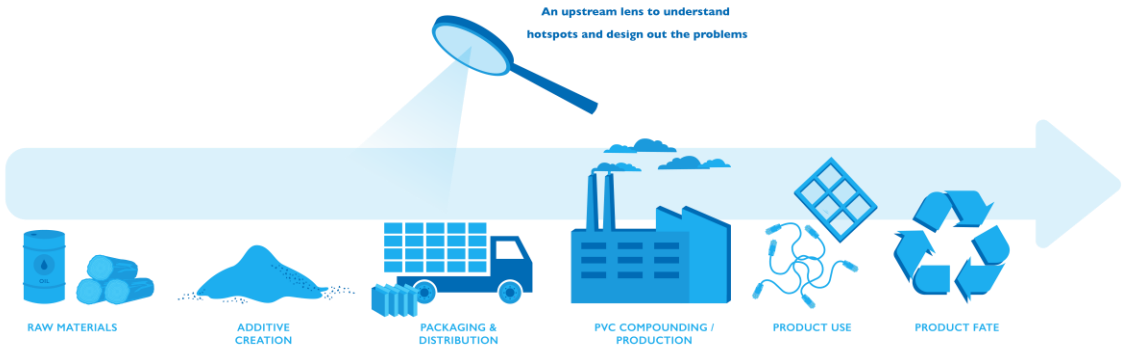
ASF METHODOLOGY AND ITS INTENDED APPLICATION

ASF has been developed primarily as an internal tool for additive manufacturers to get a better grip of their current sustainability challenges, and to guide innovation within their own operations, supply chain. However, working with their customers and other downstream actors, ASF can also help additive manufacturers demonstrate the positive contributions of their products across the life cycles of PVC articles, as well as identifying other aspects of product life cycles where innovation can promote more sustainable use of additives contributing to more sustainable PVC articles. ASF has some similarities with other life cycle assessment approaches, but it is also important to understand the differences and how they relate to piloting the approach within the industry.

Compared with traditional life cycle assessment or Environmental Product Declaration (EPD), which quantify the environmental burden of an existing product in chosen impact areas, ASF is intended to provide an upstream lens to design

[1] Mark Everard (2023), Assessment of the Sustainable Use of Chemicals on a Level Playing Field, Journal of Vinyl and Additive Technology (2020), 26(2), 196-208. *https://setac.onlinelibrary.wiley.com/doi/epdf/10.1002/ieam.4723*.
[2] Mark Everard, Richard Blume (2019), Additive Sustainability Footprint: Rationale and Pilot Evaluation of a Tool for Assessing the Sustainable Use of PVC Additives, Journal of Vinyl and Additive Technology (2020), 26(2), 196-208. *https://doi.org/10.1002/vnl.21733*
[3] Mark Everard, A lead on recycling PVC (2020), Materials World, 47
[4] Mark Everard (2019), Twenty Years of the Polyvinyl Chloride Sustainability Challenges, Journal of Vinyl and Additive Technology (2020), *https://doi.org/10.1002/vnl.21754*

out problems and define pathways towards circularity and sustainability. It is a process to build shared awarenesss, establish goals and success criteria, and then qualitatively to assess today's life cycle hotspots in relation to a desired future position. An action plan can subsequently be developed to guide company innovation efforts, while fostering collaboration and further innovation up and down the value chain. Significantly, ASF is also distinguished by recognising the positive contributions of additives to delivery of human needs, as well as acknowledging ongoing initiatives enhancing the sustainability of additive systems and uses.

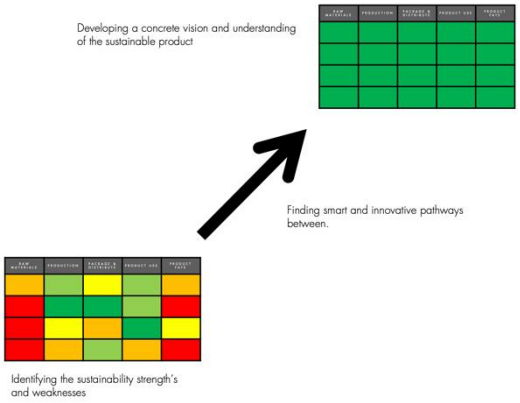


The ASF approach can be used to assess an existing product life cycle. More strategically, It can also help develop a vision of a future, more sustainable product life cycle, thereby helping actors shift perspective from simply measuring today's impacts to actively exploring how to close their sustainability gap. The ASF methodology is implemented with the help of a trained facilitator or process leader, and is intended to be both participatory and educational rather than a static desktop study.

Although ASF is a qualitative assessment approach, different forms of quantitative data are used together with expert opinions to help those implementing ASF to make informed judements about impacts and progress towards a sustainable product or outcome.

A particular strength of ASF is that it uses science-based principles to define socio-ecological sustainability, establishing a robust reference point for assessing PVC and its additives. This means that a shared understanding of sustainability is developed amongst participants, with the direction of innovation also guided by science. This goes well 'beyond compliance' and takes into account a holistic scope of issues.

The logic for this approach is that the pathway toward sustainability is not necessarily a straight line, but rather takes a systems view recognising multiple interacting dimensions. Strategic progress can not achieved by setting narrowly framed targets for specific aspects of sustainability addressed in isolation (such as chemical hazards and risks) whilst ignoring wider, systemically connected outcomes (such as climate impact, circularity, worker conditions, etc.)



THE PILOT PROJECTS (GENERIC ASSESSMENTS)

Recognizing that it presents a novel approach for the industry, ASF was first tested through 'generic assessments' at European industry level. This enabled the testing and validatation of criteria for assessment of the sustainable use of additives, and how these could be best framed to enable additive manufacturers to apply ASF consistently. The two ASF pilot projects at industry level, referred to as "ASF Generic Assessments", were undertaken in a controlled process with key stakeholders to assess a representative set of key additives and life cycle assumptions in selected applications.

It is important to state that the two pilot projects should be seen as steps toward preparing for the roll-out of ASF for use by individual companies on a bespoke basis to assess their specific additive products and additive systems. The objectives of the pilots are therefore somewhat different from the objectives and outcomes expected from the use of ASF by an individual company, as explained below.

The following is a summary of the objectives of the pilot ASF Generic Assessments and a commentary on the extent to which their objectives have been met:

Objective 1: Provide a learning process for piloting ASF methodology.

This objective has been well met and has led to refinement of the methodology and process surrounding its use. Some of the learnings are as follows:

Overall process: The initial intent of the pilots was to assess key additives used in a PVC formulation designed for a specific PVC application (e.g. stabilizers used in PVC window profiles). The pilots have been valuable for the participants as well as the VinylPlus Additives Committee, but have also shown that the scope of generic assessments needs to be contained. This is due to the complexity of the additives and the limitations inherent in studying a generic product and life cycle scenario (e.g a typical window profile with typical additives within typical supply and value chains).

Data management and document control. Throughout both pilots, various improvements were made to documentation of the ASF method, manage data, improve the way in which questionnaires were answered collaboratively, review results, provide feedback, and to ensure document version control and manage digital access. These improvements are beneficial for any future generic assessments, but are less relevant for when individual additive manufacturers make bespoke use of ASF since this will likely be customized to align with internal company processes.

Initial Project Scoping. Issues such as availability of personnel, access to data or experts, and even anti-competition concerns were identified in the pilots. For the homogenous flooring assessment, this meant that only 1-2 additives were considered when testing ASF, rather than a complete assessment of all key additives in the PVC article as originally intended. A set of scoping questions have since been developed to determine the feasibility earlier in the process of conducting a comprehensive ASF assessment.

Inventory analysis and supply chain transparency. As ASF is intended to make use of existing data, it was initially assumed that prior LCA studies and the available Environmental Product Declarations would provide a substantial amount of information about life cycle inputs, outputs and throughputs. However, aggregated results in the LCA studies had insufficient granularity, the assumptions in the LCA datasets were unknown, and ASF spans wider aspects of sustainability than those in pre-existing tools (particularly social sustainability aspects which are not addressed in LCA data). Therefore, a bespoke inventory approach was developed.

Assessment questionnaire. An assessment questionnaire was tailored to screen the key life cycle stages of additives as part of ASF method development. Based on feedback when conducting the pilots, various improvements to the assessment questions were made. There is room for further simplification and better guidance to help assessment teams (e.g. linked access to glossary, linkages to criteria, etc.) It is also important to acknowledge the limitations of the pilots, since the assessment questionnaire is ultimately intended to be answered by specific companies when ASF is rolled out for bespoke, product-specific applications. A simplified approach for future generic assessments would be to categorize questions in terms of whether they have industry-wide applicability or are company-specific.

Data verification levels. Since ASF draws on multiple sources of data with different levels of accuracy, a filter was introduced so that the level of certainty (verified / not verified) could be shown in the assessment results. This allows for better understanding about where expert knowledge is relied upon, as opposed to claims more robustly supported by documented evidence.

Cross-referencing other tools, indicators and policy developments, During development of the pilots, it was recognised that the industry must continue to engage with other initiatives looking at chemical and product sustainability. Examples include the Product Environmental Footprint and other EU regulatory developments such as ECHA work on reviewing and categorizing additives. Cross-referencing to other approaches is helpful for avoiding duplication, making use of best available information and investments, and for helping to clarify similarities and differences in approaches and aims with different assessment methodologies.

Objective 2: Set rules for how ASF should be applied in different product categories
This objective has also been met in the sense that there is a clear understanding of what ASF entails, what is in and out of scope, and how it shall be used. One important development has been establishing definitions around which additives are included / excluded by ASF via threshold tests that are consistent with REACH legislation. A 'key additive' screen was developed to identify additives priorized in an assessment including clarification of concentration thresholds for ingredients used in additives. Necessary methodological differences between assessment of stabilizers and plasticizers were identified. These insights will help provide consistency when ASF is implemented on a product-specific basis by additive manufacturers, similar to how 'product category rules' are applied in Environmental Product Declarations.

Objective 3. Make it easier for companies to use ASF by pre-completing generic information relevant to all
Meeting this objective is dependent upon how the roll-out of ASF towards company-specific additives and additive systems is approached. It is intended that the generic answers from the pilot results will help individual manufacturers save time and

better understand common issues relevant to all additives or particular groups of additives. Currently, the protocols for accessing these assessment results are still to be specified. However, it is intended that generic results will be available to registered companies who agree to participate in a company programme following the Terms of Use provided by VinylPlus.

Objective 4: Inform VinylPlus communications and advocacy related to additives
This objective is partially achieved as VinylPlus has begun to actively communicate the development of ASF. However, as the pilots have been limited to a relatively small number of participants, there is now an opportunity to make further use of the results in VinylPlus advocacy. An example of this would be to make clearer reference to the VinylPlus and ASF definition of sustainable use of additives, showing how it is referenced against science-based sustainability principles. This clearly shows the scope of issues assessed within the ASF methodology, the ultimate success criteria, and the direction of innovation being fostered. Beyond the PVC Industry, the tranparency and replicability of the ASF approach, as well as its potential for application beyond the PVC sector to provide a 'level playing field' for chemcial assessment, can also support advocacy with regulators.

System Conditions for a sustainable society	Related topics	Success criteria for the sustainable use of additives
 1. Substances from the Earth's crust must not systematically increase in concentration in nature.	• Metals & minerals • Energy • Renewable / recycled materials	• Scarce metals, minerals and fossil carbon must not be released to nature at a rate that exceeds the rate of re-assimilation. This implies the phase-out, or the recapture in controlled loops, of scarce mined materials. • The energy sources must be renewable. • The sources of raw materials must be renewable, or the resources must be fully recycled.
 2. Substances produced by society must not systematically increase in concentration in nature	• Circular flows (bio-degradability / technical loops) • Efficient production • Benign emissions	• Raw materials used for production of additive components must be degradable unless managed in controlled-loop systems or incorporated into articles which can be recycled. • Additive components that are able to migrate must be degradable unless managed in controlled-loop systems. • Across product life cycles, emissions or discharges resulting from the production/use of additive systems must be kept to a minimum as a resource conservation measure but, where unavoidable, should only comprise degradable substances. • Controlled-loop systems and recycling processes must themselves avoid pollution and must also be optimized to retain the highest resource potential.
 3. Nature must not be systematically degraded by physical means.	• Water use • Resource use • Land use • Ecosystem disturbance	• Sourcing of raw materials used for production of additives must come from well-managed ecosystems.
 4. People must not be subject to structural obstacles to health, influence, competence, impartiality and meaning.	• Health & safety • Basic rights • Skills and knowledge • Equity (resource efficiency / depletion) • Well-being / meaning	• The additives enable reliable technical performance to deliver functionality that helps to support diverse human needs. • The sourcing and production of additives must occur under safe and responsible social conditions. • PVC products & additives embedded in them must not lead to negative impacts on the wellbeing of humans or the environment. • The additives must not restrict the capacity for efficient management of resources through mechanical & feedstock recycling either by: a) reduction in the quality and quantity of the recyclate b) preventing the mixing of PVC from multiple end-of-life and post-industrial products in recycling streams (compatibility) o There must be trust-worthy information to track and trace PVC products and their additives.

Objective 5. Provide a forum to address issues that are relevant to VinylPlus goals and targets
This objective is met as the pilots have been regularly discussed within the VinylPlus Additive Committee. Interim progress with the pilots was also considered when VinylPlus established new targets in the 2021-2030 roadmap. Furthermore, VinylPlus has been developing other innovation tools such as a the VinylPlus Supplier Certificate to help customers and suppliers meet critieria within the VinylPlus® Product Label. The linkages between the Product Label, VinylPlus Supplier Certificates and the use of ASF has been regularly raised during the pilots and within the VinylPlus Additives Committee.

Objective 6. Provide oversight on ASF use in collaboration with The Natural Step
This objective is also met. ASF builds on pre-existing tools and methods developed by The Natural Step. TNS has therefore played an important role in transferring knowledge, sharing past experiences and giving advice on how ASF might best be applied within VinylPlus. The pilot projects have provided a forum for discussion around the industry needs and challenges regarding assessing sustainability performance in the use of additives. Various improvements and recommendations have been identified regarding how the process of implementing ASF can be facilitated, how to ensure that the needs and expectations of participants are met, how training is provided prior to an assessment, and how to ensure that goals and outcomes from the pilots are understood.

A key concern raised by some participants in the pilots was the uncertainty around answers, the potential consequences of admitting a certain answer, simply answering incorrectly, and even a worry that results might get misinterpreted or misused if not properly vetted first. As already noted, a key difficulty in facilitating a group assessment of this nature with different company representatives was a concern about anti-competition issues, an issue routinely monitored by VinylPlus to ensure compliance with the relevant rules. VinylPlus and TNS also highlighted that implementation of ASF will become much more straightforward when individual companies use the process to frankly assess their internal challenges and guide their sustainability efforts in a confidential setting. For this to happen, trained ASF Coaches and process leaders are required,

further facilitated by improvements to online tools potentially also including autofilling of responses to some questions based on chemical properties and relevant answers from pilot and other prior ASF assessments.

LEADING CHANGE TOWARD SUSTAINABLE USE OF ADDITIVES

As noted above, the learning from piloting ASF in Generic Assessments has been valuable for determining the overall parameters for how ASF should be applied within the VinylPlus programme. From the outset the intent has been to develop a methodology to assess and then move toward more sustainable use of additives. To date, the primary focus of effort has been on refinement of the ASF methodology and creating better understanding of the purpose and delivery of the ASF assessment approach. The next step is for individual companies within the industry to begin using ASF to guide innovation and make real improvement to the footprint of their specific additive products and product systems. A company training programme has therefore been proposed for VinylPlus member companies.