Sustainability: shaping the evolution of PVC stabilisers

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European Stabiliser Producers Association

- Pan-European trade association representing more than 95% of the PVC stabiliser industry across Europe (www.stabilisers.eu)

- Affiliated to Cefic - the European Chemical Industry Council

- Member of VinylPlus (www.vinylplus.eu)
European Stabiliser Producers Association

- A unique organisation representing four chemistries of stabilisers:
  - **Calcium-based stabilisers** (including Ca-Zn and organic) for food contact & medical applications, plus all lead replacement systems
  - **Tin-based stabilisers** used primarily in rigid applications including food contact use
  - **Liquid stabilisers** used in a wide range of flexible PVC, calendered sheets, flooring
  - **Lead-based stabilisers**, used principally in pipes and outdoor profiles
ESPA 2014: 12 Members
Sustainability: how to define it?

**High level definition** *(World Commission on Environment and Development)*

«To allow to meet the needs of the present without compromising the ability of future generations to meet their own needs»

**Sustainable chemistry** *(OECD definition)*

“Promoting the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes.

Within the broad framework of sustainable development, strive to maximise resource efficiency through activities such as energy and non-renewable resource conservation, risk minimisation, pollution prevention, minimisation of waste at all stages of a product life-cycle, and the development of products that are durable and can be re-used and recycled”
Assessing Sustainability

- The above-mentioned definition includes many aspects
- A multi-dimensional indicator is appropriate to reflect this complexity (spider diagramme)
- Merging the ratings of widely different aspects to end-up with a single number is tempting for comparison purpose

- However doing so would require to introduce questionable assumptions: how to compare 1m² of land usage with the toxicity potential or with 1m³ of water?
Sustainable use of additives

- Additives are usually used at a low percentage in the formulation of a product. However they play a crucial role.
- Let us consider a PVC window: stabilisers are critical to maintain the physical and aesthetic properties of the frame (colour, gloss, mechanical performance…). As such they extend the service life of the window and contribute to save the “grey energy” associated to its premature replacement.
- Hence for stabilisers it is appropriate to evaluate the so-called “functional units” (~= articles), not just the stabiliser as it comes out of the factory.
- Limiting the assessment to the intrinsic characteristics of stabilisers may bias the comparisons.
Quantifying sustainability

- Various schemes have been developed to attempt to quantify the underlying components in the sustainability definition
  - Carbon Footprint / Green House gas, water and land usage…
  - More comprehensive schemes like the Environmental Product Declarations (EPDs) (based on ISO standards)
- Recent addition: the Product Environmental Footprint (PEF)
  - Developed by the EU Commission to allow for product comparison in terms of their environmental impact
  - Currently pilot-tested
- The wider the scope of those schemes, the more arbitrary parameters need to be introduced; and the less they lend themselves to measure incremental improvements brought by the individual components of a system
The increasing awareness of sustainability triggers the emergence of additional regulatory measures:

*e.g. the awareness of CO₂ emissions linked to electrical power generation ended-up with the high-power conventional light bulbs being progressively taken out of the market*

Once more sustainable products or technologies have gained a sizeable market share this may trigger (additional) regulatory measures (*ban of the remaining conventional bulbs*)
Classification and Sustainability

- The classification of a chemical is related to its intrinsic properties («hazard based»)
- Classification does not take into account how a substance is used (no «risk based» considerations)
- What should be the «weight» of a particular classification of a substance when trying to quantify the Sustainability of a functional unit of which it is a component?
REACH and Sustainability

- REACH is largely building on the «Risk based approach», which materializes in the form of an Exposure Scenario for classified substances.
- The «Risk based approach» fits well with the Sustainability definition.
- However the Authorization part of REACH is, to some extent, also «hazard based»: substances classified with CMR, PBT, Endocrine Disrupters and Equivalent Concern follow a different route.
- The process is summarized on the next slide.
REACH and Sustainable (use of) substances

Registration
→ Hazardous?
  - No → Risk controlled
  - Yes → SVHC

SVHC
→ Exposure Scenario (use specific)
  - Risk controlled

Annex XIV
→ Sunset date

Sunset date
→ Authorisation procedure

Authorisation procedure
→ Adequate control route (CMR 1-2 with threshold)
  - Time-limited use

Adequate control route (CMR 1-2 with threshold)
→ SEA* route (e.g., PBT with no suitable alternative)
  - Time-limited use

SEA* route (e.g., PBT with no suitable alternative)
→ PBT with Suitable alternative
  - Time-limited use

PBT with Suitable alternative
→ Substitution & Ban at sunset date
  - Ban at sunset date

SVHC
→ Substitution & Ban at sunset date

*SEA = Socio-Economic Analysis
As can be seen, once ear-marked with some classifications, the future of that particular substance may be compromised at short to medium term.

In addition such classifications do often trigger some de-selections which can speed-up and anticipate the consequences of the regulatory process itself.

Those substances become «non-sustainable» in terms of their future but it could be debated in certain cases whether, in their use, they are sustainable or not with respect to the definition of Sustainability.
Stabilisers formulations evolution

- The stabilisers formulation have evolved significantly over the last 20 years.
- Whilst part of the evolution can be linked to technical progresses a substantial part was driven by sustainability considerations and regulatory pressure.
- Typical formulations for pipes and window profiles in the ’90s were relying strongly on cadmium and/or lead-based stabilisers.
- Those metals were already inviting themselves when sustainability was on the agenda and quite naturally they became the first substances to trigger substantial reformulations.
Cadmium-based stabilisers substitution

- Cadmium salts are efficient stabilisers and they have been used during many years for demanding applications like window frames.
- Cadmium and its compounds became the subject of concerns due to evidences of carcinogenicity.
- Therefore the manufacturers of cadmium-based stabilisers and the downstream users made a voluntary commitment (part of the Vinyl 2010 programme) to phase them out gradually.
- The phase-out was completed in the EU-15 already in 2001 and the commitment was later extended and completed in the EU-27 in 2007.
Lead and its compounds have been regulated since a long time: initially on the basis of acute or chronic effects and more recently on the basis of CMR properties.

Adequate Risk Management Measures applied to the use of lead compounds can however guarantee the protection of the Human health and the Environment.

Around 2000 it became clear that the use of lead-based PVC stabilisers was not scoring high for sustainability and that additional regulatory measures would likely be enacted.

Therefore the manufacturers of lead-based stabilisers and the downstream users made a Voluntary Commitment (part of the Vinyl 2010 programme – now VinylPlus) to substitute those lead-based stabilisers in the EU-27 by the end of 2015.

At the end of 2013 over 81% of the initial quantity of lead-based stabilisers used in 2000 has already been substituted (see next slides).
Stabilisers consumption by category
Year 2000 – EU-15

- Lead: 72%
- Tin: 8%
- Liquid: 10%
- Ca-Based: 10%
- PVC 2014 - Brighton - 1 April 2014
Stabilisers consumption by category
Year 2013 – EU-27

- Ca-based: 67%
- Tin: 9%
- Lead: 13%
- Liquid: 11%

<table>
<thead>
<tr>
<th>Type</th>
<th>kt/annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>19</td>
</tr>
<tr>
<td>Calcium-based</td>
<td>93</td>
</tr>
<tr>
<td>Liquid</td>
<td>15</td>
</tr>
<tr>
<td>Tin</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>139</strong></td>
</tr>
</tbody>
</table>

* as formulated stabilisers
Evolution in the other families of stabilisers

- **Calcium-based stabilisers** (either containing Zinc or not; «COS»)
  - stabilisers of this group are of particular relevance for lead replacement
- **Liquid Mixed Metals** (liquid BaZn and CaZn)
  - almost totally reformulated over the last years owing to:
    - REACH registration
    - re-classification of some components
- **Tin-based stabilisers**
  - the Risk Assessment completed in 2005 had shown that the major applications were safe
  - ETINSA members proactively reformulated for the minor applications ahead of any restriction
Together towards more sustainability

VinylPlus is the new ten-year Voluntary Commitment of the European PVC industry – www.vinylplus.eu

- cross-stakeholders: manufacturers (resin and additives), downstream users (converters and products associations), NGO
- builds upon the achievements of the Vinyl 2010 programme, of which ESPA members were co-founders
- tackles the sustainability challenges for PVC on the basis of the sustainability principles of The Natural Step - www.naturalstep.org
In the sustainable society, nature is not subject to systematically increasing...

1… concentrations of substances extracted from the Earth’s crust
2….concentrations of substances produced by society
3… degradation by physical means

and, in that society

4… people are not subject to conditions that systematically undermine their capacity to meet their needs

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Another scheme...?

- No; the TNS System Conditions are rather a way of translating the Sustainability definition into actions
- Being high-level principles they do:
  - address the issue globally:
    - Human health aspects
    - Environmental aspects
    - Societal aspects
  - leave freedom on how to measure the progress
- The existing schemes can be used to monitor the progress
- Additional schemes might have to be developed to cover any remaining gap
Summary and outlook

- Integration of the sustainability principles in planning the future of chemicals reduces the risk of hitting regulatory barriers at a later stage.
- Additives like stabilisers are crucial to maintain the properties of articles throughout their entire life. Hence the use phase, including recycling, has to be taken into account when assessing their sustainability.
- Measuring sustainability is key to foster progress; however data must be interpreted carefully when comparing different (stabiliser) systems.
- ESPA members are devoting important resources to R&D to supply REACH-compliant and performing solutions to the PVC chain.
- The European PVC industry, represented by VinylPlus, is progressing constantly on the sustainability scale. Its effort exerts an influence on markets beyond the EU boundaries and continent.
“It is not the destination which matters, it is the journey”