Plasticizers and flexible vinyl – a sustainability success story!

SAVA 2017
June 7, 2017

Nigel Sarginson
REACH, Product Stewardship and Regulatory Affairs Manager
Wide Range of Benefits to Society

Safely and cost effectively
The flying bird – Nice Allianz Stadium

Allianz Riviera in Nice, France. Resembling a flying bird, the stadium epitomizes sustainable design practices and is one of the first to bear the EnergyPlus label. Naturally, vinyl plays an important role: the material is used for the tensile fabric covering the wood frame, and PVC profiles keep the many photovoltaic panels on the roof in place. TV viewers worldwide will get a glimpse of this stunning piece of architecture when the UEFA Euro 2016 kicks off.

Benefits of Flexible PVC

- Durability and long life of products made with flexible PVC
- Energy Efficiency
- Electrical Safety
- Physical Safety
- Lifesaving equipment and devices
- Hygiene and prevention of bacterial infections
- Easy and low cost maintenance
- Environmental and resource conservation
Flexible PVC stands for

Performance (Durability)

Value (Cost effectiveness)

Conservation (Resources, Environment)
Much more than that...

Businesses
Enterprise
Innovation
Competition

... delivering the needs of the value chain and consumers, and the environment
Over 50 plasticizers are REACH registered – 5 true general purpose plasticisers

| 30,000 substances described in literature or IP’s | 50 REACH registered (commercial products) | 5 true general purpose plasticisers |

1 in 600 substances commercially successful as plasticiser

Specialty plasticisers

<table>
<thead>
<tr>
<th>Aliphatics</th>
<th>Cyclohexanoates</th>
<th>Trimellitates</th>
<th>Benzoates (di and mono)</th>
<th>Phosphates</th>
<th>Polymeric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrates</td>
<td>Aromatics</td>
<td>Modified</td>
<td>Modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sulfonates</td>
<td>vegetable</td>
<td>starch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Flexible PVC durability requires strong interaction between PVC and plasticisers.

**OPTIMUM BALANCE BETWEEN POLAR AND NON-POLAR GROUPS**

PVC + plasticisers

![Diagram of PVC and Ortho-Phthalate](image)

- PVC structure: Cl - C - C - C - C - C - C - C - H
- Ortho-Phthalate structure: \( \text{O} - \text{O} - \text{O} - \text{O} - \text{O} - \text{O} \)
Different plasticisers, different structure, different interaction, different performance

Ortho-phthalate

Hydrogenated phthalate

Tere-phthalate

Adipate

Citrate

Trimeellitate

Optimum balance between polar and non-polar groups

Poor processability

Poor compatibility

Polar compatibility and aging

Higher processing T
European Plasticisers (formerly ECPI)

Pan-European trade association representing eight producers of plasticisers and intermediates in Europe

One of more than 100 Sector Groups of CEFIC, the European Chemical Industry Council

OUR MISSION

Health

Environment

Safety
- Founding member of the VinylPlus sustainability programme

- ECPI members have been contributing and actively participating since 2000

- ECPI is committed to ensuring the sustainable and responsible use of plasticisers
What is ASF?

The Additive Sustainability Footprint methodology is a voluntary, European-wide approach to assess and promote the sustainable use of PVC additives in different product applications.

It was initiated by the VinylPlus Additive Task Force (Challenge 3) using scientific input (such as REACh, LCA, etc.) and the sustainability principles developed by TNS (The Natural Step).
Guiding principles

- Use robust sustainability criteria
- Consult and engage stakeholders to get it right
- Follow a transparent and trustworthy process
- Build on existing schemes and available data e.g. EPD / PEF
- Take full life cycle & product applications into account
- Guide improvement over time
- Science-based
- Inclusive
- Credible
- Holistic
- Innovative
- Pragmatic

www.vinylplus.eu
### ASF - Baseline

SLCA provides a gap analysis of current performance and progress to align the value chain with science-based sustainability principles.

Visit [www.vinylplus.eu](http://www.vinylplus.eu) for more information.

---

<table>
<thead>
<tr>
<th></th>
<th>RAW MATERIALS</th>
<th>PRODUCTION</th>
<th>PACKAGING &amp; DISTRIBUTION</th>
<th>PRODUCT USE</th>
<th>END-OF-LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP1: Materials from the earth’s crust</td>
<td>Dark Brown</td>
<td>Orange</td>
<td>Red</td>
<td>Dark Brown</td>
<td>Yellow</td>
</tr>
<tr>
<td>SP2: Problematic man-made substances</td>
<td>Green</td>
<td>Yellow</td>
<td>Green</td>
<td>Red</td>
<td>Green</td>
</tr>
<tr>
<td>SP3: Degradation of nature</td>
<td>Orange</td>
<td>Green</td>
<td>Orange</td>
<td>Red</td>
<td>Green</td>
</tr>
<tr>
<td>SP4: Meeting people’s needs</td>
<td>Red</td>
<td>Blue</td>
<td>Blue</td>
<td>Yellow</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
LCA - DINP

Life Cycle Assessment

- **Objective**: determine LCA of DINP

- **Work with PE international**: Validation from Denkstatt

- **Key conclusion**: LCA of DINP available for supply chain
The complexity of the REACH and CLP system

- Registration and Dossier Updates
  - Dossier Evaluation Prelist
  - Verification work
  - Automated screening (200 - 250 substances/year)
  - MS national priorities

- Evaluation Processes
  - Compliance Check
  - Dossier Evaluation
  - Substance Evaluation CoRAP
  - RMOA PACT (SPoC)

- Outcomes
  - Testing Requests
  - Classification for Hazards (Via CLP Regulation)
  - Candidate List Authorisation
  - Restriction: Product banned from specific uses
  - No further action

- PHASE-OUT
REACH Review & Chemicals REFIT by 2018

Potential for **burden reduction**
**NON-CLASSIFIED PLASTICISERS**
*Not on REACH Candidate list*

**Orthophthalates**
*High molecular weight ≥7C*

- DINP
- DIDP
- DPHP

**Orthophthalates**
*Low molecular weight 3-6C*
- DEHP*
- DBP*
- DIBP
- BBP
- DPP
- DIPP
- PIPP
- DIHP
- 711P
- DMeP
- DHxP
- DnHxP
- DCHP

**CLASSIFIED PLASTICISERS**
*Category 1B reprotox agents*

**REACH Candidate List**

- Azelates
  - DMS
  - DBS
- Sebacates
- DIDAz
- Trimellitates
  - TOTM
- Citrates
  - ATBC
- Adipates
  - DEHA
  - DINA
  - DIDA
  - DTDA
- Phosphate Esters
  - TPP

**Dibenoates**
- ODEDB
- OXPDB

**Vegetable oil based**
- ELO
- ESBO
- H. Castor oil

**Benzoates**
- INB
- IDB

*Note: some members of above families may not be REACH registered nor evaluated for classification or risk assessed*
Not all phthalates are the same

**Low molecular weight (LMW)**
- C3 to C8 alcohol + Phthalic Anhydride
  - Cat 1B Reproductive Agents
  - Risk reduction required
  - REACH Candidate List
  - Endocrine Disrupters
  - Subject to REACH Authorisation and Restriction

**High molecular weight (HMW)**
- C9 & C10 Alcohol + Phthalic Anhydride
  - Not CMR
  - Not classified and labelled
  - No risk reduction required in current uses (mouthing toy restrictions)
  - Not Endocrine disrupters

**PVC+DINP, DIDP:** safe, flexible, durable, cost effective, can be recycled
DINP and DIDP are safe for use in all current applications

ECHA concludes that DINP and DIDP are safe for use in all current applications (*)

In-depth evaluation of all hazard and exposure data during a four year process

- Review of all available studies regarding DINP and DIDP
- Public consultation and RAC (Risk Assessment Committee) opinion on the draft report
- Final Report of 370 pages
- “No additional risk management measures are needed to reduce the exposure of children and adults to DINP and DIDP” (**)

European Commission confirms ECHA conclusions (Jan 2014)

- “Absence of any further risks”
- “Tasks called for by the review clause are satisfied and fully completed.”


(**) While maintaining existing precautionary restrictions for toys that can be placed in the mouth
Mature regions shift to high molecular weight

USA and Western Europe plasticizer consumption

KTA

Source: IHS Chemical Economics Handbook 2015 report – Plasticizers

- LMW = low molecular weight
- HMW = high molecular weight
When politics meet science and regulation

Danish National phthalates strategy

• Despite conclusion of safe use in ECHA re-evaluation Danish EPA submitted registry of intent to propose classification of DINP (Nov 2014)

• Extensive discussions between Plasticiser Trade Association (ECPI) and the Danish EPA

• Sharing of scientific information including raw data from key studies – lack of reproducibility for a key study

• Lack of regulatory predictability undermining jobs, growth and investment due to uncertainty within value chain

• Public consultation on Danish EPA proposal for classification of DINP – finished May 19, 2017

• Further RAC process of 9 – 12 months
Using Robust Science is part of our core beliefs
Assessment of reproductive and developmental effects of DINP, DnHP and DCHP: using quantitative weight of evidence

Prof. Dr. Wolfgang Dekant
Department of Toxicology
University of Würzburg
Germany

Jim Bridges, PhD, DSc, DSc
Emeritus Professor
University of Surrey
Guildford, UK

Gerard Swaen, PhD
Maastricht University
Complex Genetics
Netherlands
Conclusions on classification for DnHP, DCHP, and DINP

- In the case of DINP, the application of the developed WoE-methodology do not provide science-based support for a classification of DINP for either developmental or fertility effects.

- The conclusions from the use of the quantitative weight of evidence methodology, supported by an analysis of consistency and plausibility, confirm the conclusions on the assignment of category of 1b for DnHP regarding reprotox.

- For DCHP, the conclusions support category 2 classification for development.

- The above confirms the robustness of the methodology for regulatory purposes.
Critical elements for success – overall sustainability

**SUCCESS**

- **PERFORMANCE/AVAILABILITY**
- **ECONOMICS**
- **SOCIAL**
- **HEALTH AND ENVIRONMENTAL**
- **REGULATIONS**

**DRIVEN BY BUSINESS, ENTERPRISE, INNOVATION AND COMPETITION**
Engage regulators and advocate for general interest

Promoting benefits of flexible PVC, including plasticisers, with facts (tangible attributes and benefits) and sound science
Advocacy platform: plasticiser App, plasticizerfacts.com
Disclaimer

©2017 ExxonMobil. ExxonMobil, the ExxonMobil logo, the interlocking “X” device and other product or service names used herein are trademarks of ExxonMobil, unless indicated otherwise. This document may not be distributed, displayed, copied or altered without ExxonMobil’s prior written authorization. To the extent ExxonMobil authorizes distributing, displaying and/or copying of this document, the user may do so only if the document is unaltered and complete, including all of its headers, footers, disclaimers and other information. You may not copy this document to or reproduce it in whole or in part on a website. ExxonMobil does not guarantee the typical (or other) values. Any data included herein is based upon analysis of representative samples and not the actual product shipped. The information in this document relates only to the named product or materials when not in combination with any other product or materials. We based the information on data believed to be reliable on the date compiled, but we do not represent, warrant, or otherwise guarantee, expressly or impliedly, the merchantability, fitness for a particular purpose, freedom from patent infringement, suitability, accuracy, reliability, or completeness of this information or the products, materials or processes described. The user is solely responsible for all determinations regarding any use of material or product and any process in its territories of interest. We expressly disclaim liability for any loss, damage or injury directly or indirectly suffered or incurred as a result of or related to anyone using or relying on any of the information in this document. This document is not an endorsement of any non-ExxonMobil product or process, and we expressly disclaim any contrary implication. The terms “we,” “our,” “ExxonMobil Chemical” and “ExxonMobil” are each used for convenience, and may include any one or more of ExxonMobil Chemical Company, Exxon Mobil Corporation, or any affiliate either directly or indirectly stewarded.