The role of plasticisers in Wires & Cables

PVC and Cables - ECVM and Italian PVC Council workshop
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ECPI - European Council for Plasticisers and Intermediates

- Pan-European trade association representing the interests of six major 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
PLASTICISERS

What are plasticisers?
NON-CLASSIFIED PLASTICISERS
Not on REACH Candidate list

Ortho-phthalates
High molecular weight ≥C7

Ortho-phthalates
Low molecular weight
3-6C
DEHP*
DIBP DBP* BBP DNPP
DCHP DIHP DNHP DIHXP

DINP DIDP DPHP

Phosphate esters
Trimellitates
Citrates
Azelates
Terephthalates
DOTP DBT
Dibenzoates
Cyclohexanoate DINCH
Epoxidized soybean oil ELO ESBO
Benzoates INB IDB

Note: some low volumes plasticisers may not have been yet evaluated for classification or risk assessed

*ECHA recommends Authorisation for Deza, Grupa Azoty and Arkema – selected applications

www.plasticisers.org
Wire & Cable is the major segment for plasticised PVC in Europe

Source: ECPI data

- Wire and cable: 21%
- Flooring: 19%
- Film and sheet: 18%
- Coated fabric: 11%
- Tubing: 7%
- Other non-paste: 17%
- Other paste: 7%

www.plasticisers.org
Flexible PVC Wire & Cable

Power cable requirements

# 1. Safe, permanent insulation
# 2. Fire retardant
# 3. Does not propagate fire
# 4. Durable (remain flexible)

Plasticiser + PVC offer

• Superior thermal stability, outstanding productivity and energy efficiency during cable manufacture and relatively low cost
• Resistance to heat degradation at operating temperatures from 70°C up to 125 °C
• Flame retardancy and fire preventing ignition and propagation
• Flexibility over very long life span, at high and low temperatures well below -30 °C

PVC cable lifetime from 20 to 80 years!
Plasticiser selection is critical for all stages of a cable manufacturing.

- Plasticisers positively influence mixing and extrusion output of PVC.
- High Temperature specification requires thermally stable and permanent plasticisers.
- Plasticiser selection is determined by the performance specification of the insulation and jacketing.
- Specifications apply to cable performance and/or plasticised compounds.
- Plasticiser LCA can favorably influence cable LCA.

**PVC compounding**
Mixing
Dry blending/Pelletising

**Cable Extrusion**
Throughput
Heat stability

**Cable ageing**
Retained properties
Resistivity
Fire retardancy

**Specification**
Safety margin
Durability
Recyclability
Key plasticiser requirements for wire & cable

- Good compatibility with PVC
- High permanency:
  - low vapor pressure, low neat volatility
  - low diffusion, low migration, resistance to extraction
- Good stability:
  - Thermal (oxidative stability)
  - Water resistant
- Cost effective
  - Low density, good efficiency
  - Good lubrication / High extrusion throughput
- Globally available

- Safe for use, Regulatory clearance
- Safe in use (retained flexibility over time - permanency)
- Favorable Life Cycle Assessment (LCA)
Main plasticisers used for the production of wire & cable in Europe

- High phthalates (increased production speed, durable, ageing resistance, low costs)
  - DINP, DIDP, DPHP are among the preferred plasticisers
  - DTDP, Linear C11 (low volatility) for automotive cables

- Trimellitates: (High service temperature but poorer efficiency and higher costs)
  - TOTM
  - 810TM for low temperature

- Phosphates: (Flame retardancy but higher costs and poorer Cold T° and processability)
  - Alkyl Aryl phosphates
  - Triaryl phosphates

- Chlorinated paraffins (Flame retardancy, secondary plasticisers, poorer compatibility, lower costs)
  - C14-C17 fraction chlorinated at 52%

- Aliphatics: (Good Cold T°, secondary plasticisers, poorer compatibility, higher volatility)
  - Adipates
  - Azelates (lower volatility than adipates, higher costs)

- ESBO (Co-stabiliser for PVC but poor processability and compatibility)
Only a few plasticisers meet the wide cable rating performance

<table>
<thead>
<tr>
<th>Plasticiser Type</th>
<th>Compatibility</th>
<th>Plasticiser Efficiency</th>
<th>Low T° flexibility</th>
<th>Low volatility</th>
<th>Permanency</th>
<th>Ease of processing</th>
<th>Thermal stability</th>
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<tbody>
<tr>
<td>Low Ortho-Phthalates (C8)</td>
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<td>High Ortho-Phthalates (C9, C10 and higher)</td>
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<td>Trimellitates</td>
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<td>Aliphatics</td>
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<td>Epoxides</td>
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<tr>
<td>Chlorinated paraffins (C14-C17 – 52% Cl2)</td>
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<td>Phosphates (triaryl)</td>
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</table>

◇ indicates improved performance / = indicates average performance / ♀ indicates impaired performance

Two high molecular weight phthalates evaluated under REACH

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
REACH process - CoRAP list of substances

- Community Rolling Action Plan indicates substances for evaluation by the Member States in the next three years (updated each year in March)
  - Evaluation aims at clarifying initial grounds for concern.
  - 120 substances listed on the 2014-2016 action plan including following plasticisers having potential cable use:

<table>
<thead>
<tr>
<th>Cas #</th>
<th>Product</th>
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<tbody>
<tr>
<td>911P</td>
<td>68515-43-5 1,2-benzenedicarboxylic acid, di-C9-11-branched and linear alkyl esters</td>
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<tr>
<td>DTDP</td>
<td>68515-47-9 1,2-benzenedicarboxylic acid, di-C11-14-branched alkyl esters, C13-rich</td>
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<tr>
<td>DUP</td>
<td>3648-20-2 diundecyl phthalate</td>
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<tr>
<td>DIUP</td>
<td>85507-79-5 diundecyl phthalate, branched and linear</td>
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<tr>
<td>DPHP</td>
<td>53306-54-0 bis(2-propylheptyl) phthalate</td>
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<tr>
<td>DIDAZ</td>
<td>28472-97-1 diisodecyl azelate</td>
</tr>
<tr>
<td>DOA</td>
<td>103-23-1 bis(2-ethylhexyl) adipate</td>
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Regulatory initiative

RoHS
- Draft methodology used for prioritisation and dossiers for 4 LMW phthalates
- Some stakeholders pushing for « family grouping » approach that could affect all phthalates
- Advocacy:
  - Promote coherence between RoHS and REACH
  - Scientific criteria for prioritisation and grouping
  - Keep plasticisers and PVC outside prioritisation list

REACH Authorisation
- First Authorisation granted to Rolls-Royce plc, for continued use of DEHP in the manufacturing of aircraft engines (7 years)
- Favourable opinion from RAC and SEAC on the use of DEHP and DBP in 7 different applications including the use of DEHP in recyclates
- No applications for BBP and DIBP have been submitted, their use in the EU will be phased out by February 2015.
Regulatory initiative

Denmark:

- Ongoing national strategy on phthalates: identification of areas where more research is needed
- In June 2014, DK decided to withdraw a proposed national ban on DEHP, DBP, DIBP and BBP:
  - The ban is not compatible with EU’s legislation
  - The ban encountered strong opposition from brandholders
- Introduction of Annex XV dossiers proposing the identification of DEHP, DBP, DIBP and BBP as SVHCs
- Substances of Equivalent Level of Concern having probable serious effects to human health and the environment based on Endocrine Disrupting properties as defined under Article 57(f)
- ECPI argumentation against double listing since the same substances have already been submitted under 57 (c)
LCA for DINP

Work with PE int
Validation from Denkstatt

- **Final presentation**: done end October
- **Final report**: in preparation
- **Key conclusion**: LCA of DINP available for supply chain

- Dataset for DINP will be available in the following formats:
  - EcoSpold (version 2)
  - ILCD format
  - GaBi dataset

- Report and dataset will be uploaded to PlasticsEurope homepage (by DEKRA)
Bisphenol A is a phenolic antioxidant used in polymer systems that are sensitive to thermal degradation. When added to plasticisers it inhibits oxidative degradation and embrittlement of PVC compounds.

Antioxidants are efficiently dissolved in plasticisers and added upon specific customer request.

Traditional Bisphenol-A was substituted due to its proposed classification as toxic for reproduction category 1B.

Plasticiser producers helped cable industry reformulate smoothly away to high molecular weight hindered phenolic antioxidant:

- Irganox 1076, Irganox 1010
- Topanol CA
Conclusions

- Substantial investment made by the plasticiser industry to grow high molecular weight phthalates globally, providing cost effective and highly permanent plasticisers for Wire & Cable

- Specialty plasticisers available for specific properties

- Alternative or Bio-Based plasticisers need still to demonstrate their long life span performance in cables and sufficient compatibility with PVC

- Plasticiser industry provide cable producers with safe, cost-effective, high performance plasticisers for over 50 years

- Defending the benefits of flexible PVC cable remain key
  - Low smoke PVC cables
  - Recyclability
  - Superior flexibility at low temperature
  - Medium to High temperature rating
  - Cost efficiency over polyolefin