

## PLASTICISERS

People have been using plasticisers to make things soft and flexible for thousands of years. Water has been used to soften clay since the early evolution of man and oils are known to have been used centuries ago to plasticise pitch for waterproofing boats.

Modern plasticisers are similar and different at the same time. They are colourless and odourless organic liquids which cannot be simply treated as additives, like pigments or fillers, as they constitute a wide range of chemistries and molecules bringing high performance countless applications in a safe and sustainable manner.

### DIVERSE RANGE – DEMANDING PERFORMANCE

Over the last 60 years more than 30,000 different substances have been evaluated for their plasticising properties. Of these, only a small number – approximately 50 – are today in commercial use after meeting the rigorous performance, cost, availability, health and environmental requirements which are imposed by the market, users and regulators.

The most common plasticisers include esters such as adipates, azelates, benzoates, citrates, cyclohexanoates, orthophthalates, sebacates, terephthalates and trimellitates. They are produced by reacting an alcohol – such as e.g. butanol, 2-ethylhexanol, isononanol, isodecanol or 2-propylheptanol – with an acid such as phthalic anhydride, terephthalic acid, adipic acid or trimellitic anhydride to name a few of the common starting materials.

| <h3>CLASSIFIED PLASTICISERS</h3> <p>Included in REACH Candidate List or pending Authorisation</p>                  | NON-CLASSIFIED PLASTICISERS  |   |   |  |
|--|--|---|---|--|
| <p>ORTHO-PHTHALATE<br/>Low Molecular weight<br/>3-6C (straight chain)</p> <p>DEHP DBP<br/>DIBP BBP</p> <p>DCHP</p> | <p>ORTHO-PHTHALATES<br/>High Molecular weight <math>\geq 7C</math></p> <p>DINP DIDP DPHP</p> |   | <p>Sebacates<br/>DMS DBS</p> <p>Azelates<br/>DIDAz</p>                              |  |
|  | <p>Cyclo-hexanoates</p>  | <p>Terephthalates<br/>DOTP DBT<br/>DPT</p>  | <p>Adipates<br/>DEHA DINA<br/>DIDA DTDA</p> <p>Cresyldiphenyl<br/>phosphate CDP</p> | <p>Alkyl<br/>sulfonates<br/>ASE</p> <p>Citrates<br/>ATBC</p> |
|  | <p>Dibenzoates<br/>ODEB OXPDB</p>  | <p>Trimellitates<br/>TOTM</p>   | <p>Acetates</p>   | <p>Butyrates</p>   |
|  | <p>Benzoates<br/>IDB</p>   | <p>Vegetable Oil based<br/>Expoxidized, hydrogenated and acetylated<br/>vegetable oil</p> |   | <p>Valerates</p>   |

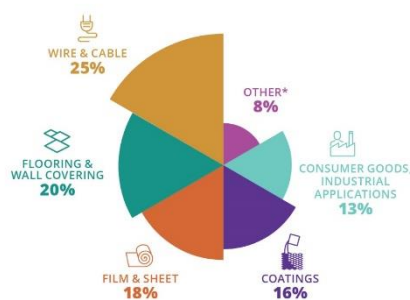
This table is for illustration purposes only. The list of plasticisers is non-exhaustive and box sizes do not accurately represent market volumes.

## NUMEROUS APPLICATIONS & EXTENSIVE TESTING

Today, over 90 percent of all plasticisers consumed in Europe are used in flexible PVC applications. They give PVC the flexibility and elasticity needed for many different applications, particularly in construction (sheathing for electric cables, roofing membranes, flooring and wall coverings), in the automobile industry (trim, cables, under body sealants), furniture and artificial leather goods. Plasticisers are major functional substances that transform the physical properties of PVC and other polymers creating a whole new world of flexible and durable applications.

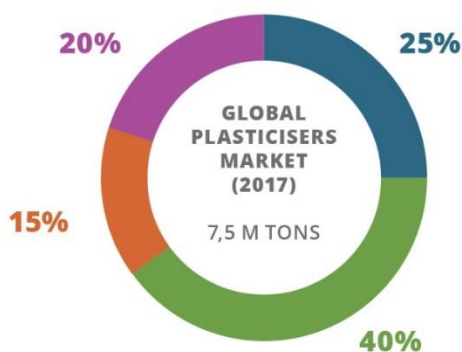
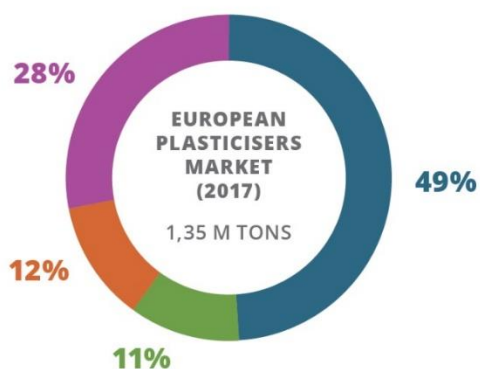
Because plasticisers are so widely used, they have undergone extensive testing for possible health and environmental effects and are amongst the most widely researched of all chemical substances. In Europe, the safe use of plasticisers is enabled by REACH, the most comprehensive chemical regulation anywhere in the world.

EUROPE'S PLASTICISERS USE (2017)



\*Other: elastomers, surface coatings, rubber compounds and medical applications  
Source: 2018 IHS and European Plasticisers estimates

## EUROPEAN & GLOBAL MARKET



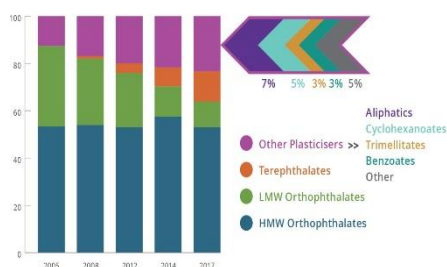
● HMW Orthophthalates ● LMW Orthophthalates ● Terephthalates ● Other Plasticisers

Source: 2018 IHS and European Plasticisers estimates

Major plasticisers are high volume commodity chemicals, which take decades and millions of Euros of capital investment to reach full commercial development. Globally, approximately 8.4 million tonnes of plasticisers are consumed every year, of which European consumption accounts for well over 1.3 million tonnes. Orthophthalates are the most widely consumed plasticisers.

The European market has evolved rapidly in response to market and regulatory pressure. Orthophthalates make up for the majority of the plasticisers followed by terephthalates and cyclohexanoates. Other plasticisers are also gaining market share.

EUROPEAN MARKET TRENDS (2017)



Source: 2018 IHS and European Plasticisers estimates

However, DEHP still represents almost 40 percent of the global consumption. DEHP is still widely produced and used in China, India, and other parts of Asia, the Middle East, Africa and Latin America and may be included in articles imported into Europe.