

Phenylmercury neodecanoate : The major use of the five phenylmercury compounds in the EU and EFTA countries today is the use of phenylmercury neodecanoate as a catalyst in production of polyurethane (PU) coatings, adhesives, sealants and elastomers (often referred to as CASE applications). The catalyst product is formulated by a mixing of the phenylmercury neodecanoate with other compounds e.g. neodecanoic acid. The formulation of the catalyst product takes place by less than four companies in the EU.

In the polyurethane manufacture, the catalysts are used for catalysing the reaction between a polyol and an isocyanate component, i.e. for hardening or curing the polyurethane. A two-component PU system consists of a polyol component and an isocyanate component which is mixed by the application of the system. The catalyst is typically included in the polyol component. The specific properties of the phenylmercury neodecanoate catalyst are further described in Section C.1 in the context of the discussion of alternative solutions.

Two catalyst products with phenylmercury neodecanoate have been identified, but more may be marketed: Thorcat 535 and Cocure® 55. One of the products is produced within the EU. Thorcat 535 contains 35% mercury (COWI and Concorde East/West, 2008) (=78% phenylmercury neodecanoate by weight) while Cocure® 55 contains 60-70% (by weight) phenylmercuric neodecanoate (Vertellus 2009d).

The Cocure® 55 is a mixture of phenylmercury neodecanoate and neodecanoic acid (Vertellus 2009d). The mixture is a clear, yellow, viscous liquid with a mild odour. The boiling point is 200C and the vapour pressure <5 mm Hg at 20C.

Like any catalyst used in PU systems, the mercury catalyst is incorporated into the polymer structure and remains in the final product, e.g. in elastomer coatings for leather finishing, textile and fibre treatment or coating of computer parts. The catalyst is added to the polyurethanes at levels of 0.2-1%, depending on the other components, the desired properties of the polymer, etc. Consequently the

phenylmercury neodecanoate concentration in the polyurethane material is in the order of 0.1-0.6%.

It is estimated that 300-350 tonnes/year of mercury catalyst may be used globally in PU elastomer applications, of which some 60-105 tonnes/year in the EU (COWI and Concorde East/West, 2008). The report use the term «elastomer», which is the main application area, but the estimate seems to cover all CASE applications. This corresponds to an EU + EFTA consumption of approximately 36-70 tonnes phenylmercury neodecanoate. With 45% mercury it corresponds to a total mercury content of approximately 20-35 tonnes/year. The estimate has for this report been confirmed by the major supplier of the catalysts as being reasonable. Further < 1 tonnes of other phenylmercury compounds may be used for the production of PU systems. For the estimation of the releases to the environment maximum figures for the use will be applied for worst case estimates: 71 tonnes phenylmercury compounds per year corresponding to 33 tonnes Hg per year.

According to a major manufacturer of PU catalysts, the mercury consumption was probably 2-3 times higher 10 years ago, but no actual data have been available.

The mercury-catalyzed PU two-component systems with phenylmercury neodecanoate are in particular used for the following CASE applications:

- (C) Spraying onto a surface as insulation or corrosion protection (coating);
- (A) Adhesives.
- (S) Sealants and filling materials;
- (E) Casting of complex shapes of PU elastomers (poured or injected into a mould); Elastomers are polymers with the property of elasticity and are sometimes designated —synthetic rubbers.

According to a major supplier of catalysts, elastomers take up about 90% of the market of mercury catalysts while about 10% is used for sealants. For adhesives and coatings, according to the supplier, the

mercury use is today small while organotin or amine catalysts are the major catalysts for these applications. However, other information indicates that the mercury catalysts are still widely used for coatings.

The applications can be exemplified with the recommended application of the catalysts for PU systems: Cocure 55® is recommended for polyurethane elastomer and polyurethane coating applications in automotive, electronic, sealant, and shoe sole end-use markets (Vertellus 2009c).

Table B2.2 illustrates the wide range of applications of some of the PU systems for which Material Safety Data Sheets, specifically indicating the presence of phenylmercury neodecanoate, have been available.

Table B2.2. Examples of applications of PU systems with mercury catalyst specifically mentioned by suppliers

Application	Product
Two-component, elastomeric materials for repairing, rebuilding or creating rubber. Applications include pumps, diaphragms, drive couplings, flexible moulds, shock absorbers, guide bearings, rubber linings, seals, deburring machines, ship fenders, filter casings and conveyor belts.	The Belzona 2100 series (UK) (Belzona, 2009)
2-component polyurethanes that cure at room temperature to tough rubber-like materials, remaining flexible at temperatures down to even -60°C. For making: Vibration dampers, assembling jigs, flexible seals, rubber-like prototypes, foundry patterns and forms For repairs on: Conveyor belts, solid rubber tyres, conveyor rollers For coatings on: Rollers, centrifuges, polishing drums, tanks, chutes and funnels, pumps, bulk containers, dry and wet mixers, cyclones, housings, loading areas. In addition suitable as vibration or insulation protection of machines.	WEICON Urethane 45, 60, 80 (Germany) (Weicon, 2009) Urethane 45 and 60 with phenylmercury neodecanoate, catalyst of Urethane 80 not indicated
Clear polyurethane compound for use on decals, labels, emblems and other decorated substrates	Z-8200 (U.S.A) (Development Associates, 2009)
Self-levelling sealants for penetration into joints of concrete flooring.	Permaflex B Gun Grade (UK) (Permaban, 2009)
For the production of film or theatre props where a firm flexible urethane moulding is required such as reproduction of weapons, etc.	J-Foam 130 (UK) (Jacobson Chemicals, 2009)
Film and television props and special effects applications for embedding hairs and for creating skin effects; Soft encapsulant for low voltage electronic assemblies; Soft seals or gaskets; General purpose mouldmaking; Rubber use as a mould backing material for silicone mould liners where a soft silicone requires firm but flexible support; Wear resistant coating for polyurethane foam and as a general purpose coating or repair system for items such as buoys fenders and conveyor belts. Electronic encapsulation and modelling display applications. Artistic and modelling display applications	E1105, E1118, XE1013, E106, E053 XR3002, XR3006 (UK) (Polymed, 2009) Indicated as "organic mercury catalyst"

Other applications mentioned by suppliers are different rollers of hard PU elastomers used for different applications, among these, rollers for swivel chairs and roller skates.

No specific confirmation of the current use of the mercury catalysts for flooring (discussed later under exposure) has been available, however, data sheets have been available for a few of the PU systems only. The application range is probably wider than indicated in the table above.

For many of the applications listed in the table above mercury-free alternatives exist. As many different PU elastomer systems exist, each used for production of different products, it has not been possible to obtain information on the break down of the total use into the different product groups. The mercury-based products are used both for the professional market and for consumer products.

According to a major manufacturer of PU catalysts, PU elastomer systems with aliphatic isocyanates is one of the areas where it has been difficult to replace mercury catalysts although the manufacturer estimate that substitution may be possible within a period of 3-5 years (discussed later).

According to the trade organisation ALIPA, polyurethanes based on aliphatic isocyanates are present in most of the high quality, long lasting coatings used in a wide number of applications such as (ALIPA, 2009): Automotive coatings, applied both as original equipment (OEM) and in car repair. Transportation applications such as aerospace, railway equipment, trucks and buses.

Agricultural, construction and earth moving machinery. Plastic articles and components: bumpers, wheel covers, rear mirrors, door handles as well as phones, computers, skis, hifi equipment, kitchen ware.

Wood Coatings: parquet flooring, heavy duty and high quality furniture for kitchen, school, counters.

Maintenance & Protection Coatings: heavy industry anticorrosion (metallic structures), high performance decorative finishes.

Marine: superstructure, topsides and decks of ships and yachts.

Coil & Can Coatings: buildings (cladding and roofing), appliances, transport, packaging.

General Industry: motorcycles, bicycles, metal office furniture.

Industry contacts have pointed out that mercury catalysts are widely used in the UK, Spain and Italy; relatively little used in Germany, although the overall industrial output is very high; while France is somewhere in the middle (COWI and Concorde East/West, 2008). Other EU countries do significantly less PU elastomer processing. Kometani *et al.* (year not indicated) from the Japanese chemical company Tosoh Corporation report, that although mercury catalysts are highly toxic and not used in Japan, Europeans and Americans continue to formulate using these catalysts. SPIN is a database on the use of substances and substances in mixtures in the Nordic countries. According to the SPIN database the compound was registered in 5 mixtures in Denmark in 2007 within the use category —construction materials‖ with a total indicated tonnage of 0. No use is registered for the other Nordic countries.

The catalysts are used for the manufacturing of different PU elastomer systems by manufacturers of plastic raw material systems like Dow Hyperlast, Baxenden Chemicals, Weicon and Belzona International. An Internet search reveals a large number of different systems with phenylmercury neodecanoate. Based upon a detailed investigation of the UK situation, COWI and Concorde East/West (2008) estimated that some 30-45 different mercury containing PU elastomer systems were marketed in the UK and at the EU level, recognizing that many systems are marketed in more than one EU country, they estimated that there may be as many as 200-250 different mercury containing PU elastomer systems. The total number of companies applying the mercury-containing PU systems is not known but likely several thousands. One of the areas, where mercury catalyst is widely used, is PU elastomers based on aliphatic isocyanates. According to the trade organisation ALIPA, for this particular market area, three companies was involved in the production of the chemical raw materials, 140 companies were involved in manufacturing of formulations while the number of end-use applicators was 2 200 (ALIPA, 2006).