

## 欧洲联盟关于修正《关于汞的水俣公约》附件 A 第一部分的提案

Proposal by the European Union to amend part I of Annex A to the Minamata Convention on mercury

欧洲联盟建议在附件 A 第一部分增加以下条目：

The European Union proposes to add the following clauses to part I of Annex A:

含汞产品 Mercury containing products	开始禁止产品生产、进口或出口的时间（淘汰日期） Time when the production, import or export of prohibited products begins (elimination date)
含汞量低于 2% 的扣式锌氧化银电池，以及含汞量低于 2% 的扣式锌空气电池 zinc silver oxide button battery with mercury content less than 2% and mercury content less than 2% zinc air button battery	2023 年
用于普通照明用途的卤磷酸盐荧光粉直管型荧光灯 Halogen phosphate phosphor straight tube fluorescent lamp for general lighting purposes	2023 年
体积描记仪中使用的应变片；张力计 Strain gauge used in plethysmograph; tensiometer	2023 年
熔体压力传感器、发射器和传感器；汞真空泵 Melt pressure sensor, transmitter and sensor; Mercury vacuum pump	2023 年
聚氨酯，包括用于使用聚氨酯的罐 Polyurethane, including cans for using polyurethane	2023 年

本表中关于聚氨酯的修正提案是对在附件B第一部分增加“使用含汞催化剂生产聚氨酯”条目这一提案的补充。

拟议的附件B第一部分新增条目不会禁止进口含汞的聚氨酯罐。

The amendment proposal on polyurethane in this table is a supplement to the proposal to add the clause "production of polyurethane using mercury containing catalyst" in part I of Annex B. The proposed new clause in part I of Annex B will not prohibit the import of polyurethane cans containing mercury.

## 欧洲联盟关于修正《关于汞的水俣公约》附件 B 第一部分的提案

Proposal by the European Union to amend part I of Annex B to the Minamata Convention on mercury

欧洲联盟建议在附件 B 第一部分增加以下条目：

The European Union proposes to add the following entry to part I of Annex B:

使用汞或汞化合物的生产工艺 Production process using mercury or mercury compounds	淘汰日期 elimination date
使用含汞催化剂进行的聚氨酯生产 Polyurethane production using mercury containing catalysts	2023 年



## Further explanatory note from the European Union regarding the proposed amendments 欧洲联盟关于拟议修正案的进一步解释性说明

TECHNICAL, ECONOMIC AND ENVIRONMENTAL INFORMATION IN ACCORDANCE WITH ARTICLES 4(7) AND 5(9) TO THE CONVENTION 根据《公约》第4(7)条和第5(9)条提供的技术、经济和环境信息

SUBMISSION FROM THE EU ON MERCURY-ADDED PRODUCTS AND MANUFACTURING PROCESSES USING MERCURY OF MERCURY COMPOUNDS 欧盟提交的关于使用汞或汞化合物中的汞的添加汞产品和制造工艺的文件

### Production of polyurethane 聚氨酯生产

#### Summary Overview 概述

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Polyurethane is a polymer comprised of a series of organic units, which are linked by urethane (ChemEurope, 2019). Polyurethane is available in a number of forms and densities, and is used in bedding, thermal insulation and in floorings (ibid). However, the primary use of mercury catalysts is in the production of polyurethane coatings, adhesives, sealants and elastomers (referred to as CASE applications). According to a major catalyst supplier, elastomers comprise approximately 90% of the mercury catalyst market (Norwegian Climate and Policy Agency, 2010).

聚氨酯是由一系列有机单元组成的聚合物，由氨基甲酸乙酯连接组成（ChemEurope, 2019）。聚氨酯的形式和密度多种多样，用于垫层、隔热和地板（同上）。然而，汞催化剂的主要用途是生产聚氨酯涂料、粘合剂、密封剂和弹性体（称为CASE应用）。根据某家主要催化剂供应商的数据，弹性体约占汞催化剂市场的90%（挪威气候和政策局，2010年）。

Mercury catalysts are used for the manufacture of a number of polyurethane elastomers. In particular, mercury is used in the production of polyurethane elastomers that are cast into complex shapes, or sprayed onto a surface as insulation (i.e. corrosion protection). It is estimated that polyurethane elastomer castings and coatings comprise at least 90% of the total applications of polyurethane elastomers (COWI, 2008).

汞催化剂用于制造许多聚氨酯弹性体。特别是，汞被用于生产聚氨酯弹性体，这些弹性体被铸造成各种复杂的形状，或作为绝缘材料喷到物体表面上（即防腐）。据估计，聚氨酯弹性体铸件和涂料至少占聚氨酯弹性体总应用的90%（COWI, 2008）。

Under Annex B Part II of the Minamata Convention, a series of measures are outlined, to reduce the use of mercury catalysts and conduct research into the use of mercury-free alternatives. However, there is no prohibition of the use of mercury-containing catalysts in polyurethane production.

《水俣公约》附件B第二部分罗列了一系列措施，以减少汞催化剂的使用，并对无汞替代品的使用进行研究。然而，没有禁止在聚氨酯生产中使用含汞催化剂。

It is estimated that globally, mercury catalysts account for less than 5% of polyurethane production and that in 2008, 300-350 tonnes of mercury catalyst were used in the global production of polyurethane elastomers (COWI, 2008).

据估计，全球范围内，汞催化剂在聚氨酯生产中所占比例不到5%，2008年，全球聚氨酯弹性体生产中使用了300-350吨汞催化剂（COWI, 2008）。

Bismuth and zinc carboxylates, and tertiary amines, are technically an economically viable alternatives to the use of mercury catalysts, which are already in use internationally. However, both of these alternatives require additional adjustments, to ensure that they reflect the characteristics of mercury. Relative to mercury, these alternatives have limited impact on health and the environment.

铋锌羧酸盐和叔胺在技术上和经济上是一种可行的汞催化剂替代品，国际上已在使用。然而，这两类替代品都需要额外的调整，以确保它们呈现汞的特性。相对于汞，这些替代品对健康和环境的影响有限。

Use of mercury compounds in the production of polyurethane is completely prohibited within the EU since 1 January 2018.

自2018年1月1日起，欧盟完全禁止在聚氨酯生产中使用汞化合物。



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## Technical Description 技术说明

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In the formation of polyurethane, mercury catalysts are used in the reaction between a polyol and an isocyanate component. During the reaction, mercury catalysts enable a long induction period, followed by a rapid reaction for curing the product. The catalyst tends to be present in the polyol component. The mercury catalyst is integrated into the polymer and remains present in the final polyurethane product (Norwegian Climate and Policy Agency, 2010).

在聚氨酯的形成过程中，在多元醇和异氰酸酯组分之间的反应中使用汞催化剂。在反应过程中，汞催化剂提供长诱导期，然后快速反应固化产品。催化剂倾向于加在多元醇组分中。汞催化剂被整合到聚合物中，并且仍然存在于最终的聚氨酯产品中（挪威气候和政策局，2010年）。

Organic mercury compounds provide the desired characteristics of catalysts for the majority of polyurethane applications. Mercury catalysts offer an initial induction period (pot life) where the reaction between polyurethane and the catalyst is slow or does not occur. This enables sufficient time for the mixture to be cast, following the addition of the catalyst. This provides the manufacturer with greater oversight of the polyurethane application (ibid).

有机汞化合物为大多数聚氨酯应用提供了所需的催化特性。汞催化剂提供了一个初始诱导期（适用期），其中聚氨酯和催化剂之间的反应缓慢或不会发生。这使得在添加催化剂之后有足够的时间浇注混合物。这为制造商提供了对聚氨酯应用的更大前瞻性（同上）。

Secondly, mercury catalysts engender a rapid reaction following the initial induction period, which enables the product to reach its final form and adopt the desired properties in relation to shape, density and malleability. In addition to allowing the product to take on its desired characteristics, the rapid reaction enables the production process to occur in a timely manner (COWI, 2008).

其次，汞催化剂在初始诱导期后会产生快速反应，使产品达到最终形态，并在形状、密度和延展性方面具有所需的性能。除了使产品具有预期的特性外，快速反应还能使生产过程及时进行（COWI，2008）。

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## Range of mercury content/consumption per unit product 单位产品汞含量/消耗量范围

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The mercury catalyst is typically added to the polyurethane systems at concentration levels of 0.2 % – 1 %. However, this depends on the specifications of the end product and the other components present (Norwegian Climate and Policy Agency, 2010).

汞催化剂通常以0.2%–1%的浓度水平添加到聚氨酯系统中。然而，这取决于最终产品的规格和其他组份的构成（挪威气候和政策局，2010年）。

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## Availability of non-mercury alternatives 无汞替代品的可得性

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**Main alternatives: bismuth and zinc carboxylates, tertiary amines, organotin compounds**

**主要替代品：羧酸铋和锌、叔胺、有机锡化合物**

According to the European trade association for producers of diisocyanates and polyols (ISOPA) and the European Aliphatic Isocyanates Producers Association (ALIPA), using the polyurethane systems currently in place with a non-mercury catalyst does not enable the same level of performance as using these systems with mercury catalysts. Therefore, designing alternative polyurethane systems, which use alternative polyol or isocyanate components, with a non-mercury catalyst is preferable (ISOPA, 2009).

根据欧洲二异氰酸酯和多元醇生产商贸易协会（ISOPA）和欧洲脂肪族异氰酸酯生产商协会（ALIPA）的说法，现有聚氨酯系统和无汞催化剂搭配使用，无法实现和汞催化剂搭配使用所呈现的相同性能。因此，设计替代多元醇或异氰酸酯组分的替代性聚氨酯系统和无汞催化剂搭配，是更为可取的（ISOPA，2009）。

There is also the potential for the development of systems based on other polymers to replace mercury polyurethane systems. However, due to the wide range of applications required, finding suitable polymers is expected to be a complex task (Norwegian Climate and Policy Agency, 2010).

此外，还可能开发基于其他聚合物的体系，以取代汞聚氨酯体系。然而，由于广泛的应用需求，寻找合适的聚合物将是一项复杂的任务（挪威气候和政策局，2010年）。



In contrast, non-mercury catalysts are available for the majority of applications, and are used as catalysts in over 95% of polyurethane elastomer applications (ChemEurope, 2019). Several non-mercury catalysts with distinct properties have been developed for polyurethane elastomers, as a 'one-size-fits-all' approach is not applicable in the case of replacing mercury catalysts for multiple applications (Norwegian Climate and Policy Agency, 2010).

相比之下，无汞催化剂可用于大多数应用，并在超过95%的聚氨酯弹性体应用中用作催化剂（ChemEurope, 2019）。现已为聚氨酯弹性体开发了几种具有不同性质的无汞催化剂，因为在为多种应用替换汞催化剂的情况下，“一体通用”的方法是不适用的（挪威气候和政策局，2010年）。

Bismuth and zinc carboxylates have been used as alternatives to mercury catalysts since the 1980s. Bismuth and zirconium systems are also available on the market as mercury catalyst alternatives. In addition, tertiary amines and organotin compounds have also been used as substitutes to mercury catalysts in a range of applications (ibid).

自20世纪80年代以来，羧酸铋和羧酸锌一直被用作汞催化剂的替代品。铋和锆系统也可用作汞催化剂的替代品。此外，叔胺和有机锡化合物也被广泛用作汞催化剂的替代品（同上）。

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### Technical feasibility of mercury-free alternatives 无汞替代品的技术可行性

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Bismuth and zinc carboxylates have been adopted for many decades, and are designed to replace the use of mercury, lead and tin catalysts. These catalysts have displayed commercial success, despite their shortcomings relative to mercury (ChemEurope, 2019). For example, bismuth compounds require manufacturers to make adjustments to account for the differing reactivity of bismuth relative to mercury. In addition, bismuth compounds result in greater viscosity relative to mercury, as the reaction occurs. This produces polymers with different consistencies, relative to the polymers which a mercury catalyst produces. However, the use of a bismuth neodecanoate and zinc neodecanoate mixture enables users to adjust the concentration of the two metals, and hence adjust the behaviour of the gel (Norwegian Climate and Policy Agency, 2010).

铋和锌羧酸盐已经采用了几十年，并被设计来取代汞、铅和锡催化剂的使用。尽管这些催化剂与汞相比存在缺点，但在商业上还是取得了成功（ChemEurope, 2019）。例如，铋化合物要求制造商调整说明铋相对于汞的不同反应性。此外，当反应发生时，铋化合物相对于汞的粘度更大。相对于汞催化剂产生的聚合物，它产生的聚合物具有不同的稠度。然而，新癸酸铋和新癸酸锌混合物的使用使使用者能够调整这两种金属的浓度，从而调整凝胶的进行（挪威气候和政策局，2010年）。

Bismuth and zirconium systems are also used as mercury catalysts for the production of polyurethane elastomers. However, their sensitivity to moisture renders it difficult for these systems to act as catalysts in the presence of water.

铋和锆系也代替汞催化剂，用于生产聚氨酯弹性体。然而，它们对水分的敏感性使得它们很难在有水的情况下起到催化剂的作用。

Organotin compounds are not considered direct replacements for mercury catalysts, although they have been used to replace mercury in some applications. For example, organotin compounds are used in polyurethane systems to produce foams, coatings, adhesive and elastomers. However, these compounds cannot replace the use of mercury in all applications (ibid).

有机锡化合物不被认为是汞催化剂的直接替代品，尽管它们在某些应用中已被用来取代汞。例如，有机锡化合物用于聚氨酯系统中，以生产泡沫、涂料、粘合剂和弹性体。然而，这些化合物不能取代汞在所有应用中的用途（同上）。

Tertiary amines have also been used as catalysts, producing a long pot life, followed by rapid reaction rate, two characteristics necessary for a suitable alternative to mercury catalysts. These can be used in adhesive, sealant and elastomer applications. However, the water content of polyurethane systems needs to be controlled, to ensure that foaming issues do not occur (ibid).

叔胺也被用作催化剂，具有很长的适用期和很快的反应速率，这两个特性是汞催化剂的合适替代品所必需的。这些可用于粘合剂、密封剂和弹性体应用领域。但是，需要控制聚氨酯系统的含水量，以确保不会出现起泡问题（同上）。

The aforementioned catalysts are all currently available on the market.

上述催化剂目前都可以在市场上买到。



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## Economic feasibility of non-mercury alternatives 无汞替代品的经济可行性

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The cost of mercury-free catalysts is expected to be comparable with the cost of mercury catalysts. The cost of mercury catalysts has increased, and therefore, the price of alternatives is not expected to be a barrier (COWI, 2008). Broader research and development is expected to engender higher costs, as sourcing substitutes for a relatively simple polyurethane system is expected to require two months of research from one researcher (equivalent to €10,000 - €15,000). However, it is not expected that additional machinery costs will be incurred, as the same machinery can be used for both mercury and non-mercury systems (Norwegian Climate and Policy Agency, 2010).

无汞催化剂的成本被寄望与汞催化剂的成本相当。汞催化剂的成本增加，因此，替代品的价格预计不会成为障碍（COWI，2008）。更广泛的研究和开发预计会产生更高的成本，因为采购相对简单的聚氨酯系统的替代品预计需要一名研究人员进行两个月的研究（相当于10,000欧元 - 15,000欧元）。然而，预计不会产生额外的机械成本，因为相同的机械可用于汞和非汞系统（挪威气候和政策局，2010年）。

Only non-mercury alternatives are used for manufacturing of polyurethane in the EU.

在欧盟，只有无汞替代品用于制造聚氨酯。

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## Health/Environmental Risks and benefits of non-mercury alternatives

### 无汞替代品的健康/环境风险和益处

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All of the mercury catalyst used in polyurethane production remains in the product. This represents 0.2 to 1% of the polyurethane in products and several hundred tonnes of mercury catalyst globally. In most cases, polyurethane waste is subject to unspecific waste disposal and therefore represents significant risks of emissions and releases to the environment.

聚氨酯生产中使用的所有汞催化剂都留在产品中。这相当于产品中聚氨酯的0.2%到1%，以及全球几百吨汞催化剂。在大多数情况下，聚氨酯废品会遭到不特定的废物处理，因此会对环境造成重大的排放和释放风险。

There are in some cases health concerns associated with non-mercury alternatives. For example, zinc neodecanoate is reported to cause potential irritation to skin and eyes. In addition, there are some adverse effects associated with ingestion of zinc and bismuth. However, bismuth and zirconium are not considered to be skin irritants (ibid).

在某些情况下，健康问题与无汞替代品有关。例如，据报道，新癸酸锌会对皮肤和眼睛造成潜在的刺激。此外，摄入锌和铋也有一些不良影响。然而，铋和锆不被认为是皮肤刺激物（同上）。

One of the primary environmental concerns associated with the use of mercury in polyurethane elastomers is the contamination of municipal waste streams and waste incinerators. This contamination is likely to contribute towards atmospheric mercury releases (COWI, 2008), as well as being toxic to aquatic organisms (Norwegian Climate and Policy Agency, 2010). In contrast, mercury-free alternatives have minimal impact on the toxicity of aquatic organisms.

在聚氨酯弹性体中使用汞的主要环境问题之一，是城市废物流和垃圾焚烧炉的污染。这种污染可能导致大气汞释放（COWI，2008年），并对水生生物有毒（挪威气候和政策局，2010年）。相比之下，无汞替代品对水生生物的毒性影响极小。

In relation to both health and environmental impacts, mercury-free alternatives have minimal impact relative to mercury.

就健康和环境影响而言，相对于汞，无汞替代品的影响极小。



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## Examples of regional or national restrictions 区域或国家限制的例子

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In the EU, Regulation (EC) No 2017/852 prohibits manufacturing processes in which mercury or mercury compounds are used as a catalyst from 1 January 2018.

在欧盟，第2017/852号法规（EC）自2018年1月1日起禁止将汞或汞化合物用作催化剂的生产工艺。

Before Regulation (EC) No 2017/852 came into effect, national legislation in Norway exceeded EU-level restriction, prohibiting the production, use and sale of mercury compounds, which include polyurethane elastomers using mercury (COWI, 2008).

在第2017/852号法规（EC）生效之前，挪威的国家立法限制级别超过了欧盟：禁止生产、使用和销售汞化合物，其中包括使用汞的聚氨酯弹性体（COWI，2008）。

In 2017, Japan implemented the Mercury Pollution Prevention Act, which adopts measures in line with the Minamata Convention, as well as additional stricter measures. In the National Implementation plan, Japan states that 'no manufacturing process using mercury catalysts has been found in the polyurethane production processes' (Mercury Convention, 2017, p. 16).

2017年，日本实施了《汞污染防治法》，该法采取了与《水俣公约》一致的措施，以及其他更严格的措施。在国家实施计划中，日本指出“在聚氨酯生产工艺中未发现使用汞催化剂的生产工艺”（汞公约，2017年，第16页）。



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