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IZM

Adaptation to scientific and technical progress of Annex II to Directive 2000/53/EC (ELV) and of the Annex to Directive 2002/95/EC (RoHS)

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4.2 Exemption no. 2(c)

"Aluminium with a lead content up to 0,4% by weight"

4.2.2 Description of exemption

Currently, the use of lead as an alloying element in aluminium is only allowed up to 0,4%. As a result of the latest consultation, stakeholders request an unchanged extension of the exemption.

Leaded aluminium alloys are widely used for automotive applications. In general, three different types need to be distinguished:

1. aluminium alloys where lead is intentionally added for improved machinability;
2. aluminium alloys where lead is intentionally added for corrosion prevention;
3. aluminium alloys that contain lead unintentionally due to their production from scrap metal.

Aluminium alloys for machining purposes are covered by specific EN standards which define the composition of the different alloys. The widely-used aluminium alloy EN AW 2011 – AlCuBiPb – (AA 2011) with standardized lead range between 0,2% and 0,6% is still in use. This alloy has been specified for many applications, however with a limited lead content of maximum 0,4%. Most of the aluminium used is secondary aluminium (only 3%–5% are primary aluminium).

Typical uses for aluminium alloys from the first category are automotive transmission valves, cylinders and pistons for brake systems or for air conditioning systems, as well as applications in steering systems and in the chassis (e.g. steering knuckles). The following figure shows the applications in a vehicle as a rough example.

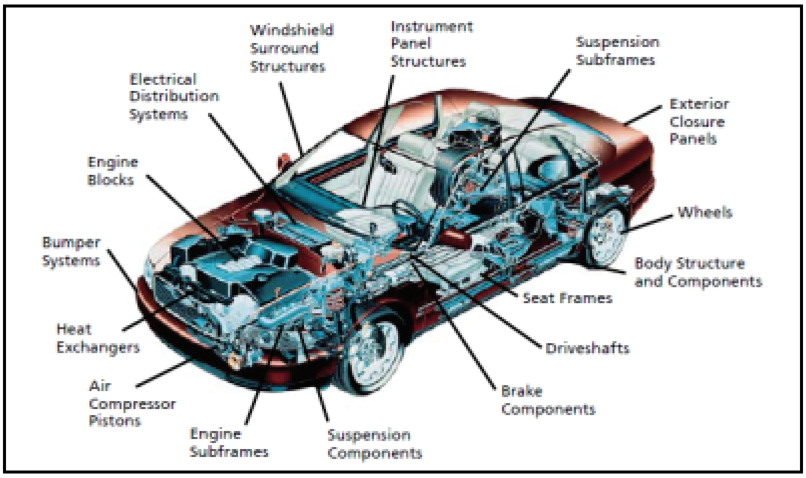

Figure 1 Lead applications in a vehicle

Some body and electrical components e.g. motors, starters, generators and even (machined) casting components are made out of secondary raw material from the scrap streams. Most of the secondary alloys e.g. the most prominent alloy is AlSi9Cu3 (also known as "226 alloy") have lead impurities content of about 0,2%.

Aluminium is increasingly used in automobile production because of its weight reduction potential (which leads to better fuel economy) over steel. Actual lead content is said to vary between 0,1% and 0,35%, with an average 0,18%–0,20% lead concentration. It is estimated that 90% of the aluminium used in this application is secondary, which requires about 90% less production energy than primary lead. When lifecycle energy is taken account, primary lead needs more than 20 times more energy than secondary lead.

The average vehicle is estimated to contain about 70 kg of aluminium, adding up to an average 130–140 g of lead per vehicle from this application. This would represent about 2 500 t of lead use in the EU27, considering a production of 17,7 million vehicles, i.e. 1,3 million tonnes of aluminium.

Unintentionally added lead may have been added to the scrap stream over years through inaccurately separated wheel rims, machined aluminium, lead from batteries and other lead-containing applications. Thus, lead is included in the scrap flow as an impurity which cannot be separated during the scrap process phase. Lead is neither necessary to attain specific properties, nor does the contained lead harm the properties of aluminium alloys as long as its quantity stays within the limits set by European standards[10].

With regard to the environmental relevance of lead in aluminium, (Lohse et al. 2001) concluded that most aluminium will end up in the shredder heavy fraction and will be recycled. A 2006 study by GHK in association with BioIS indicates average recycling rates of 97,8% for non-ferrous metals (GHK 2006). Due to the fact that lead is an unwanted tramp element with negative characteristics in the finished products if exceeding certain levels, the aluminium industry has an interest to keep the lead impurities in the secondary aluminium cycle as low as possible.

4.2.3 Justification for exemption

Industry stakeholders from ACEA/KAMA/JAMA/CLEPA/EAA/OEA et al. responded together to the consultation, providing information on leaded aluminium alloys (ACEA et al. 2009a). Stakeholders from the Schrader Group and the German non-ferrous metal association WGM and the German VDM Association also supplied independent answers (Schrader Group

[10] European standard EN 1706 sets standards for a great number of aluminium alloys and specifies different limits for lead.

2009; WGM 2009). Supporting evidence was provided on the energy requirement of secondary aluminium vs. primary aluminium. Furthermore, stakeholders from ACEA/KAMA/ JAMA/CLEPA et al. answered to additional questions (ACEA et al. 2009b).

As with all exemptions, the goal is to either reduce lead content or replace lead-containing aluminium alloys altogether. Since the implementation of the ELV Directive, many efforts have gone into lead concentration reductions, from an original maximum 2% lead by weight to the current 0,4% lead by weight.

Lead reduction

Much information on this topic was supplied but no supporting evidence was provided. Some references were made to previously supplied data from the last consultation (ACEA et al. 2009a; ACEA et al. 2009b).

Stakeholders claim that 0,4% lead by weight is the minimum value that can be reached by the automotive industry. Lower concentrations are said to lead to reduced machinability through sticking effects, reduced form and flow ability as well as increased tool wear. It is explained that the higher lead concentrations are necessary for complicated machining (small deep hole drilling, small grove milling, etc.). No evidence was provided to support these claims.

Furthermore, stakeholders argue that even if lead concentrations could be reduced from the industry's point of view, concentrations could only be reduced by diluting secondary scrap with primary aluminium. This would in turn create enormous pressures on primary aluminium production. For example, if the average concentration was to be reduced from 0,2% to 0,1%, an additional 1,3 million tonnes/year of primary aluminium would be required to achieve this in the automotive industry alone. Stakeholders argue that this would be a waste of resources and energy, considering that lead in aluminium has no environmental or health impact. Furthermore, such a dilution is said to be impossible given that demand for primary aluminium already surpasses production by 200 000 tonnes according to supply-and-demand models. No supporting evidence was provided to support these claims.

No new information on the possibility of separating lead from scrap aluminium was provided. However, previous consultations provided two studies from the 1990s (Tailoka & Fray 1993; Tailoka et al. 1994) indicating that research in this direction was underway and seemed promising on small scales. It was argued that these technologies are expensive and create too much chlorine waste. Currently, no other methods are known but investigation into other possible technologies is said to be starting soon. In this context, the Organisation of European Aluminium Refiners and Remelters (OEA) is elaborating an overview on current studies and research related to lead removal from scrap aluminium. The results should become available at the end of 2010 (ACEA et al. 2009b).

Alternative alloys

From what stakeholders have indicated, it would seem that a bismuth-lead aluminium alloy (AlCuBiPb, i.e. AA 2011) is used to substitute aluminium alloys that used to contain 0,7%–1,5% lead (ACEA et al. 2009a). According to its definition, AA 2011 contains 0,2%–0,6%, but only material containing less than 0,4% is used by the automotive industry.

However, the current conclusions from stakeholders stated that some applications of AA 2011 alloy have been replaced by to lead-free alternatives e.g. AlEco62Sn or AA 6023 (AlMgSiSnBi) (ACEA et al. 2009b). They argued also that during the next years it might be possible to introduce some more lead-free materials in automotive application.

No further research in regards to completely lead-free alloys or to alloys containing even less lead are available.

4.2.4 Critical review of data and information

Overall, it should be stated that detailed fact and figure based supporting evidence is lacking.

Lead reduction

Arguments made on scrap dilution are plausible and reliable. The contractor supports the notion that diluting aluminium scrap with primary aluminium to reduce lead concentrations is unreasonable.

One of the main issues with this solution is that it does not reduce the absolute amount of lead in circulation in the sector. It would also require very large amounts of energy as the amount needed to produce primary metal is 20 times higher than the amount needed to produce secondary aluminium. Data provided by stakeholders in previous consultations[11] indicated that recycled aluminium requires 2,9% (for remelted scrap) and 8,2% (for refined scrap) of the energy required to produce primary aluminium.

On the same topic of lead removal from scrap aluminium, the previous contribution had provided 15-year-old publications confirming that in small scale experiments it was possible to energy-efficiently (i.e. less than 0,5 kWh/kg of purified aluminium alloy) remove lead from aluminium by the electrochemical addition of sodium or potassium (Tailoka & Fray 1993; Tailoka et al. 1994). However, up-scaling this method form small scale laboratory experiments to industrial scale applications was considered to be difficult, thus confirming the industry position that the research activities have not yet produced practicable solutions for industry applications. It was claimed by stakeholders that these solutions had proved too expensive and lead to problematic chlorine releases from the lead removal process.

[11] EAA Energy figures primaryrecycled.xls

Regrettably, no newer information was provided on these issues, although explained that the chlorine release and high energy demand could be overcome by electro refining sodium from the sodium-lead and aluminium-sodium alloys (Tailoka & Fray 1993).

No data was provided to support the claim that aluminium demand is 200 000 tonnes higher than production can supply. A short investigation on the contractor's part found no mention of aluminium shortages in global production according to (Bray 2007).

Furthermore, no data was provided to support that machining properties would be too severely affected to allow a reduction of lead concentrations.

Alternative alloys

Overall, it is regrettable that so little evidence was provided, as only extensive evidence enables the contractor to definitively and precisely evaluate the necessity of an exemption. Stakeholders indicated that no studies of the type requested were available and could thus not be provided. Furthermore, the industry was unable to indicate what aluminium applications strictly required the use of 0,4% lead. Short reference was made to an alternative alloy already being used, which seems to have allowed the reduction from 0,7-1,5% leaded aluminium to 0,2%–0,4% leaded aluminium. However, no details were given on which applications technically require 0,4% while the majority was stated to use an average 0,18%–0,20% lead concentration. The question on possibilities to reduce the maximum concentration value for a majority of the applications while leaving it at 0,4% for a definite number of applications thus remains unanswered.

Since it was mentioned that the AA 2011 alloy has been changed to lead-free alternatives (e.g. AlEco62Sn or AA 6023 (AlMgSiSnBi)), a future use of lead-free aluminium alloys seems possible. AlEco62Sn is the first lead-free aluminium alloy which for example BOSCH had homologated for their applications. In the next years, researchers will keep developing new lead-free materials with the same quality characteristics as leaded aluminium alloys. A review of the exemption in due time – once more practical experience has been gained – is thus considered useful.

4.2.5 Final recommendation

As explained previously, the automotive industry was unable to provide necessary detailed evidence to support their claims that reductions of lead concentrations in aluminium alloys are not feasible. Even though lead-free substitutes are already used in some applications, the automotive industry could not support large efforts for a complete or majoritarian switch to lead-free alternatives.

The contractor cannot support an unconditioned further extension of this exemption without further evidence and duly recommends a review date 5 years after a revised Annex II comes into force. This period of time should allow industry stakeholders to gather the missing evidence and studies supporting their claims.

4.2.6 References

ACEA et al. 2009a — ACEA/JAMA/KAMA/CLEPA/EAA/OEA et al. joint stakeholder response document “20090804_Global Al_exe 2c.pdf”

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GHK 2006 — GHK, in association with Bio IS; A study to examine the benefits of the End of Life Vehicles Directive and the costs and benefits of a revision of the 2015 targets for recycling, re-use and recovery under the ELV Directive; 2006

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Schrader Group 2009 — Schrader Group response document “20090803_SEL response ELV consultation ex2c and 3.pdf”

Tailoka & Fray 1993 — Tailoka, F. & Fray, D.J. (1993); Selective removal of lead from aluminium

Tailoka et al. 1994 — Tailoka, F. et al. (1994); Electrochemical removal of lead from aluminium using fused salts

WGM 2009 — WGM and the VDM response document “Stakeholder Consultation ELV und RoHS Position WGM und VDM.pdf”