Comments on the Exposure Assessment Part of RoHS Annex II Dossier for Diantimony trioxide (flame retardant) Restriction proposal for substance in electrical and electronic equipment under RoHS

15 January 2020

Final Report

D. Vetter, T. Bodenschatz & Dr. K. Lippert
EBRC Consulting GmbH
Raffaelstr. 4
30177 Hannover
Germany

Table of contents

1 Introduction

In December 2019, Oeko-Institut published an Annex II Dossier for diantimony trioxide (ATO) to assess whether there is a need to restrict the use of ATO in electric and electronic equipment in the EU. The assessment for ATO was performed as part of the "*Study on the review of the list of restricted substances and to assess a new exemption request under RoHS 2 – Pack 15*" (Oeko-Institut, 2019).

EBRC was commissioned by the International Antimony Association (i2A) to review and comment on the exposure assessment related sections, i.e. Section 6 "Exposure estimation during use and during WEEE treatment" and Section 7 "Impact and risk evaluation".

Based on this review two major points of critique are addressed in this document and can be summarised as deficiencies in (i) derivation of exposure estimates for workers involved with WEEE recycling and in (ii) the comparison of these estimates with national OELs for ATO in the EU.

2 Deficiencies in derived exposure levels

The authors conclude that

> "an impact on workers in the formal WEEE recycling by ATO is inconclusive"

based on an apparent inconsistency between the results derived by the authors by using ECETOC TRA (a first tier exposure assessment tool), the summary statistics published by IFA (2017) on their website and the results of an exposure sampling campaign published in a peer-reviewed article (Julander et al., 2014). These results are therefore examined below.

2.1 Modelled exposure levels by Oeko-Institut (2019)

The authors used the ECETOC TRA tool for exposure estimation despite their assessment that the tool may not be suitable for the processes associated with WEEE recycling

> *("The ECETOC TRA tool is intended for manufacturing and formulation processes. Hence, appropriate processes to describe the exposure conditions of waste treatment processes do not yet exist.")*

and derived a reasonable worst-case exposure level of 0.42 mg ATO/m³. A description how the exposure assessment tool was selected and why the ECETOC TRA tool was considered most appropriate is however lacking. It is noted that more suitable exposure assessment tools could have been used instead such as the MEASE tool that is particularly developed to assess particulate exposure to inorganic substances.

In addition, the assessment conducted in ECETOC TRA has deficiencies as well:

a) Although the authors describe that waste treatment plants must follow strict occupational hygiene rules including local exhaust ventilation (LEV), such LEV was not considered in the assessment.
b) Although WEEE treatment in the EU is operated in highly controlled facilities (see point above), the authors assessed the associated processes as being at the non-industrial (i.e. professional) scale.
c) The concentration of ATO in the shredded material (i.e. plastic articles) was considered as exclusively antimony containing articles were treated (i.e. concentration of antimony in plastic articles considered). However, since there is a sorting process after shredding (as also described by the authors) that distinguishes antimony containing waste from other waste, it is clear that the concentration of antimony must be significantly lower in the material that is sent to the shredding process (because of the other waste that does not contain antimony). It is believed that the antimony concentration in the materials to be shredded is significantly below 1 % (this is because the sorting wouldn't be economically viable otherwise).

Because of the questionable appropriateness of the tool used and the incorrectly selected model parameters, this assessment is considered of very low evidence.

2.2 Measured exposure levels by IFA (2017)

The authors report exposure levels as summarised by IFA (2017) in a not peer-reviewed report published on the IFA website. The authors report the 37th percentile of 0.0075 mg/m³ and the 95th percentile of 0.011 mg/m³ for a dataset of n=43 values from the general waste disposal sector.

However, when reviewing the referenced data set it becomes clear that only 2 measurements are potentially relevant for shredding processes in EEE recycling (see page 8 of the IFA-report: “Workplace: EEE-Recycling, Shredding, generic” given in original German language: “Arbeitsbereich: Elektronikschrott-Recycling, Zerkleinern, allgemein”). The actual values for the 2 data points are however not reported.

Because the values of the relevant data points (n=2) are not reported, this data set cannot be used for risk assessment.

2.3 Measured exposure levels by Julander et al. (2014)

Julander et al. (2014) reports measured personal exposure levels (n=77) in the range of 0.004 µg/m³ - 1.1 µg/m³ for e-waste recycling plants in Sweden. The authors take account of these data and conclude that the even the maximum(!) measured exposure levels are well below the strictest OEL for antimony trioxide in the EU but relativize that

> “[…] *it is not known whether the workplaces examined by Julander et al. (2014) have different protection routines than other facilities in the EU*”.

It is noted that it is not required that all plants have the same protection routines rather than having protection routines implemented that provide a comparable level of exposure control. Since the authors themselves state

> *“In Europe, it is a precondition that recycling plants are equipped with proper ventilation and that the protection of workers is ensured.”*

it is not understandable why this should not be the case for ATO.

Because of the comprehensive and peer-reviewed nature of the dataset, as well as its specific relevance for recycling of e-waste, this study is considered as being highly relevant for exposure estimation for workers involved in recycling of EEE articles.

3 Comparison with national OELs in the EU

In Section 7 of their report, Oeko-Institut concludes on the risk for workers in recycling plants:

> *"The potential exposure as estimated by ECETOC TRA indicates a risk exceeding the occupational exposure limits. The results obtained by ECETOC indicate that risk management measures such as proper ventilation have to be installed."*

Both sentences are misleading: It is common sense that there is always some remaining risk for workers when hazardous substances are being handled and it is also well known that exposure during e-waste shredding activities by workers should be controlled by LEV (amongst other occupational hygiene measures). The increase in knowledge by referencing the results of an assessment based on the erroneous use of a superficial first tier screening model (see Section 2.1) is therefore close to zero.

Instead, conclusions should have exclusively been drawn based on an available and peer-reviewed set of monitoring data by Julander et al. (2014) that is specific to the activities conducted by workers in e-waste recycling. The fact that LEV was not present during all operations for one of the three sites that were monitored is highlighting the very low risk associated with such activities (the maximum exposure level was reported at 1.1 µg ATO/m³ for the inhalable fraction) instead of supporting Oeko-Institut's argumentation that such settings could lead to risk that are not reflected in the data set.

Finally, there is a high degree of neglection in Oeko-Institut's report of the nature of the referenced national OELs, which manifests in two important types of information:

Firstly, OELs are cited as being relevant for ATO without consideration of the fact that most of the existing OELs are given as mass antimony per volume air (e.g. mg Sb/m³). Thus, estimates derived with ECETOC TRA cannot directly be compared with such OELs as the model estimates represent substance-exposure (i.e. mg Sb_2O_3/m³).

Secondly and of much higher relevance, the fraction of dust (according to EN 481) is neither reported nor considered for the OELs. Since all reported exposure levels (i.e. ECETOC TRA, IFA, Julander et al.) refer to the inhalable fraction, they cannot directly be compared with OELs given for the respirable fraction as is the case for the German OEL, which is also the lowest OEL referenced. Vetter (2018) calculated factors for converting inhalable exposure levels into respirable levels relevant for the ATO industry. The suggested overall conversion factor was derived at 5.

Thus, when converting the maximum exposure level reported by Julander et al. (2014) for the inhalable fraction of dust of 1.1 µg Sb/m³, the respirable equivalent exposure concentration would be calculated at 0.22 µg Sb/m³.

4 Conclusions

In the current document, several deficiencies in Oeko-Institut (2019) are identified. Most important is the missing weighing of evidence of available exposure data. As discussed in Section 2, Julander et al. (2014) represents the only data source that contains a comprehensive exposure data set (n = 77) that is specific for worker's activities related to e-waste recycling. Based on such strong exposure evidence, it can only be concluded that risks are well controlled even when the maximum exposure level of 0.22 µg Sb/m³ (converted to the respirable fraction) is compared with the lowest national OEL in the EU of 6 µg Sb/m³.

5 References

EN 481:1993, Workplace atmospheres — Size fraction definitions for the measurement of airborne particles.

IFA Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung (n.y.): MEGA-Auswertungen zur Erstellung von REACH-Expositionsszenarien für Diantimontrioxid sowie Antimon und seine Verbindungen, außer Antimonwasserstoff; https://www.dguv.de/medien/ifa/de/fac/reach/mega_auswertungen/antimon.pdf

Julander et al. (2014): Anneli Julander, Lennart Lundgren, Lizbet Skare, Margaretha Grandér, Brita Palm, Marie Vahter, Carola Lidén, Formal recycling of e-waste leads to increased exposure to toxic metals: An occupational exposure study from Sweden, Environment International, Volume 73, 2014, Pages 243-251, https://doi.org/10.1016/j.envint.2014.07.006

Oeko-Institut (2019): ROHS Annex II Dossier for Diantimony trioxide (flame retardant). Restriction proposal for substances in electrical and electronic equipment under RoHS. Report No. 1, Substance Name: Diantimony trioxide (flame retardant), EC Number: 215-175-0, CAS Number: 1309-64-4, Version 2, 04/12/2019. Oeko-Institut for Applied Ecology

Vetter (2018): Daniel Vetter, Antimony metal and Antimony Substances – Derivation of a Conversion Factor for Exposure Levels of Respirable Antimony Dust from Measurements of the Inhalable Fraction, Final Report, December 2018