CAN DIFFUSE SOURCE ANALYSIS HELP TO PRIORITISE CHEMICALS RISK MANAGEMENT FOR METALS?

Hugo Waeterschoot[1], **P. Van Sprang**[2], **V. Verougstraete**[1], **K. Oorts**[2]
[1] ***EUROMETAUX, Brussels, Belgium,*** [2] ***ARCHE, Ghent, Belgium***
Waeterschoot@eurometaux.be

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Introduction

Emission sources of metals refer to what eventually ends up in collecting environmental compartments like water, soil and sediment. Contrary to the point emissions resulting from manufacturing and uses of a metal (e.g. galvanizers), diffuse emission sources consist of a wide variety of anthropogenic non-point sources like releases from products, unintended emissions (e.g. metals from energy production), transport, agriculture, etc. . Diffuse sources are together with the natural background responsible for the "regional background" concentration in the environment, a key parameter in chemicals management risk assessment. An in-depth inventory of diffuse sources by the metals sector at EU scale confirmed the relative importance of the anthropogenic fraction of the regional background. For some metals, this fraction can be as large as 80 % of the allowable exposure in water, soil or sediments, often dwarfing the local emissions of metal manufacturing and use. Understanding the origin and contribution of different emission sources to the regional background, is therefore a key factor in defining priorities for exposure reduction or risk management, where relevant.

Methods

Extensive point and diffuse sources datasets including product release estimates and releases from non-intended uses, as well as measured monitoring values in EU waters, soils and sediments for base metals were collected in the metals risk assessments part of the Existing Substances Regulation (ESR, EC No 793/93) and in the registration dossiers under the European REACH regulation (EC, 1907/2006).

Natural background values for metals in aquatic systems were defined in the EU ESR Dossiers while a very comprehensive mapping of background values for more than 15 metals in soils was conducted by the Geochemical Mapping of Agricultural and Grazing land Soil (GEMAS) Project, which aimed at collecting high quality data on metals concentrations and parameters that determine the bioavailability.

The partial contribution of the metals diffuse sources to the overall regional background is estimated by comparing the calculated diffuse sources with an estimate based on monitoring data minus the natural background. The respective contributions of the different types of diffuse sources to a given compartment (e.g. run off from corrosion, releases from tires, …) are then compared to each other to determine how large the various contributions are. An understanding of the driver behind an individual diffuse emission source (e.g. SO_{2-} based run off, metal concentration and wearing/km driven) helps to understand the potential for risk management by further exposure reduction and consequently the prioritization for chemicals management.

Results

An overview of the total combined regional emissions for 9 metals in the EU demonstrates the large differences between different metals and in general the large relative contributions caused by agriculture (e.g. Cu, Zn, Ni, Co and Cd), while also traffic releases can be extensive (e.g. Cu, Zn and V).

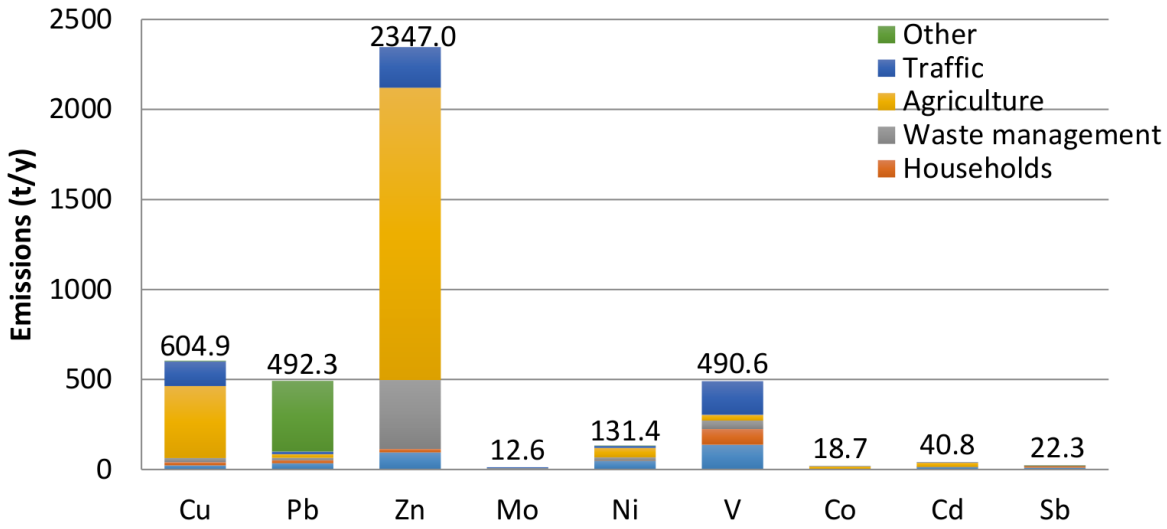

Figure 1: Overview of the total regional emissions for the different metals (sources for Cu, Pb, Ni and Zn are restricted to the original EU 15 countries)

Ni is a typical representative for metals with high relative releases from sources with no relationship to the manufacturing and use of the metal and its compounds. Indeed, 40% of the emissions originates from unintended impurities from organic and inorganic fertilisers for agricultural practices, while more than 35 % comes from unintended emissions from mainly energy sources. Product release contributions are relatively small and are part of the household (0.5%) and a small proportion of the waste management emissions (15%). Lead is almost the opposite and a quite unique case. While the emissions of manufacturing and use are small, the contribution from metal product use is very significant (almost 80%) and almost exclusively caused by hunting shot.

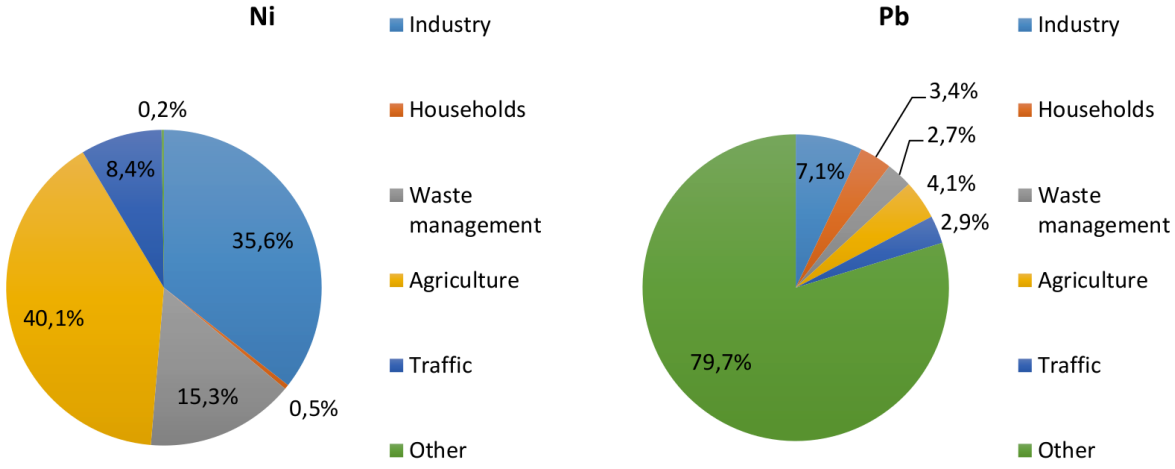

Figure 2: Detailed Relative contribution of different sources of Ni and Pb to the total emissions (%)

Aggregating all intentional and non-intentional releases by compartment for selected metals (figure 3) demonstrates the large differences in contribution from unintended sources compared to product releases and provides a view on the relative differences by receiving environmental compartments. Air for example is for Cu impacted by the releases from traffic (break pads …) while for soil agriculture is dominant as an unintended source.

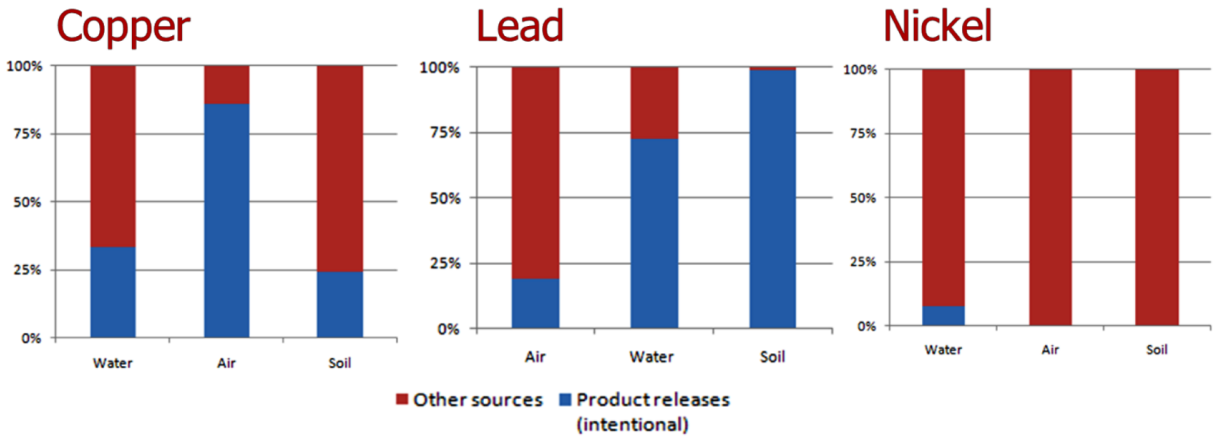

Figure 3: relative contributions from intentional product releases versus unintentional sources

Conclusion

The sum of the industrial emissions for metals do rarely contribute significantly to the regional background, although it can be locally of high relevance and importance. Releases from unintended sources, usually as an impurity, are often critical contributors to the regional emissions. Impurities in organic and inorganic fertilizers are "leading" emission sources at EU scale in general and more specifically for Zn, Cu, and Ni. Lead is the only metal where the product release contribution is dominant in the regional emission balance. A proper understanding of these selective contributions to the regional background and the factors that influence them (e.g. corrosion, fertilizer application rates etc.) allows to determine best options for potential exposure and risk reduction. Such a 'diffuse sources' analysis should be conducted per receiving environmental compartment, as the lead emission sources can be different. The poster will propose a framework for the assessment of metals diffuse sources in the context of chemicals risk management prioritization and present examples of metals that provide large and small contributions as a function of their use in products, unintended emissions, transport and others.

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