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Depollution benchmarks for capacitors, batteries and printed wiring boards from waste electrical and electronic equipment (WEEE)

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Highlights

- We’ve analysed data on the dismantling of electronic and electrical appliances.
- Ten years of mass balance data of more than recycling companies have been considered.
- Percentages of dismantled batteries, capacitors and PWB have been studied.
- Threshold values and benchmarks for batteries and capacitors have been identified.
- No benchmark for the dismantling of printed wiring boards should be set.

Abstract

The article compiles and analyses sample data for toxic components removed from waste electronic and electrical equipment (WEEE) from more than 30 recycling companies in Switzerland over the past ten years. According to European and Swiss legislation, toxic components like batteries, capacitors and printed wiring boards have to be removed from WEEE. The control bodies of the Swiss take back schemes have been monitoring the activities of WEEE recyclers in Switzerland for about 15years. All recyclers have to provide annual mass balance data for every year of operation. From this data, percentage shares of removed batteries and capacitors are calculated in relation to the amount of each respective WEEE category treated. A rationale is developed, why such an indicator should not be calculated for printed wiring boards. The distributions of these de-pollution indicators are analysed and their suitability for defining lower threshold values and benchmarks for the depollution of WEEE is discussed. Recommendations for benchmarks and threshold values for the removal of capacitors and batteries are given.

Introduction

SENS and SWICO organise the Swiss take-back systems for WEEE from consumers. Over

90% of the WEEE from private consumers is collected and treated under the control of one of these two take back schemes (Müller and Widmer, 2010). The two recycling systems in Switzerland already existed in the 1980ies. They cover categories of appliances without the strict separation into B2B and B2C appliances as defined in the WEEE directive. For example, SWICO collects all computers regardless of their origin. The control bodies of the two schemes cooperate and have implemented joint monitoring schemes to achieve efficient and comprehensive control of the operations of recyclers and manual dismantlers. Indicators for the separation of hazardous components have been developed as one control instrument and these indicators have been recorded for ten years at the time of writing.

As far as we are aware, from our own research and also from statements in recent articles (Salhofer and Tesar, 2011), there have been no publications so far of data sampled in daily recycling operations on the percentages of hazardous components in WEEE over a larger time scale. Several technical reports exist from the Swiss take-back scheme SENS (SENS, 2011). Mean sample values for capacitors and batteries have been reported. The annual report by the French take-back system Eco-systèmes contains detailed figures about toxic components removed from WEEE (Eco-systèmes, 2011). Morf et al. (2007) investigated the chemical composition of WEEE from one recycling plant, including manual dismantling of capacitors and batteries. With many recently implemented take back schemes throughout Europe and current efforts to harmonise technical guidelines on a European level by the LifePlus project WEEELABEX (Weeeforum, 2012), the question how to define and record depollution indicators and how benchmarks can be set for depollution becomes important for many take back schemes.

This article will illustrate the definition of depollution indicators by an experienced conformity assessment body. It will further examine the benefits and shortcomings of these indicators. It will also develop a methodology to set lower threshold values and benchmarks for the depollution of batteries and capacitors. Finally, some anomalies found during data analysis will be explained.

Section snippets

Data base

All recyclers operating under a contract with one of the Swiss take back schemes have to provide annual mass balance reports to the technical control bodies of the two take back schemes (SENS and SWICO, 2010, SWICO, 2013). The collection of annual mass balance data has been jointly implemented since 2001. All input and output data including stocks at the beginning and end of year on all operations related to WEEE are included in one annual record per recycler. Records from 2001 to 2010 were…

Distribution analysis

The histogram in Fig. 2 shows the distribution of the battery indicator in grey bars and the fitted normal distribution as black line. In Fig. 3, the densities for the trimmed log–normal distribution are plotted on the histogram for the capacitor indicators. Histograms for battery and capacitor indicators show the lower threshold value as a dotted vertical line.

The distribution of the battery indicators follows a normal distribution almost ideally, as it can be seen in the histogram in Fig. 2.…

Discussion and conclusions

After assessing the overall quality of the data in annual reports, it became obvious that a significant number of recyclers have problems with their reporting system and sometimes provide questionable annual mass balance data. Several depollution indicator values had to be excluded and some outliers still remained in the data selected. The authors know from personal experience, that the external quality assurance of annual

mass balance data is a complex and time consuming task that needs…

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Glossary

Batch
: “Manual or mechanical processing of a definite and well-defined amount of WEEE or fractions thereof to determine the yields and compositions of the resulting output fractions and depollution performance“ (Weeeforum, 2011)

SENS
: SENS Foundation Switzerland

SWICO
: Swiss Association for IT and Communication technology

PCB
: Polychlorinated biphenyls

PWB
: Printed wiring board(s), Printed circuit board(s)

LHA
: Large household appliances

CFA
: Cooling & freezing appliances

ITCE
: Information technology, communications

Recommended articles

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There are more references available in the full text version of this article.

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Emerging trends in consumers' E-waste disposal behaviour and awareness: A worldwide overview with special focus on India

2017, Resources, Conservation and Recycling

> *Citation Excerpt :*
>
> ...The fundamental reason for the success of E-waste management initiatives in the country has been its responsible, environmentally conscious and law abiding consumers who return their discarded appliances to the designated retail-outlets or collection points or directly transport E-waste to the recyclers at regular intervals. Further, SENS and SWICO (as the two Producer Responsibility Organizations in Switzerland), are the core of Swiss E-waste take-back system (Hischier et al., 2005) with over 90% of the E-waste from private consumers is collected and treated under the control of one of these two take back schemes (Savi et al., 2013). Financed by an Advanced Recycling Fee (ARF) that the consumers pay while purchasing their EEEs, comprehensive take-back and recycling systems have been established by both SENS and SWICO (Hischier et al., 2005)....

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