

HAZARD TRAFFIC LIGHTS AND TOTAL HAZARD POINTS: TWO LEGISLATION-BASED METHODOLOGIES FOR RISK ASSESSMENT OF MATERIALS

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Keywords: CPL regulation, Hazard statements, Lead, Seveso III Directive, Titanium

Introduction

The growing concern about environmental and health safety has resulted in the EU passing a number of laws on the subject. The classification, packaging and labeling (CPL) regulation (EC, 2008) has made freely available information facilitating the identification of hazardous materials. Here we introduce two methodologies for ranking products and materials according to their safety based on the CPL regulation and the Seveso III directive (EU, 2012).

Methods

Hazard Traffic Lights (HTL) is a qualitative visual procedure to quickly identify the potential risks of a material based on hazard statements. Total Hazard Points (THP) is a quantitative method for weighting the different hazards related to a product. THP is based on the method developed for the German Environmental Agency (UBA; Stahl et al., 2016). This methodology uses the lower tiers (LT) quantified in the Seveso III directive to rank hazards, assigning one hazard per material. THP however, includes all materials and hazards. A full description of both HTL and THP can be found in (Rodriguez-Garcia et al., 2016). There we applied HTL and THP to nine different batteries described Stahl et al. (2016).

Results

An example of HTL can be seen in Table 1. There all hazards identified for Pb and Ti appear in a traffic light fashion, using red to indicate hazards with the word “Danger,” yellow for those with “Warning” and gray for those without a hazard word. As statements like “non-hazardous” are inconsistent with the CPL regulation, there is no green light, only blank—not reported—hazards. Several physical hazards can be associated with Ti, while Pb is mostly hazardous to human health. As a qualitative method, HTL is not ideal for ranking products and even the comparison between materials should be handled with care, preferably only with materials fulfilling a similar function. Still, Table 1 suggests Pb to be a more hazardous metal than Ti—e.g. it is a suspected carcinogenic and mutagenic, and a confirmed toxic to reproduction.

Table 1. Hazard traffic light (HTL) for Pb and Ti

		Pb	Ti
Physical hazard	Explosive		
	Flammable		Danger
	Oxidizer		
	Gases under pressure		
	Self-reactive/organic peroxide		
	Pyrophoric		Danger
	Self-heating		
	Water reactant		Danger
	Corrosive to metals		
Human health hazard	Acute Oral toxicity	Danger	
	Acute Skin toxicity	Warning	
	Acute Respiratory		
	Irritant Skin		Warning
	Irritant Eye		Warning
	Sensitization		
	Germ cell mutagenicity	Warning	
	Carcinogeny	Warning	
	Reproductive toxicity	Danger	
	Specific target organ toxicity (single exposure)	Warning	Warning
Specific target organ toxicity (repeated exposure)	Danger		
Aspiration hazard			
E.	Hazardous to the aquatic environment	Warning	Danger
	Acute Chronic		

Danger
Warning
No hazard word

Table 2. Total hazard points (THP) for Pb and Ti, as part of a 1 kWh battery and per kg.

		Pb	Ti	Pb	Ti
		LT	HP(g)/kWh	HP(g)/kg	
Physical haz.	H228	50	107	20	
	H250	50	107	20	
	H251	10	533	100	
	H260	100	53	10	
	<i>Subtotal</i>		799	150	
Human health hazard	H301	50	525	20	
	H315	50	107	20	
	H319	50	107	20	
	H332	100	262	10	
	H335	100	53	10	
	H341	10	2624	100	
	H351	10	2624	100	
	H360	5	5247	200	
	H371	100	262	10	
H372	100	262	10		
<i>Subtotal</i>		11806	266	450	50
Env. haz.	H400	100	262	10	
	H410	100	262	10	
	H413	200	27	5	
<i>Subtotal</i>		525	27	20	5
TOTAL		12330	1092	470	205

When applied to products with different characteristics, THP has to be referred to a common metric. In the case of batteries, we used 1kWh of energy stored. Lead-acid are the most hazardous batteries evaluated. Lithium Titanium Oxide-Lithium Iron Phosphate (LTO-LFP) rank average, although they are the most hazardous of the four lithium-ion batteries assessed. (Rodriguez-Garcia et al., 2016) Pb and Ti respectively are responsible for most of their potential hazards. The THP of these two metals can be seen in Table 2, first for a 1 kWh battery, then for 1 kg. The latter suggest that Pb is more than twice as dangerous as Ti—470 vs. 205 HP(g). However, because lead-acid batteries have less energy density than LTP-LFPs, Pb is far more hazardous than Ti when the amounts required to store 1kWh are taken into account—12333 vs. 1092 HP(g).

Conclusion

HTL and THP are two methods that allow a quick identification and quantification of potential hazards derived from materials. Our next step is to combine them with probabilistic indicators for Risk Assessment.

References

- EC. Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (2008).
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