

Answers sent 16 September 2022, 09:52:

Further to your request for contribution, please see my comments below, to the questions.

To understand who Balcan Engineering Ltd are, we are one of the largest lamp recyclers in the UK, who also design and manufacture lamp recycling systems which are sold throughout the world. We have recently launched what we believe to be the worlds first specific LED lamp recycling system, which we are using ourselves, so our comments are based around the outputs and results from the system.

The RoHS Directive sets the maximum concentration value tolerated by weight in homogeneous materials for cadmium (Cd) to be 0.01% (100 ppm) (European Parliament and Council 2011). The past assessment recommends an exemption for quantum dots on LEDs in lighting and display applications with maximum concentration value to be 1.000 ppm or 5 µg Cd per mm<sup>2</sup> of light emitting LED chip surface. *“The mass of all LEDs is only 275 mg or 0.32% of the total mass of the retrofit lamp. [...] The liberation of basically undestroyed LED packages from the LED panel during EHF (electrohydraulic fragmentation) of LED lamps is an additional benefit paving the way for a future recovery of the valuable materials”* (LED professional - LED Lighting Technology, Application Magazine 2016).

1. Please estimate the share of LED lamps and/or the share of displays that are collected in the EU and subjected to proper treatment at WEEE facilities.

The current estimate for LED lamps coming through the UK waste stream with other lamps is approx.. 5% . These are usually mixed with traditional lamps. I believe in some EU countries this share can be 10%

2. Which are the expected treatment routes of applications containing Cd-QD at the end-of-life stage (e.g., lighting equipment and displays)? Please explain which of these applications is collected separately and which are treated with mixed WEEE, and what treatment stages are performed for each fraction.

It is not a practical or commercially viable option to try and separate the LED chip containing Cd-QD from the rest of the lamp. This process can really only be done at lab level as a sample operation.

LED currently collected are typically already mixed with other traditional lamps. Our lamp recycling system allows us to process LED with other lamps without separating them. The design of our system means LED's do not damage it. The outputs of the screened LED along with other lamp components are then put through the Balcan LED processor.

Our processor shreds the components prior to separation of the main fractions. Fractions are: Aluminium, ferrous, plastic and glass (where present).

3. Is Cd extracted and recycled from such applications, or alternatively, what is the fate of Cd in recycling practices of e.g., lighting equipment, displays in the EU?

The Balcan system operates under negative pressure to control dust emissions. Our system is also fitted with a suitable carbon filter to control mercury emissions from post processing tradition lamp components. As cadmium is similar chemically to mercury any cadmium vapours generated through the recycling process will be controlled so none should exhaust to atmosphere. Cd is not separately collected during this process as it is not practical to do so. The term LED recycling refers to recycling the lamp or fitting, but not the actual chip.

4. What is the risk for Cd emissions during end-of-life treatment stages for each of the cases referred to above?

Using a Balcan processor there should be no Cd emissions as it operates under negative pressure.

5. How would a higher concentration of Cd influence the treatment of e.g., lighting equipment, displays when treated separately or when treated in mixed WEEE?

As it is not possible to remove LED chips from lamps and fittings Cd-QD is purely diluted within the output fractions, unless it is displaced during the shredding process and taken off with the filtration system.

6. Marwede et al. (2012) explain that LEDs contain high amounts of critical raw materials (e.g., gallium, rare earth elements) and that it could be relevant to ensure their recovery from such applications in the future. Should an exemption for Cd QD applications be granted, increasing the amount of Cd in mixed WEEE fractions/lamp fractions/display fractions in the coming years, do you consider that this could create an obstacle to better extraction of rare earths in the future?

Currently I am not aware of any company operating a rare earth recovery system specifically for RE from lamps. However, there are two companies who have the technology to do so. I am not aware whether Cd will affect these technologies.

Best regards

Alistair Rinfret

Alistair Rinfret  
Managing Director



Balcan Engineering Ltd  
Banovallum Court  
Boston Road Industrial Estate  
Horncastle  
Lincolnshire  
LN9 6JR  
United Kingdom

Additional information sent 16 September 2022 15:09:

In addition to my answers below and having spoken to one of the RE recovery companies, the cadmium in the chips will not affect the recovery of the rare earth metals. However, there would have to be a further treatment processes for the effluent to ensure that if there is any cadmium that is dissolved, this is recovered.