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Thermal speciation of mercury in lighting residua

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The thermal speciation of mercury contained in phosphor powder residues from spent fluorescent lamps has been measured, with the aim of establishing the temperature of release of the element from the accompanying vitreous stuff. The studied residua came from a recycling industry, and included undetermined mixtures of material coming from fluorescent lights and from low-consumption bulbs, grinded to a grain size < 2 mm., and not containing other material than the glass fragments.
Determinations were carried out using a Lumex RA-915M device, coupled with a PYRO-915+ pyrolysis unit, and the specific software needed to perform thermal ramps. Previously, total concentrations of the elements were determined, using the same analytical array, in total contents mode. In order to optimize the process, we have tested different possibilities, finding the following best parameters:
- Heating rate: 0.74 ºC sec-1
- Heating range: 35ºC-660ºC
- Sample mass: 20 mg
- Air flow at pyrolizer: 3 L min-1
- Cooling time (delay between successive determinations): 40 min.
The five samples analyzed had total mercury concentrations between 125.4 and 151.3 mg kg-1, being the measured concentrations relatively homogeneous.
The thermal speciation assessment unveiled the presence of three species, with the following releasement temperatures:
- Species 1, released between 35 ºC and 120 ºC. Probably corresponding to metallic mercury.
- Species 2, released between 165 ºC and 350 ºC. Probably corresponding to Hg2+.
- Species 3, released between 350 ºC and 660 ºC. Probably corresponding to mercury trapped in particulates, or in the glass structure.
Different samples showed different desorption profiles, making evident differences in the proportions of different species among the studied residua.
Also interesting to note is the behavior of the Species 3: in detail, it is released following a “pop-corn” scheme, with peaks indicating a discontinuous process, most probably related with the breakdown of the glass particles hosting the element’s droplets.
The release of Hg species is total at 660 ºC, except for one of the samples, keeping a 0,39% of the original content after the desorption process.