Dangerousness determination of old paints on metallic bridges in AES

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Introduction

The French equivalent of the Highways Agency is the Laboratoire Régional des Ponts et Chaussées. This public institution is responsible for managing tenders concerning all aspects of road construction, including the maintenance of bridges and tunnels.
The French Highways Agency's main concern is that the maintenance is done as perfectly as possible for the purpose of quality assurance and to protect its reputation.
For example, the objective of this study was to research the exact quantities of heavy metals contained in the cleaning residue. In long terms, this study could downgrade it, in the legal point of view for the storage in waste reception center. In order to generate economical gain, the study has to both characterize waste, and validate a method to be used routinely.
The first interesting metal in this study is lead for its reducer power, against iron which composes bridge structures. Few other are expected, like zinc or chromium, which are also used as pigments in paints. Sandblasting is a technique that produces a dilution with a compound of silica.
In order to register the waste, the normalized assays are attentively used : NF EN 12457-2 for the leaching and NF ISO 11466 for the mineralization.

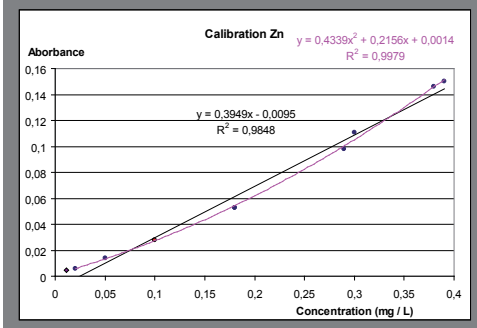
Experimental methods

Firstly, the samples were prepared. The liquid-solid ratio (L/S) of 10 L / kg was obtained, as the leaching norm specifies, in solubilising 90 g of waste, which consists in a powder, in 900 mL of quality 3 water. The flasks, used for the 24 h mechanic restlessness, were chosen in inert polyethylene (PE). Then, the liquid and solid were separated by a filter with a membrane of 0.45 µm pore diameter, this being facilitated by a vacuum pump.
At the same time, the mineralization was conducted by solubilizing 3 g of the sample with 21 mL of hydrochloric acid, then 7 mL of nitric acid drop by drop, in a 250 mL balloon flask. After 16 h at ambient temperature, the mixture was heated to boiling point during 2 h. Once the mixture had cooled, the solution was percolated on a filter paper in a 100 mL volumetric flask.
Secondly, 7 metals were analysed in the different filtrates by atomic absorption, using a calibration with 3 standards, prepared at 0.1, 0.2, and 0.4 ppm for zinc from a 1000 ppm solution.

Results and discussion

The graph in figure 1 shows that the measures of different samples follow a tendency clearly quadratic. Actually, the depicted regressions are established from the measurements obtained after calibration with standards of 0.1, 0.2, and 0.4 ppm. The constructor Varian makes so a good choice in realizing this kind of regression, which permit to cross a wide range of concentration more precisely.
A possible improvement is to determine the real absorption capacity of the sample because in view of the presence of this value in the final result :
$C=c\ (L/S+T_H)$ with c as the concentration (in mg / L), L/S as the liquid-solid ratio (in L / kg), and T_H as the humidity on dry material rate (in bulk portion).

Figure 1 : Zinc calibration curves



Black curve : linear regression
Pink curve : quadratic regression

C is the mass part that can be mobilized by leaching in water, with regards to dry mass (in mg / kg). In this case, the humidity rate does not represent the absorption capacity, on account of dry sample state, before the determination.
Few concentrations obtained after analysis can already rank the whole waste in class 1 ("dangerous waste") for storage, as defined by the legal threshold.
Moreover, the principal results does not allow to draw a conclusion at this stage on the storage class. An additional study on biological risks will be conducted in order to overcome the lack of information.
Concerning the mineralization, it presents data which allow correlating the tendency for characteristic paint metals : zinc, lead and chromium.

Conclusion

The choice to analyse the metal in paints is acute. Indeed, the waste of paints could be downgrade thanks to this study. The requirement of statistics on measurements is undisputable. In other words, each sample has to be treated separately because of the various quantities