

Proficiency testing on solid waste material, to support circular economy

Two proficiency tests (PT) were organized for the laboratories conducting analysis for solid waste samples:

- The total metals (As, Ba, Cd, Cr, Cu, Hg, Mo, Pb, V, Zn) were analyzed from fly ash (recycled fuel and wood) samples [1], and
- Two stage batch leaching test (EN 12457-3) was conducted for fly ash (wood-based) samples and metals (As, Ba, Cd, Cr, Cu, Fe, Mo, Ni, Pb, Sb, Se, Zn) and other analytes (Cl⁻, SO₄²⁻, F⁻, DOC, pH, conductivity, TDS) were analysed from the leaching eluates [2].

For the analyses of total metals in fly ash the participants were allowed to use different sample pretreatment methods (Figures 1 and 2). The results were pooled based on the pretreatment method and the assigned value was set for each group. Standard deviation for performance assessments was set to 15-20 %, depending on the measurand. In total, 90 % of the results were satisfactory, when assessed using z scores.

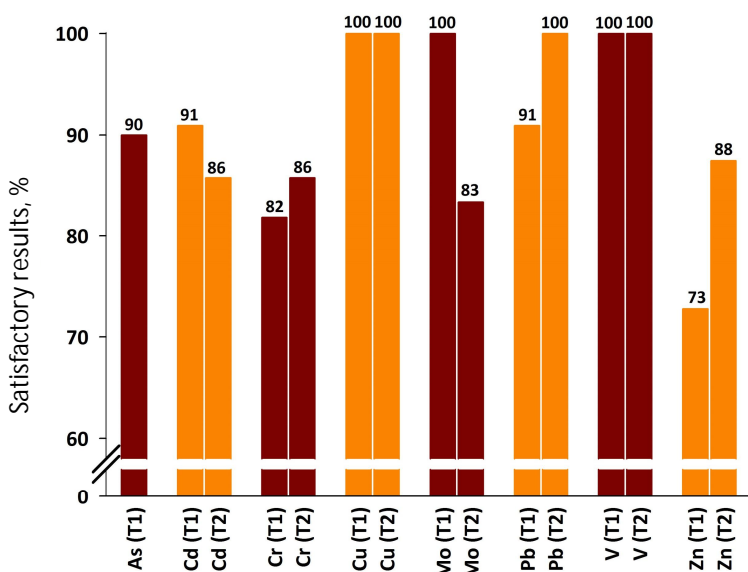


Figure 1. The percentage of satisfactory participant ($n_{all} = 18$) results for different metals in fly ash with pretreatments T1 (aqua regia) and T2 (nitric acid) [1].

In some cases, clear difference is seen between pretreatment methods, e.g. for Zn the pretreatment with nitric acid gave significantly more often satisfactory results than pretreatment with aqua regia.

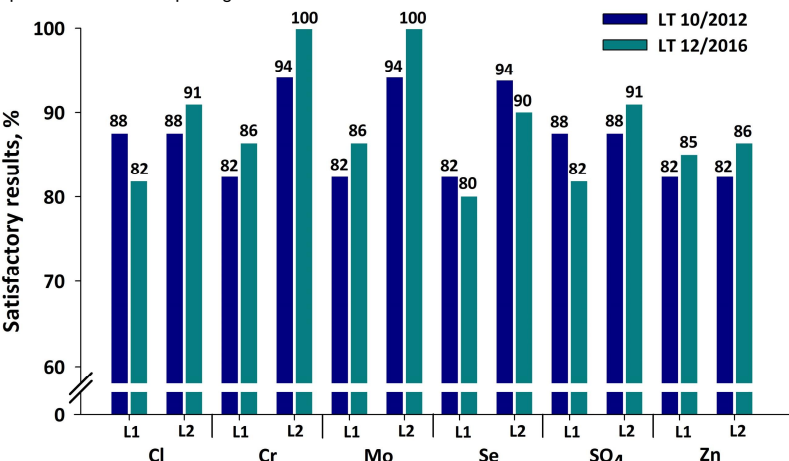


Figure 3. The performance of the participants in the proficiency tests for leaching test in years 2012 ($n_{all} = 19$) and 2016 ($n_{all} = 12$). L1 and L2 represent the two different water filtrates of the two stage batch leaching test [2,3]. The two stage batch leaching test is used as a compliance test when evaluating the environmental acceptability of the material (i) for waste landfill disposal, or (ii) for earth construction.

In the leaching test PT, 87 % of the results were satisfactory, for acceptance deviations set to 0.2 to 0.3 pH units or 10 to 40 % for the other measurands [2]. Slight increase was observed from 2012 when the overall result was satisfactory for 81 % of the participants [3] (Figures 3 and 4).

After the two stage batch leaching test, the participants were allowed to use different methods for the analyses of the leaching eluate [2]. Several analytical methods for the waste eluates are recommended in the standard EN 16192. Most of the participants applied these methods as such, or with minor modifications. To test the repeatability of the two stage batch leaching test, every participant received two blind replicate samples of the same material (Figure 4).

References

[1] Leivuori et al. 2017. Interlaboratory Proficiency Test 10/2016. Metals in waste water and recycled material. Reports of the Finnish Environment Institute 8/2017. helda.helsinki.fi/handle/10138/176910

[2] Koivikko et al. 2017. Interlaboratory Proficiency Test 12/2016. Leaching test for solid waste sample: Two stage batch leaching test. Reports of the Finnish Environment Institute 12/2017. helda.helsinki.fi/handle/10138/181510

[3] Björklöf et al. 2013. Proficiency test 10/2012. Leaching testing of solid waste sample. Reports of the Finnish Environment Institute 19/2013. hdl.handle.net/10138/39609

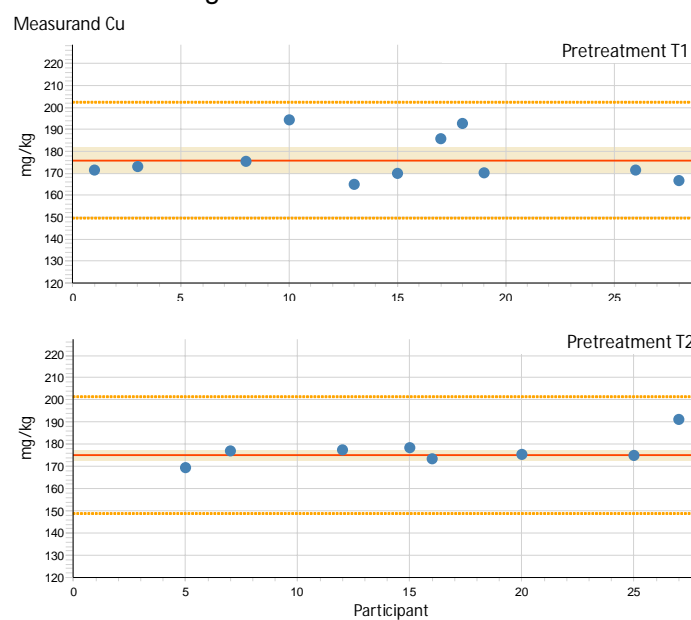


Figure 2. The results of participants for copper based on pretreatment with aqua regia (T1) and nitric acid (T2) in fly ash [1]. The dashed lines show the standard deviation for the proficiency assessment, the red solid line the assigned value, and the shaded area shows the expanded measurement uncertainty of the assigned value.

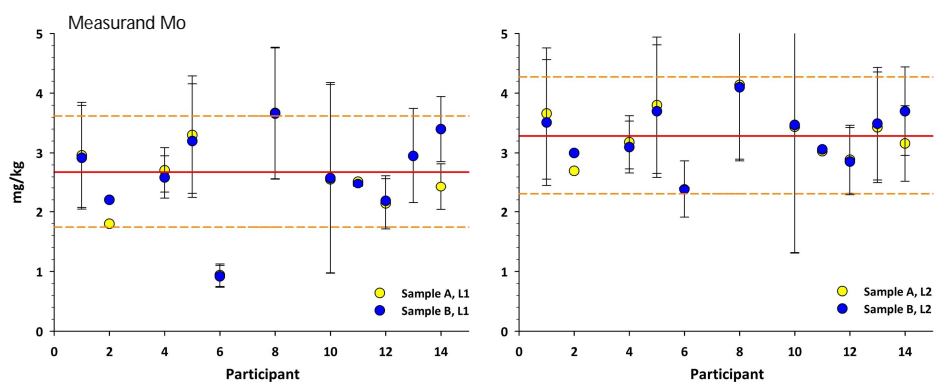


Figure 4. The results of two samples were treated as replicates. Nearly all replicate results differed less than the reported measurement uncertainty. Here, for molybdenum, only for participant 14 the difference of the replicate samples was higher, but both results were satisfactory (the dashed line is the standard deviation for the proficiency assessment and red solid line the assigned value).

CONCLUSIONS

- The overall performance for analysis of total metals was good, which reflects the high the quality of the laboratories and their competence to perform analysis on the recycled material often considered as complicated matrix.
 - Selected pretreatment method could lead to differing results for some metals.
- The results from the PT for leaching test on years 2012 and 2016 show good comparability of the results over the years and high long term competence of the participants.
 - The PT showed excellent repeatability of the leaching test.