# Optimized XRF Measurements to Estimate Cr Contamination in Ash and Leachate

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## Background

Incineration of the municipal solid waste is efficient in waste management, because of the large reduction in volume and the high energy recovery. During the incineration process, ash is produced along with flue gas and heat. After stabilization the ash is dumped into landfills, provided that the amount of hazardous elements is sufficiently low. Otherwise some ash contents can be washed away and carried to our natural water reservoir by the rain water.

*Fig. 1.* Burning waste in Korstaverket.
*https://www.svt.se/nyheter/lokalt/vasternorrland/30-jobb-bort-i-korsta*

## XRF based environmental monitoring

This work describes monitoring of hazardous metals in ash and leachate on a landfill using XRF (X-ray fluorescence). XRF elemental analysis is compared with ICP analysis (Inductively Coupled Plasma), MCNP simulations and environmental limits. Different X-ray filters and shielding are used for peak to background ratio optimization.

| Elements | C0(L/S=0.1 l/kg) mg/L | L/S=10 l/kg mg/kg |
|---|---|---|
| Arsenic | 0.3 | 2 |
| Cadmium | 0.3 | 1 |
| Chromium | 2.5 | 10 |
| Mercury | 0.03 | 0.2 |
| Molybdenum | 3.5 | 10 |

*Tab. 1.* Limit for leachate tests of dry stabilized fly ash on non-hazardous landfills in Sweden.

## XRF setup

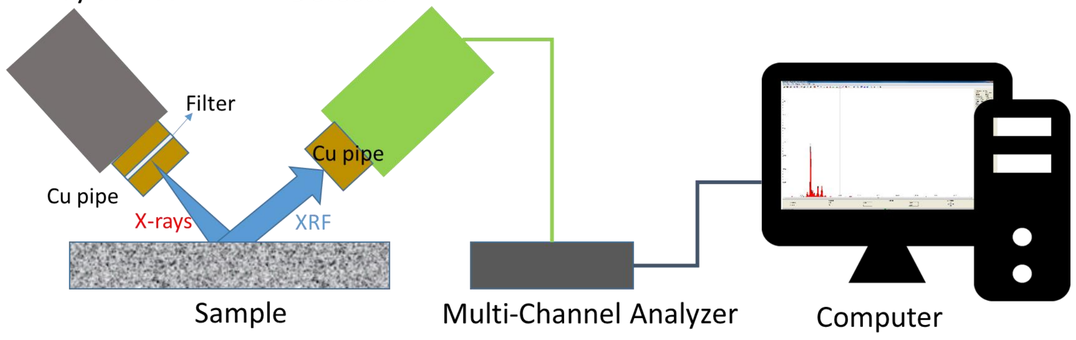


*Fig. 2. Schematic for an XRF measurement setup*

- X-ray tube with Ag target to produce X-rays.
- Silicon Drift Detector as a high energy resolution sensor for X-ray fluorescence from the sample.
- Filters to narrow the source spectrum to improve the peak to background ratio. Filters of Cu, Ge and Zr are considered.

## Results

Each element peak area corresponds to a specific element concentration after correction for; fluorescence yield, sensor absorption, source penetration in the sample and the escape of fluorescence out of the ash or leachate.

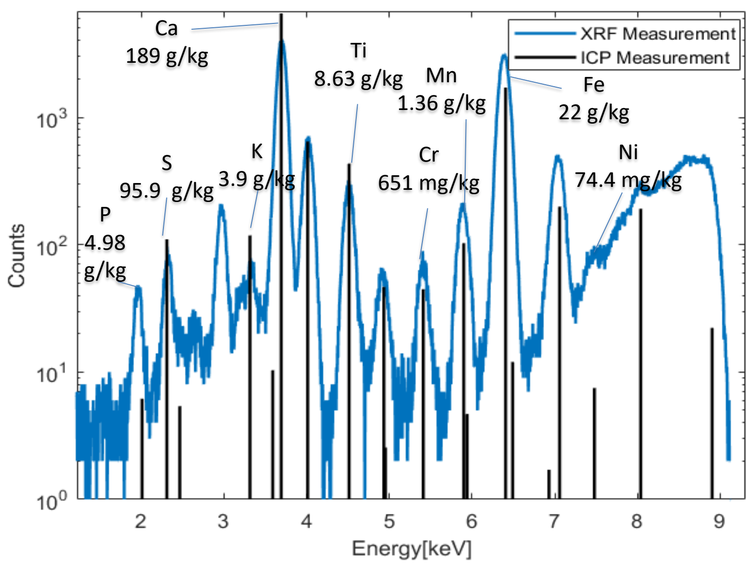


*Fig. 3. XRF measurement for ash compared to SGI lab analysis. A 170 µm Cu filter provides a source peak at 8.0 keV.*

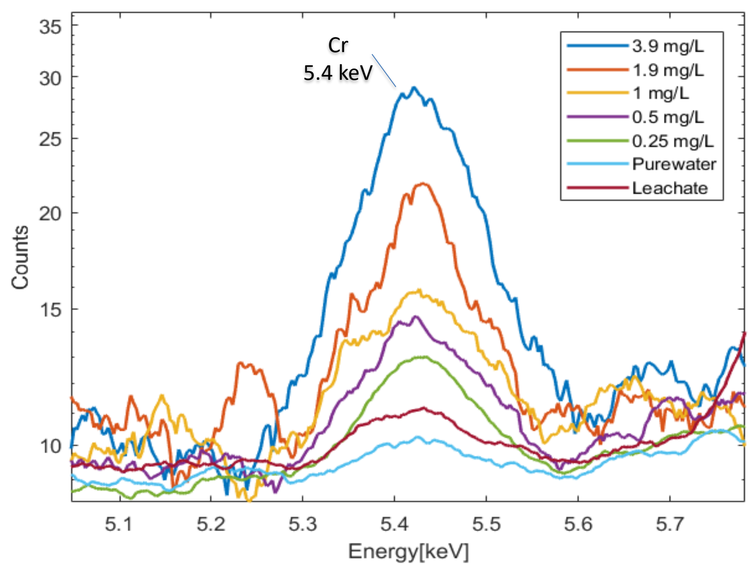


*Fig. 4. Samples with different Cr concentrations (Smoothing by 1-D digital filter). A 300 µm Ge filter provides a source peak at 9.9 keV.*

## Conclusion

- XRF is useful for monitoring of environmental limits for hazardous contents in ash and leachate.
- XRF ash measurements are consistent with ICP measurements.
- The Cr concentrations in the leachate from the local landfill is lower than 2.5 mg/L, which is the limit within the landfill.
- Online monitoring of metal content in ash is possible using XRF.

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