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A pilot study for determining ⁵⁵Fe, ⁶³Ni and ⁵⁹Ni from nuclear reactor pressure vessel steel in Finland

In this project, funded by Finnish Research Programme on Nuclear Waste Management (KYT) 2015-2018, 8 steel samples from BWR and VVER reactor pressure vessels were analyzed for testing separation methods of ⁵⁵Fe and ^{59,63}Ni with an active decommissioning material. The differences in chemical behaviour between two different steel types were observed during the analyses and even among the same steel type were differences between inactive and active samples during hydroxide precipitation and Ni-separation steps.

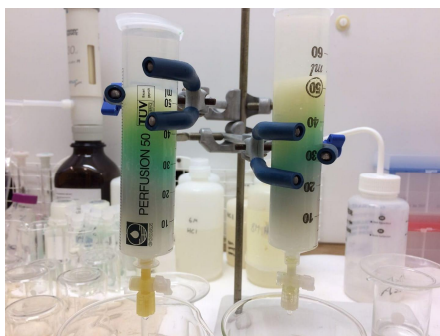


Figure 1. Anion exchange column after loading the sample solution containing Fe, Ni and Co.

Tested methods

- Anion exchange
- Ni-resin[®] separation
- DMG precipitation
- Gamma spectrometry (⁶⁰Co)
- MP-AES (stable Ni, Co, Fe)
- LSC (Quantulus 1220) for ⁶³Ni and ⁵⁵Fe
- LEGe for ⁵⁹Ni

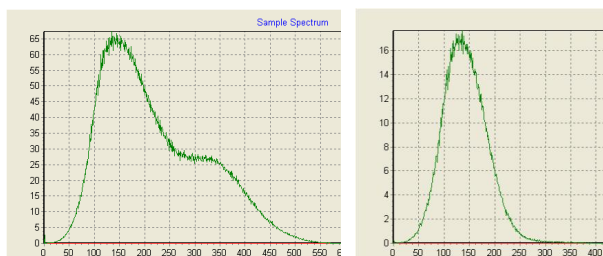


Figure 2. LSC spectra of a separated Fe fraction before (left spectrum) and after (right spectrum) ion exchange in acetone solution.

Findings

- High concentration of ⁶⁰Co in steel samples lead to adjustment of the radioanalytical method for separating Fe and Ni efficiently from ⁶⁰Co
- The main emphasis changed from comparing performances of two separation methods by means of Fe and Ni yields to elimination of ⁶⁰Co from final Fe and Ni fractions

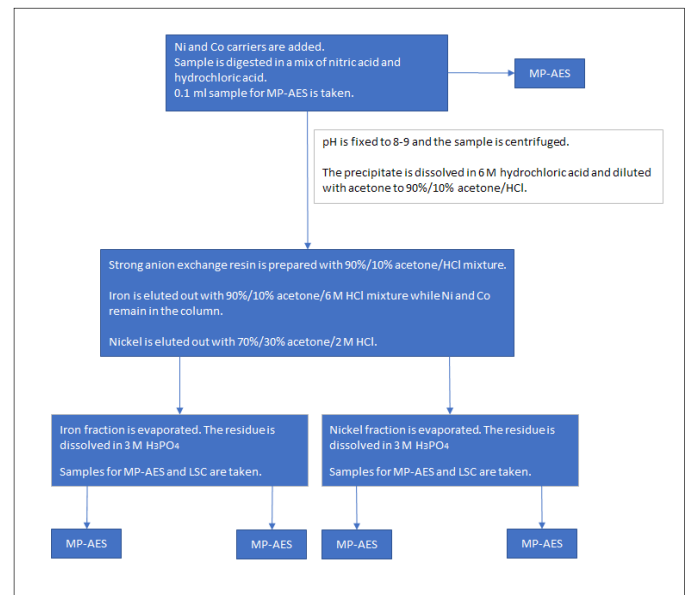


Figure 3. The final separation method for Fe and Ni from steel. The anion exchange step is modified from the separation method by Hazan and Korkisch (1965).

Next steps

- To finalize measurement data analysis
- To continue **steel** sample analyses for obtaining established determination procedure of Fe and Ni in pressure vessel steel
- To expand study of decommissioning materials with **concrete** in a following joint project