

## Introduction

- Rare Earth Elements (REEs) and trace metals are concentrated mostly in tailings compared to other parts of the oil sands production process, though this is still a relatively low concentration.<sup>[1]</sup>
- REEs found in tailings include Cerium, Neodymium, and Lanthanum etc. Iron, Titanium, and Zirconium are not considered REEs but are still valuable enough to be extracted.<sup>[2]</sup>
- REEs are currently not being collected from tailings, but if they were this could support Alberta's precious minerals economy as well as potentially reduce the amount of tailings being dumped in tailings ponds.
- Trace metals include elements such as Lead, Cadmium, Mercury, Vanadium. Many are toxic to humans and wildlife.
- The objective of this research is to determine the concentration of REEs and trace metals in bitumen froth treatment tailings.

## Methods

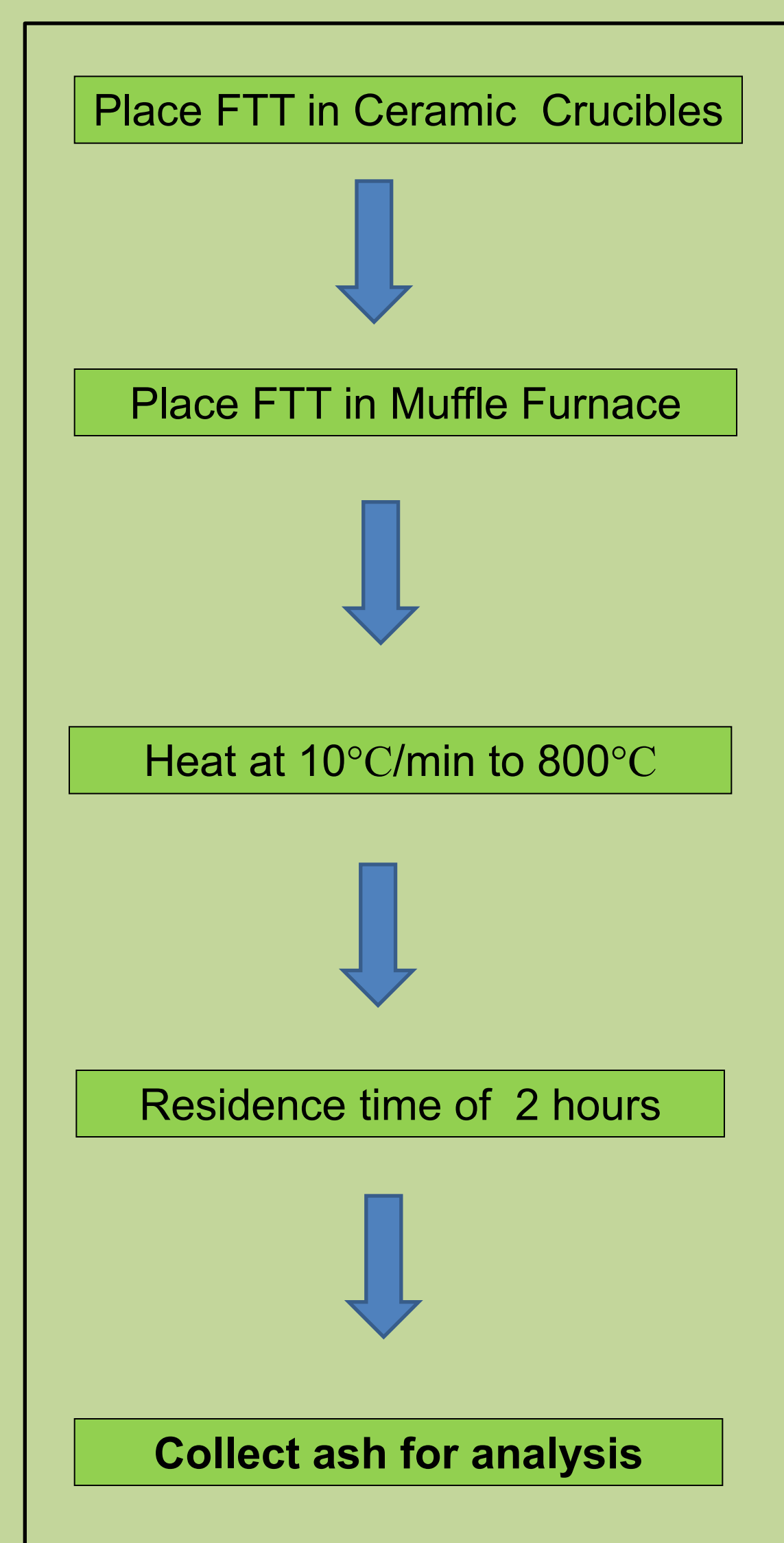
### Ash preparation from tailings



Figure 1. Crucible



Figure 2. Muffle Furnace



## Methods (cont'd)

### Analysis for metals

Acid Digestion



Inductively coupled plasma mass spectroscopy analysis (ICP-MS)

### Analysis for REEs

Three step acid digestion



Inductively coupled plasma mass spectroscopy analysis (ICP-MS)

## Results

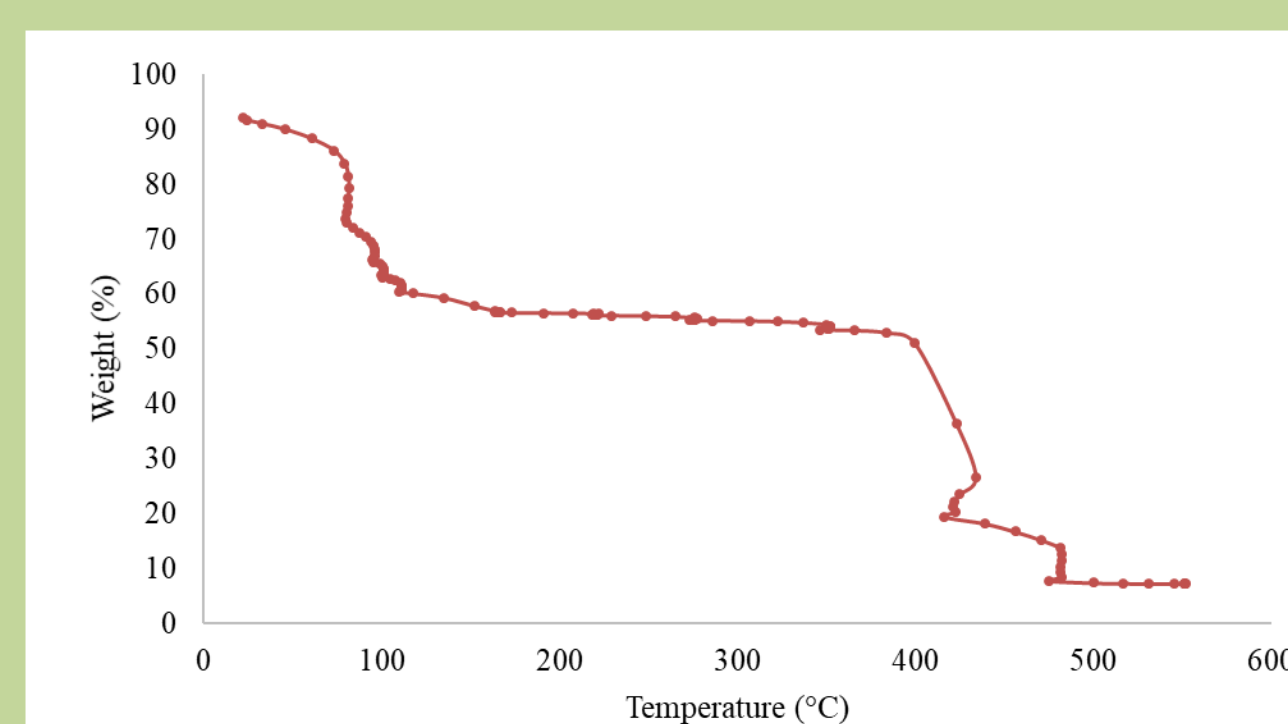


Figure 3. Thermal behavior of FTT in thermo gravimetric analyzer (TGA)



Figure 4. Thermo gravimetric analyzer

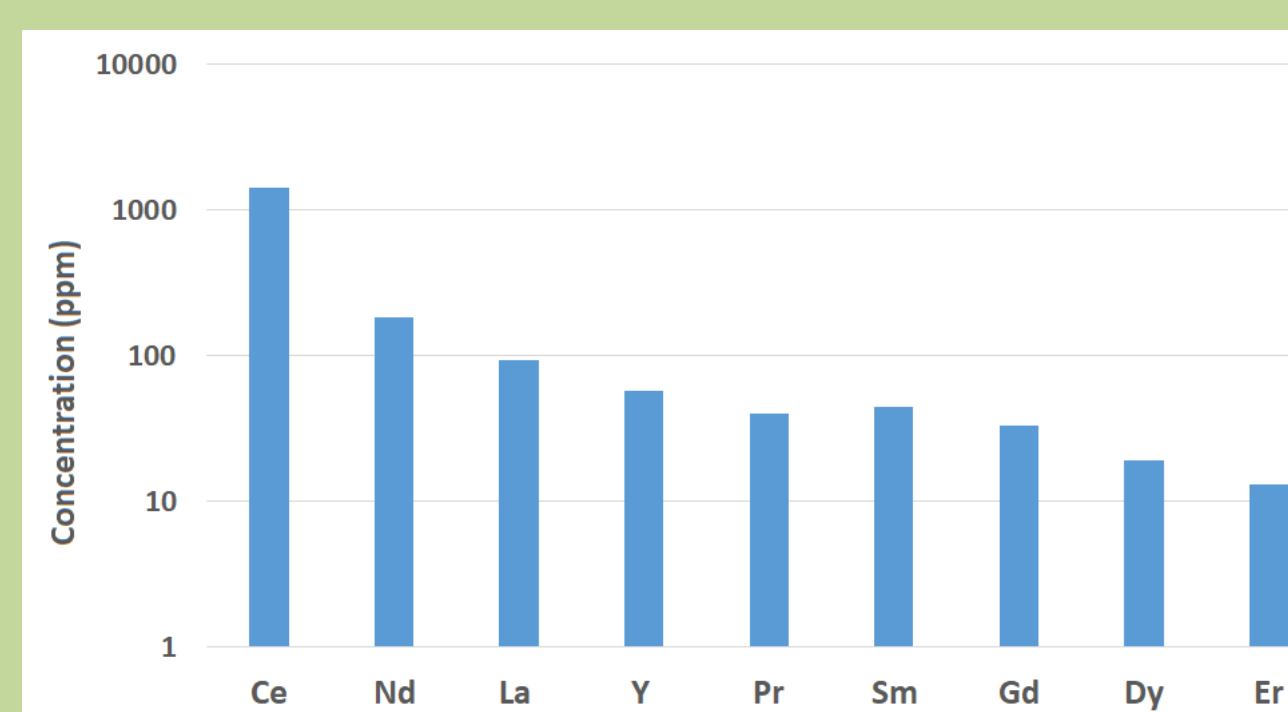


Figure 5. REEs in FTT ash. The concentration is presented in log scale



Figure 6. Dried FTT



Figure 7. FTT Ash

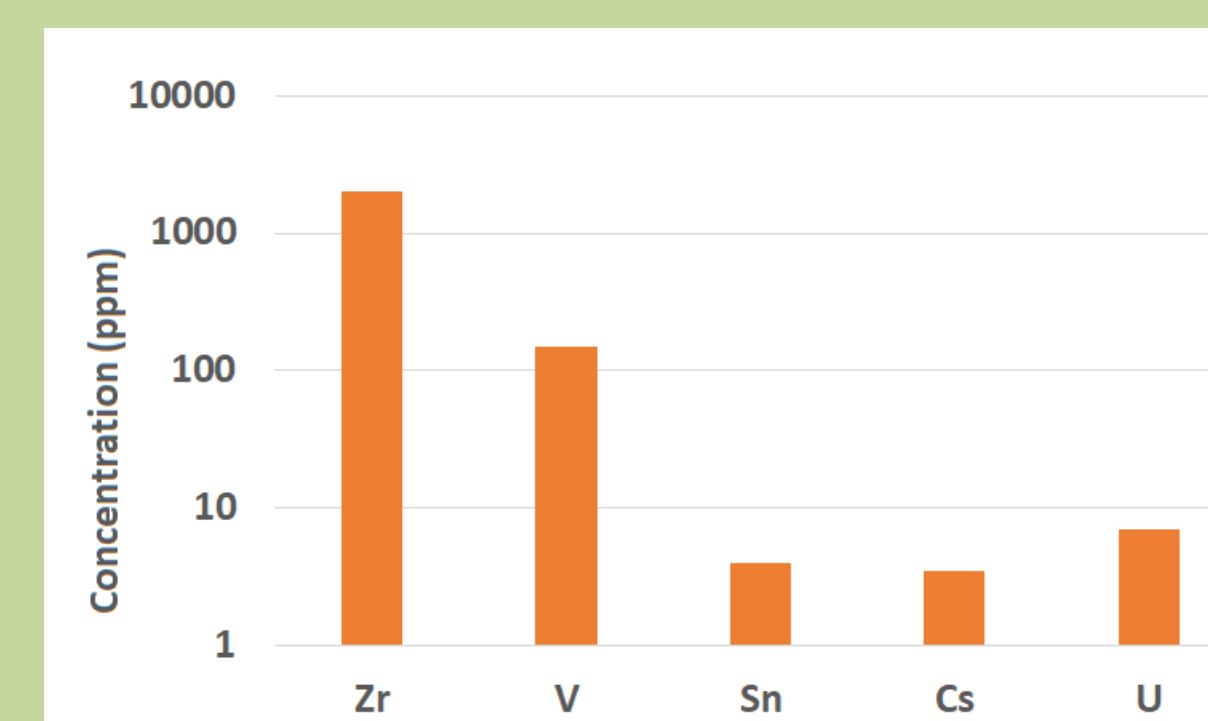


Figure 8. Trace Elements in FTT ash. The concentration is presented in log scale

## Conclusion

- The FTT lost up to 90% of its initial weight when heated to 550 °C. It has a mostly steady weight loss except for notable drops at 100°C and 400°C.
- Cerium is the most prevalent REE in tailings (>1000ppm), followed by Neodymium and Lanthanum.
- Zirconium is the most prevalent trace metal found in this tailings sample (>1000ppm), followed closely by Vanadium. Mercury, Lead, and Arsenic are also confirmed to be present in tailings but their exact concentrations are yet to be determined.
- The next step in this research would be finding suitable, low-cost methods to extract REEs and treat toxic trace metals in FTT.
- Research one step further could look at capturing these minerals and solvents before they reach tailings ponds. Combined, these two approaches would reduce total water usage while accelerating the reclamation process.

## Application

- Knowing the exact concentration of harmful trace metals in tailings will allow researchers to determine the extent of tailings ponds environmental damage and toxicity.
- Lanthanum and Yttrium are both expensive metals. Collecting and selling them from tailings could be the start of a new precious metals economy in Alberta, which would provide new investment opportunities and jobs.

## Acknowledgements

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## Literature Cited

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