Czech Nickel-based Superalloy MoNiCr Is a Superior Construction Material for Molten Salt Reactors

Static Corrosion Tests of Construction Materials in NaF-$NaBF_4$ Molten Salt

Michal Cihlář[1,2], Jan Prehradný[1,2]

[1]Faculty of Mechanical Engineering Czech Technical University in Prague, Prague, Czech Republic
[2]Research Centre Řež, Řež, Czech Republic

Introduction

- The technology of Gen IV molten salt reactors is promising; however, the environment of molten salt is very challenging.[1]
- It is already proven that purposefully designed nickel-based superalloys can withstand the harsh environment of primary loop FLiBe salt[2], but what about the secondary loop salts?

Methods

- Small (approx. 30 x 15 x 1 mm) metal sheets were placed individually into graphite ampules with a eutectic mixture of NaF-$NaBF_4$ and heated for different periods.
- Three sets of experiments were performed under a nitrogen atmosphere:
  - at 550 °C for a 1 month
  - at 550 °C for 3 months
  - at 700 °C for a 1 month
- Eight different alloys were tested:
  - Stainless steel 316 L
  - Eurofer 97
  - Incoloy 800HT
  - Inconel 600
  - Inconel 625
  - HN80MTY
  - MoNiCr – regular
  - MoNiCr – sheet

Results

- MoNiCr and MoNiCr sheet specimens have the lowest corrosion depths.
- MoNiCr has one of the lowest corrosion mass losses.
- MoNiCr showed very little structural corrosion damage in the surface layers.
- MoNiCr showed small Chromium depletion from surface layers.

Conclusions

- Purposefully designed nickel-based superalloys MoNiCr and HN80MTY show better performance in static corrosion tests in molten NaF-NaBF4 than stainless steels and other nickel-based alloys.
- Czech superalloy MoNiCr is comparable with other nickel-molybdenum alloys developed for molten salt applications such as HN80MTY, Hastelloy N, or GH3535.

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Figure 1: Graph of corrosion depth layer.

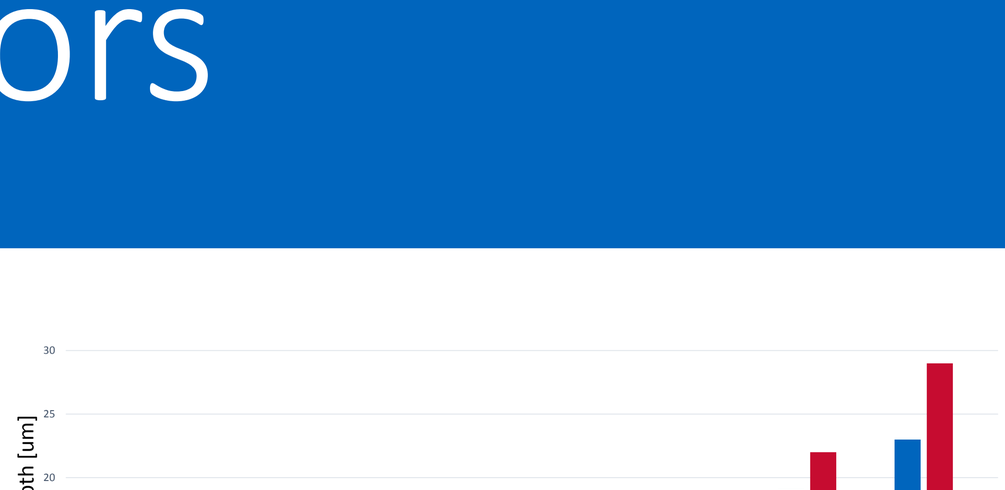

Figure 2: Graph of corrosion mass losses.

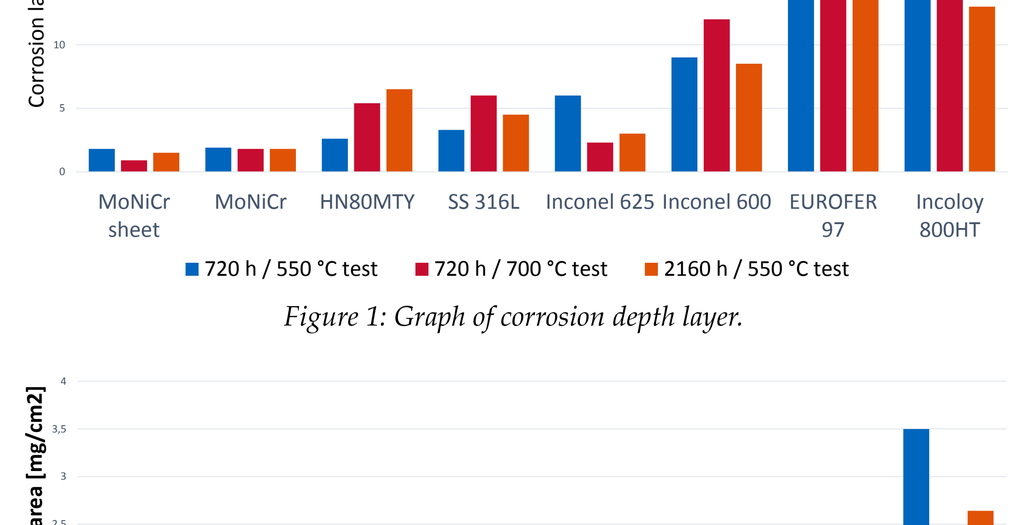

Figure 3: Pictures of structural and chemical changes in surface layers (the bottom of each picture).

References

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