Case Report – Outlet Pigtails Creep Damage Assessment

1. Introduction

This case report summarizes the condition assessment performed on outlet pigtails at a reformer unit. The work was conducted by SOIL Ingeniería Ltda. as part of a broader evaluation of the reformer's operational condition, specifically to assess the effects of creep damage on Alloy 800HT outlet pigtails. Data was collected through dimensional measurements, visual inspections, and review of metallographic replica results.

2. Background

During routine technical support activities, Positive Material Identification (PMI) and metallographic replication were being performed on the outlet pigtails and sub-headers. Based on engineering experience, these inspection methods alone are not optimal for assessing creep damage. Creep in outlet pigtails manifests primarily as diametral growth (OD expansion), which can be quantified through dimensional measurements and compared to nominal OD values.

It is important to highlight that creep damage manifests more clearly within the wall thickness of the pigtails, rather than on the outer surface. Damage typically initiates as microscopic creep voids forming at locations where hoop stress and thermal gradients intersect. These voids coalesce into fissures and cracks, progressing through the wall until they eventually reach the inner and outer surfaces.

3. Field Work Summary

OD measurements were taken on selected pigtails where insulation was removed for inspection. These measurements were compared to nominal values and plotted against creep rate curves for Alloy 800HT. The plots indicated that some pigtails have been operating at higher-than-design temperatures, resulting in elevated creep rates.

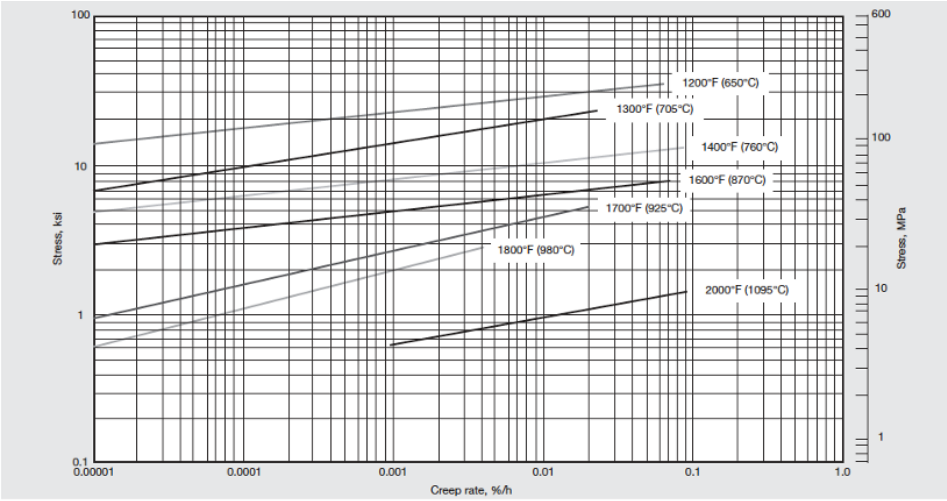

Figure 1: Reference chart or dataset visualization (Special Alloys)

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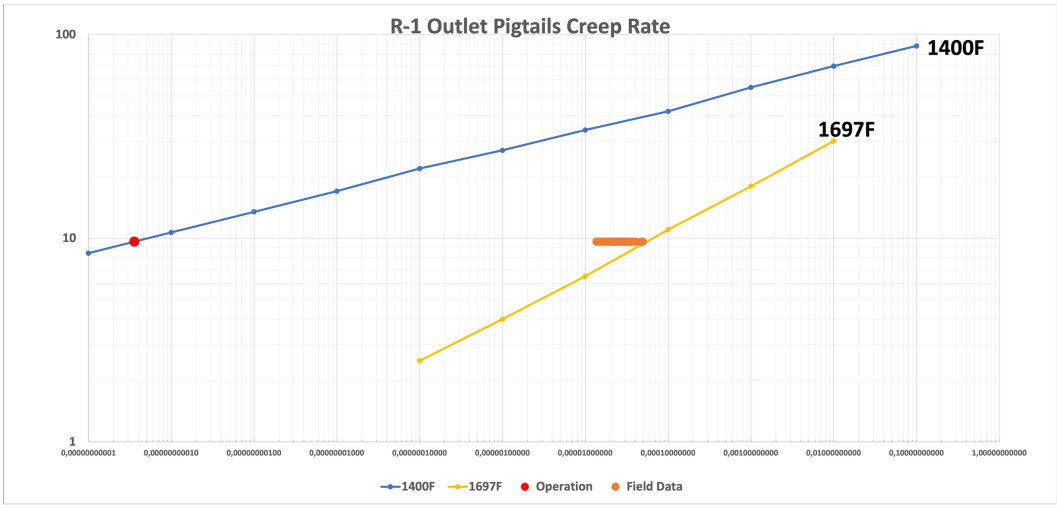

Figure 2: Real Creep of pigtail as measured. Note 1400F is the operation set point

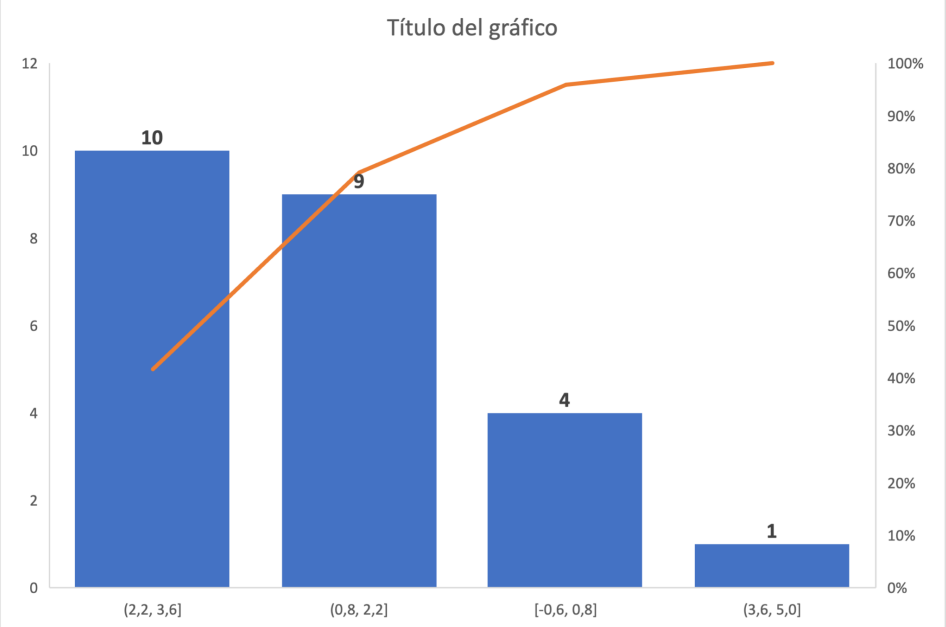

Figure 3: % of expansion from Nominal Diameter.

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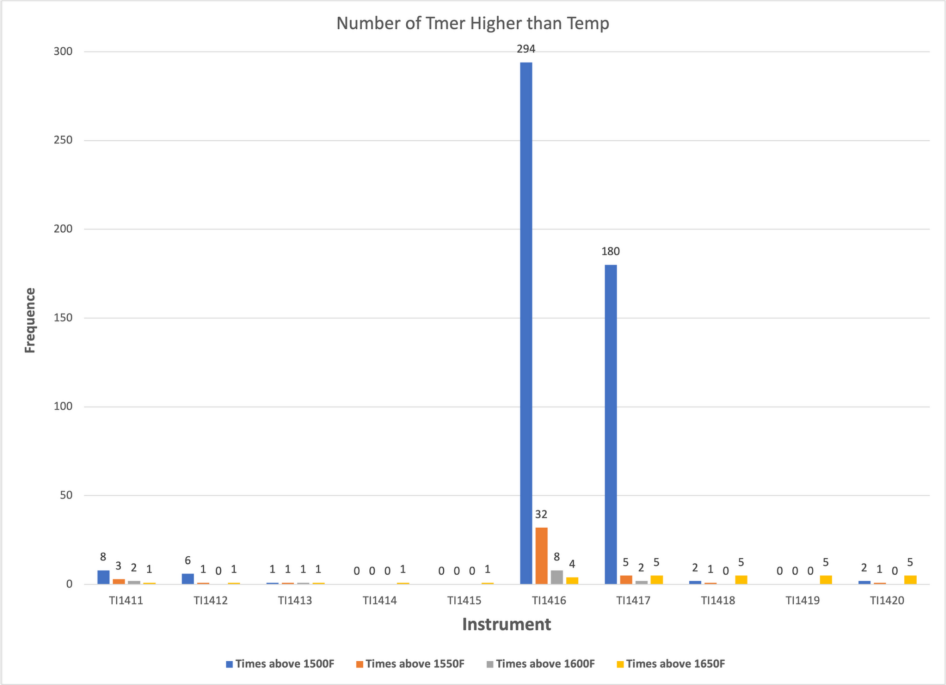

Figure 4: Times that the temperature were above the max allowable.

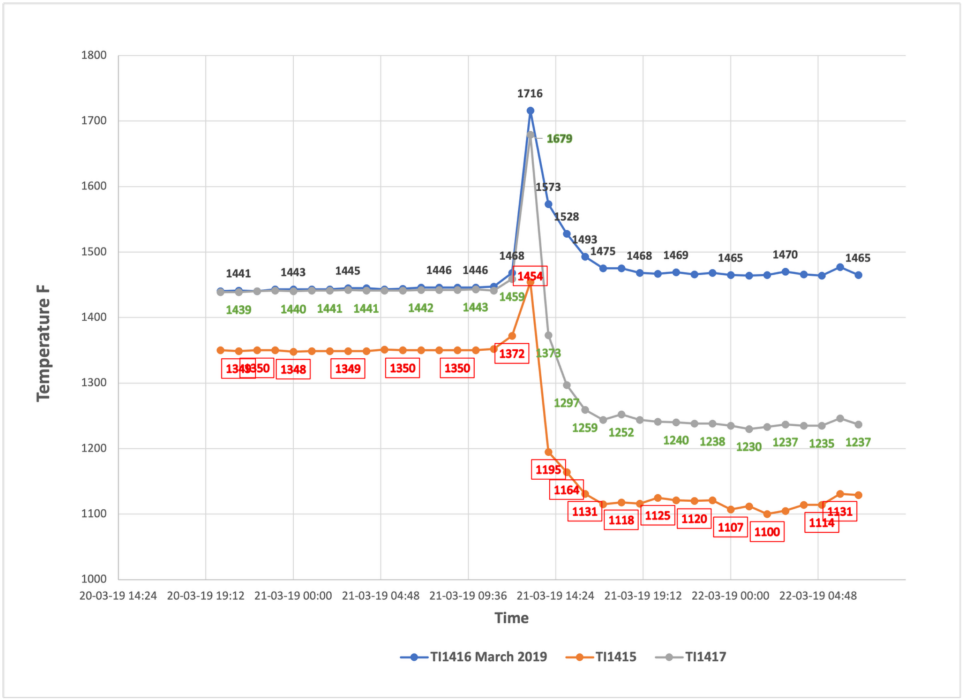

Figure 5: Temperature spike on March 2019.

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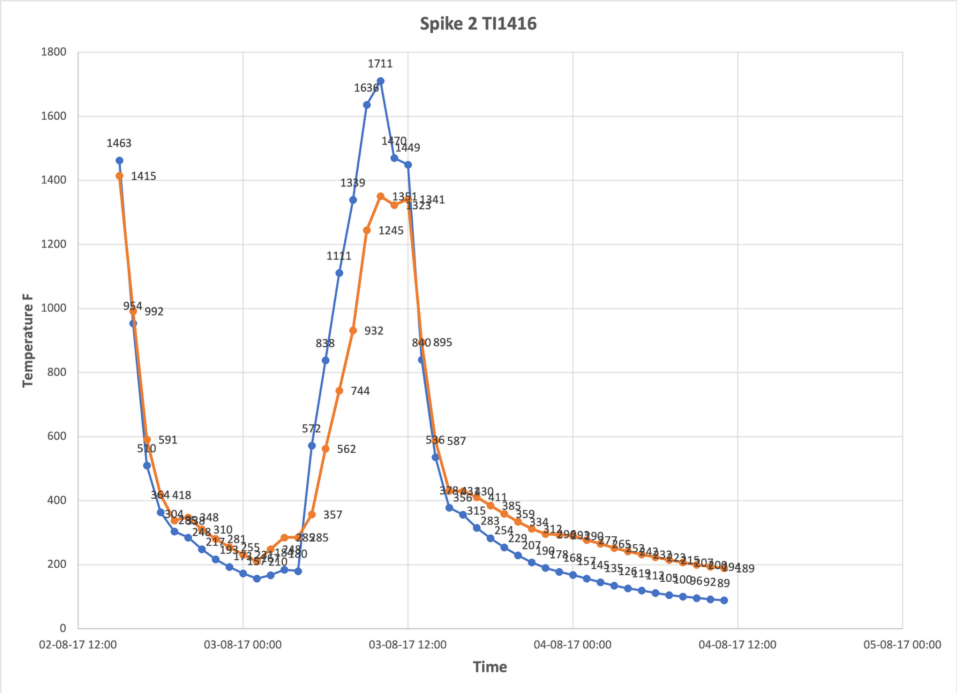

Figure 6: Temperature spike on August 2017.

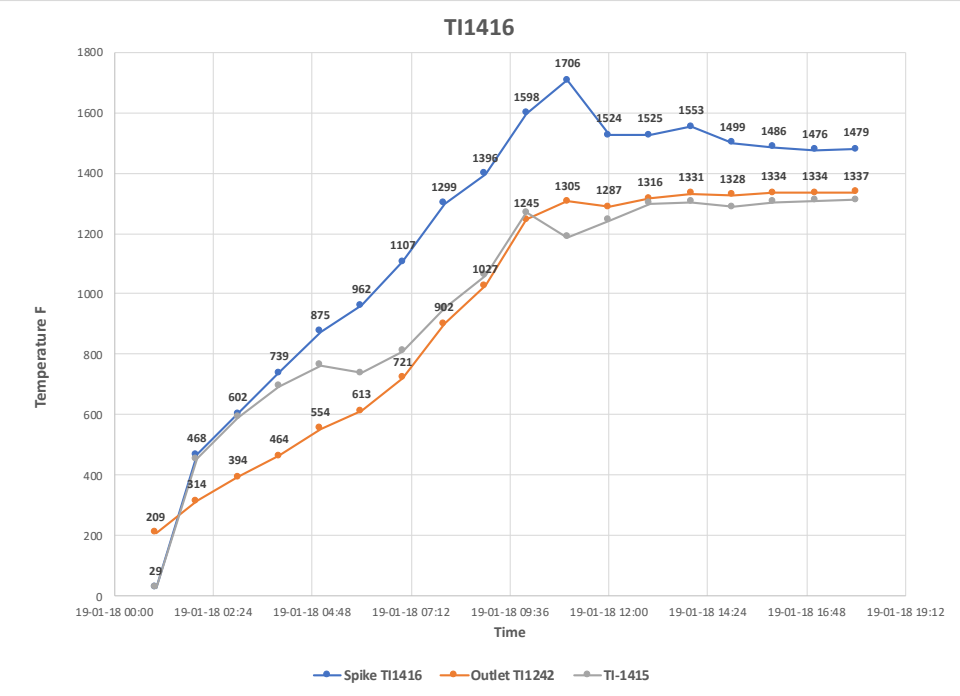

Figure 7: Temperature spike on January 2018.

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4. Observations

The OD expansion measurements suggest localized overheating in certain reformer zones. Visual inspection of catalyst tubes and pigtails confirms high-temperature operation episodes like start-ups. Replica results showed sensitization, which is expected at service temperatures and does not directly indicate creep damage. The presence of sigma phase could contribute to crack propagation but is not the primary cause of creep-related failure.

5. Recommendations

5.1. Remove and destructively examine at least one pigtail to correlate OD expansion with metallurgical condition.

5.2. Establish a baseline OD measurement for all replacement pigtails.

5.3. Perform a reformer-wide OD mapping to identify hotter zones and manage operational risk.

5.4. Evaluate the installation of Tube Growth Monitoring (TGM) systems for real-time assessment of thermal growth and hotspot detection.

5.5. Send removed samples to an accredited laboratory for detailed metallurgical evaluation.

6. Conclusion

The dimensional inspection results indicate that creep damage is progressing faster than anticipated in certain areas of the reformer outlet pigtails. Localized overheating is the most probable root cause. Implementing the recommended actions will help establish a reliable monitoring program and prevent unplanned failures.

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