

## **POST DOCTORAL POSITION IN HIGH TEMPERATURE CORROSION AT THE FRENCH CORROSION INSTITUTE**

### **1. About the Institute**

The French Corrosion Institute, subsidiary of a large Swedish group (RISE) employs around 40 people at its two French sites (Brest and Lyon / Saint-Etienne). Associated with a Swedish team of around 50 people, we are one of the world's largest laboratories in the field of corrosion. We offer corrosion testing services, failure analysis and R&D for the automotive, construction, offshore, oil&gas, low-carbon energies and construction sectors. A collaborative research service is also offered.

Since 2021, we have created a new laboratory in the area of Lyon (Solaize – 69) with mainly new equipments dedicated to the study of high temperature corrosion (furnaces, TGA) in Harsh environments (mainly explosive or toxic gases like SO<sub>2</sub>, H<sub>2</sub>S, CH<sub>4</sub>, H<sub>2</sub>, NH<sub>3</sub>...)

### **2. Introduction of the subject**

Biomass and more generally waste valorization represents a source of energy, increasingly used in most countries to lower fossil fuels consumption. Different processes have been developed since years to produce heat and/or electricity, involving combustion, gasification. The environments produced in these processes are very complex, involving mixtures of gas, solid particles, fused salts which induce high damage to metallic parts at high temperatures. The study and the prediction of the high temperature behavior of metals represents a challenge due to the high diversity of operational conditions.

With respect to biomass, waste combustion, Chlorine-Induced (CI) corrosion through the presence of KCl as fused salt, gaseous HCl, has been identified as one of the key degradation processes in the temperature range 500-650°C. Short term interactions involving the degradation of oxide layers (primary barrier) formed on high temperature materials have been extensively studied in the literature. More recently, studies aiming at understanding the long-term behavior of the materials have been conducted, stressing the interest of increasing knowledge of the reaction kinetics after primary protection (secondary stage). The layers formed during this secondary stage are complex including oxides, chlorides, potentially internal sulfides and carbides, depending on the environment composition.

At these temperatures (500-650°C), the alloys are subjected to microstructural changes with the formation of carbides, intermetallic phases, occurring after thousands of hours. The kinetics of these transformations are higher in the range of 700-900°C but even if phase precipitation is delayed, it is expected after thousands of hours at 600°C. When investigating the long-term behavior of high temperature materials, it is worth considering the effect of microstructural changes on the degradation processes. This effect is considered only in a few recent papers.

### 3. Scope of the work

This work is intended to address the CI corrosion domain (500-650°C). The work will be particularly focused on:

- The effect of metallurgical ageing
- The effect of alloy pre-oxidation, through its impact on the first and secondary stages.

The composition of the superficial layers developed, depends on the atmosphere, on the alloy composition and microstructure. Little is known about the combined effect of these factors on alloy behavior on the long term (1000 hours and more).

Different commercial alloys will be considered in the study, with different Ni, Cr, Fe, Si contents. The test conditions (atmosphere composition, salt contamination) will be selected on the basis of literature, to obtain relevant results and bring additional knowledge and understanding of the different interactions mentioned above.

### 4. Location of the work

The experimental work will be conducted in a new laboratory located in the Lyon area (Solaize – 69) but the post-doctoral researcher who will be hired could be partly based also on the Saint-Etienne site (Fraisses-42), located at 40 minutes by car from Solaize.

After completion of the post-doctoral work, under a fixed term contract of 18 months, a permanent position could be proposed to the selected applicant with aim to develop the HT-Corrosion activity at the French Corrosion Institute.

### 5. Your profile

You are a PhD graduate with already a background in high temperature corrosion or high temperature characterization of metallic materials and, ideally, in thermodynamical calculations. Since the work will be conducted in a new lab still under development, you are self-motivated with an entrepreneur spirit. These skills are keys to succeed in this work and in your future position at the institute if you are hired after this project to lead the high temperature corrosion activity. You have an excellent customer relationship and eager to develop a technical activity. You speak French and english fluent is required for this position.

To apply, please send your application with a list of your scientific papers to both:

- Christophe Mendibide: [christophe.mendibide@institut-corrosion.fr](mailto:christophe.mendibide@institut-corrosion.fr)
- Rikard Norling: [rikard.norling@ri.se](mailto:rikard.norling@ri.se)