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Cyclic Thermal Shock Test

Introduction

The insulating lining of high temperature industrial units often degrades due to periodic thermal shock events. For this, thermal shock resistance is a major property of interest for ranking the candidate lining materials and selecting the optimal solution. Different approaches exist to conduct such analysis [1], herein we briefly present a direct testing method and address its merits.

Cyclic Thermal Shock Test

A schematic drawing of an in-house developed equipment is shown in Fig.1. The equipment consists of two interconnected chambers. The shock event is realised by instantly moving samples between the chambers. Parameters of interest, temperature, time and number of thermal cycles are defined in the test program and recorded during the experiment. An example of the recorded data is depicted in Fig.2. In contrast to conventional approaches, this test routine has the following advantages:

- Less labour-intensive.
- Minimal operator error.
- Minimal disturbance from the surroundings.
- Test parameters can be tailored according to service condition.

Expected Result

During the experiment, no direct measurement of the samples' characteristics, e.g. deformation is currently possible. The physical properties, e.g. strength and dynamic Young's modulus are measured after the experiment and compared with the unshocked state. The extent or the rate of change of the property of interest is used to judge the resistance of materials [3]. Fig.3 presents the change of dynamic Young's modulus of two materials due to the thermal cycles. Qualitatively presence of cracks implies the degradation of samples and a deeper insight can be gained by microstructural analysis.

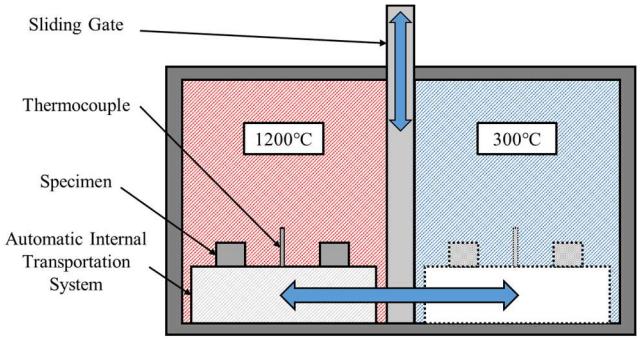

Figure 1- Schematic of the testing equipment [2].

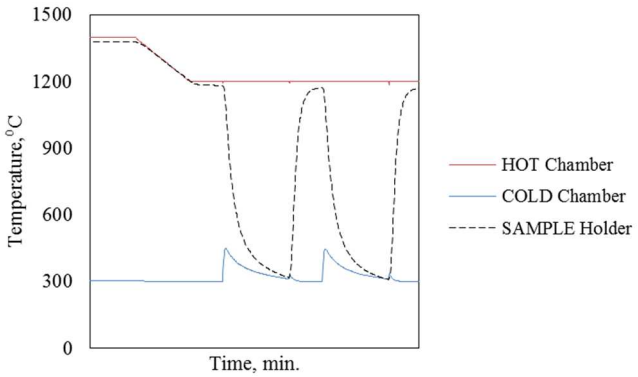

Figure 2 - Example of temperature profiles recorded during a cyclic thermal shock test with initial pre-treatment.

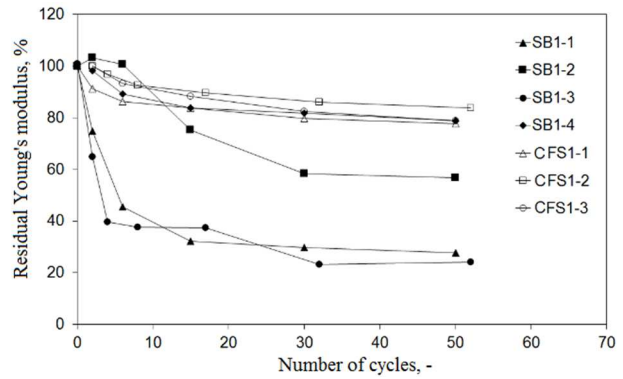

Figure 3 - Change of Young's modulus with thermal cycles in the samples of two materials.

Acknowledgments

This work was supported by the funding scheme of the European Commission, Marie Skłodowska-Curie Actions Innovative Training Networks in the frame of the project ATHOR - Advanced THermomechanical multiscale mOdelling of Refractory linings 764987 Grant.

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European Commission | Horizon 2020 European Union funding for Research & Innovation