ESR number and name surname: ESR14 – Soheil Samadi (soheil.samadi@unileoben.ac.at)
Supervisor: Dr. Shengli Jin (shengli.jin@unileoben.ac.at)
Home university: Montanuniversitaet Leoben

Wedge Splitting Test

Introduction

To consider the mode I fracture in thermo-mechanical simulation of refractories, characterization of the fracture energy and the tensile strength of the material is necessary. The Wedge Splitting Test (WST) is a suitable method to characterize the mode I fracture phenomenon in refractory materials, which enables stable crack propagation for relatively large specimen dimensions [1,2].

Specimen Dimensions and Testing Procedure

The new testing device at Chair of Ceramics (MUL) for WST, allows accurate fracture mechanical characterization of refractories at room and high temperatures up to 1500 °C using laser speckle extensometers on the back and the front side of the specimen. Reducing conditions can also be provided for carbon containing refractories [3]. Figure 1 and Figure 2 show the specimen's dimensions and a schematic of configuration for testing.

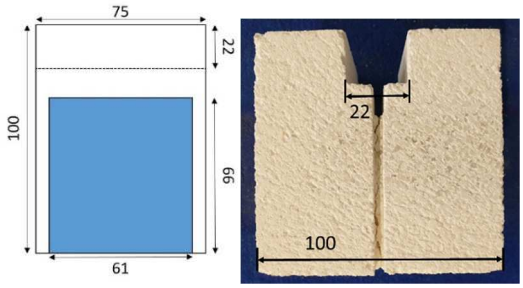

Figure 1– Specimen's dimensions.

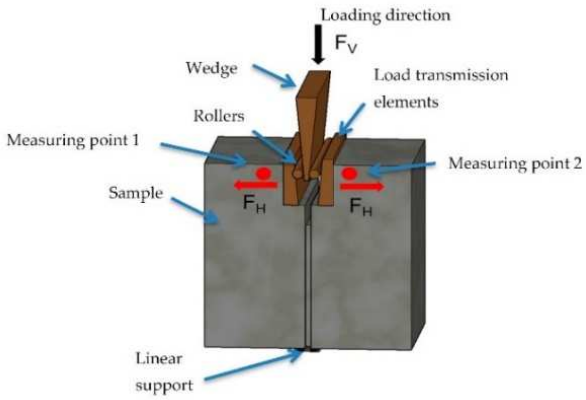

Figure 2– Schematic of specimen in WST [3].

The vertical displacement is applied with the rate 0.5 mm/min, and the load is measured using a load cell. The horizontal displacement is measured directly on the back and the front side of the specimen via laser speckle extensometer.

Expected Results

Results are received in the form of load-displacement diagrams (Figure 3), from which the following parameters can be directly calculated: specific fracture energy (G_f') and nominal notch tensile strength (σ_{NT}):

$$G_f' = \frac{1}{A}\int F_h dx_h \quad (1)$$

$$\sigma_{NT} = \frac{F_{h,max}}{bh}\left(1 + \frac{6y}{h}\right) \quad (2)$$

Where, F_h and x_h are the horizontal force and displacement, A denotes the ligament area (shaded area in Figure 1), b and h are the width and the height of the ligament area, and y is the vertical distance between the horizontal load point and the centre of A.

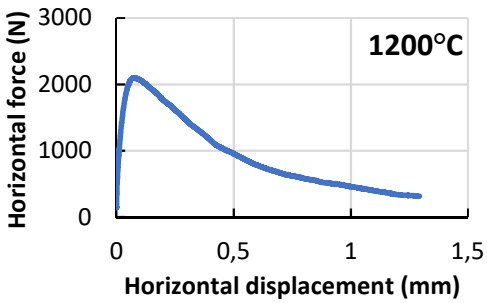

Figure 3 – Force/displacement curve.

Later on, with the means of the simulation and inverse evaluation algorithms, total fracture energy and tensile strength can be evaluated from the experimental results.

Acknowledgement

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.

References

[1] Tschegg, E. Austria Patent 390328, 1986.
[2] Harmuth, H., et al. Materials Science and Engineering: A, 214:53–61 (1996).
[3] Stückelschweiger, M., et al. Applied Sciences 9(16), 3249 (2019).

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