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Static or dynamic dipping test

Introduction

Dipping test, also called finger test or immersion test, is a test used to study corrosion. It is mainly a qualitative test used to compare samples but it can also be used to assess the mechanisms of corrosion of refractories. It consists in dipping rods or bars of refractory in a corrosive liquid: steel, slag, steel topped with slag in case of the steel industy.

Sample Preparation

The samples for this test are prepared by drilling rods [1] or cutting bars from refractory bricks.
The size of the sample can be chosen by the experimenter, but the standard size is between 10 to 30 mm in diameter (or cross-section edge length) and 50 to 120 mm in length [2].

Test Procedure

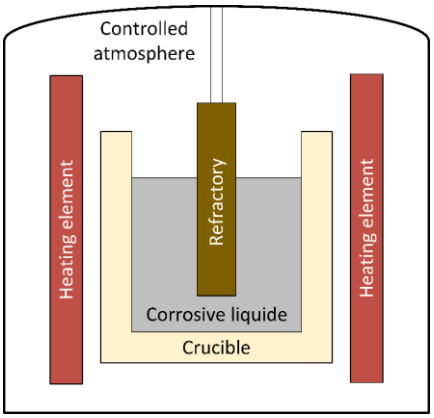

Figure 1: Schema of a stating dipping test under controlled atmosphere

To perform the experiments, the corrosive medium is usually heated up in a top loaded furnace to a selected temperature as shown in figure 1. When the liquid reaches the temperature, the rods or bars are usually maintained above it to be heated up before dipping in the liquid to avoid thermal shock [3]. After some time (few tens of minutes), the rods or bars are dipped (by 30 to 70% of their length) into the molten liquid.
During the experiment, the samples can be kept motionless, which is the static dipping test [1], or they can be rotated, which is the dynamic dipping test [3]. If the furnace is in a closed chamber, the atmosphere can be controlled. The time of the immersion is chosen by the experimenter.

Expected Result

After testing, the extent of the degradation can be estimated by measuring the samples' mass loss or thickness loss, as shown in Figure 2a, at the slag interface with the atmosphere (D_m) where the degradation is the most significant due to the Marangoni effect and at the mid-height of the sample's lower part (D_c). These measurements can be used to compare the performance of the corroded samples. They can also be used to obtain a rough approximation of the average corrosion rate (note that the corrosion rate is not uniform, and it decreases progressively during the test).
Additionally, the infiltration depth can be measured by making vertical cut in the sample. By sampling the rod or bar, it is possible to obtain the composition, phases and morphology of the different areas (interface and infiltrated zone) using XRD and SEM equipped with EDS, as shown in Figure 2b.

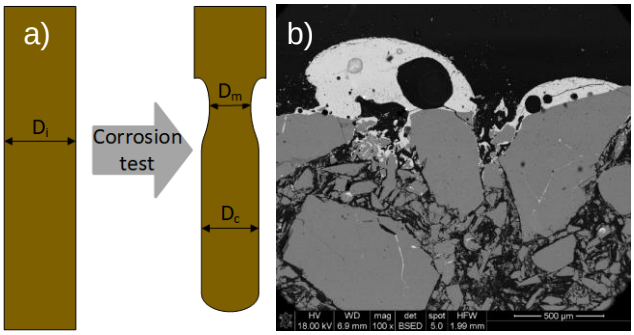

Figure 2: Evolution of the sample shape during the dipping test (a) and micrograph of the interface of a sample after corrosion (b).

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References

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