Devanathan Cell

Overview

The Devanathan cell is an applicable device for measuring hydrogen permeation through a (steel) plate. It is available in different sizes and layouts.

Description

Due to their different compositions and due to their different structural components and microstructural defects, different metals or alloys demonstrate different permeation behavior towards hydrogen. With the Devanathan cell, this behavior can be systematically researched.

The metal sample to be analyzed (e.g. steel) is located between the two half cells and separates the two electrolyte spaces of the cells. The one electrolyte space, in which hydrogen atoms are generated from the electrolyte on the sample surface, is called the loading measuring cell. The second electrolyte space, in which hydrogen atoms leaving the metal sample are oxidized, is called the oxidation cell.

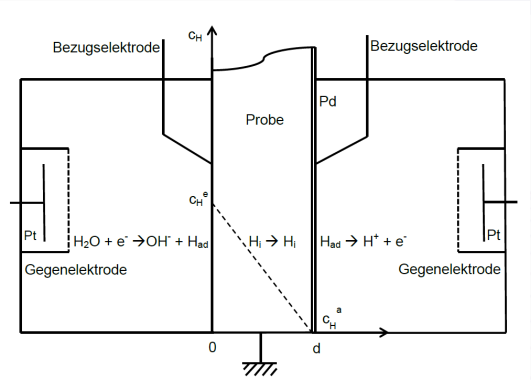

Figure 1: Scheme of a Devanathan Cell.
Bezugselektrode = Reference electrode
Gegenelektrode = Counter electrode

The metal sample is cathodically polarized (usually galvanostatically) in the loading measuring cell. The galvanostatic operation shifts the potential to the hydrogen evolution region. The hydrogen produced in this way also diffuses into the sample and can be measured on the oxidation side, which is usually coated with palladium, with a potentiostat in the form of an electric current. The loading can also be generated chemically with mordant or other chemicals. This may provide a better reproduction of the genuine process. If the entire process is implemented electrochemically, a counter electrode and a reference electrode are required for each of the two half cells. In addition, two galvanically separated potentiostats are required.

In addition, we have developed a variation of the Devanathan cell that can be installed in a tensile machine (see Fig. 2 below). This allows an additional electrochemical load to be applied to a tensile loaded sample, which can result in significantly more extensive hydrogen permeation.

Permeation-promoting factors are:
- Mechanical stress on fasteners
- Temperature, e.g. during deposit development
- Pressure, e.g. during deposit development
- Electrochemical stress (e.g. in electroplating)

Applications
- Testing the effect of hydrogen leading to material damage
- Measurement of hydrogen permeation
- Quality assurance (mordant, electrochemical coating)

Technical details

Cells	Large	Small
Volume	2x approx. 1000 mL	2x approx. 200 mL
Design	Heatable and a non heatable	Heatable version only
Material		
Glass vessel	Single-walled and double-walled	Double-walled
Lid	Polypropylene	PTFE, Cap PBT
Mounting material	Stainless steel	
Referenece electrode	Ag/AgCl	
Counter electrode	Platinized titanium rod, L-shaped	Platinized titanium rod

Enhanced version

Figure 2: Devanathan Cell with tensile sample holder

The **tensile sample holder**, developed by IPS, enables to insert a tensile specimen into the experimental setup. The sample is exposed electrochemically to hydrogen permeation and mechanically to tensile stress.