The Avesta Cell

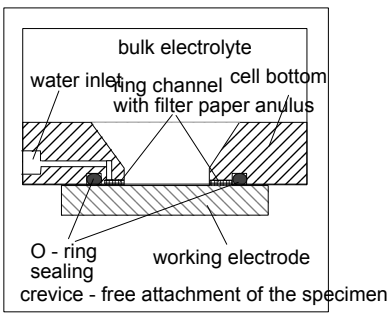
Electrochemical experiments on pitting corrosion of passive metals are usually knitted to the problem of crevice corrosion which inflects the accuracy of the pitting corrosion experiment, because crevices produce an early breakdown of passivity. So, the test material, forming the working electrode of an electrochemical cell shall be produced free of any crevice.

The simplest way is to fix the specimen between sharp tips of a clamp, which also both contact the specimen and keep it in place. However, if only a certain face of the material is to be investigated, it must be avoided that any other face contacts the electrolyte. Usually, these faces are electrically insulated by laquering, or the specimen was mounted in resin. Both methods are prone to crevice formation.

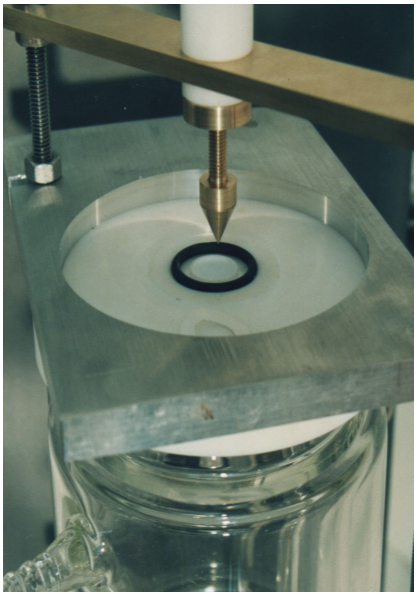
In the corrosion laboratory of Avesta Steel, a novel method of specimen mounting has been developed by Rolf Qvarfort. The surface of the material specimen is pressed against an opening in the bottom of the electrochemical cell. A ring of filter paper tightens the border line of the specimen. Distilled water is passed through this filter paper ring into the cell at an extreme low rate. This prevents the corroding electrolyte to come in contact with this zone, such avoiding aggressive electrolytes in the artificial crevice. The water flow is controlled by a peristaltic pump which delivers 0.5 to 5 ml per hour. The volume of distilled water diluting the measuring electrolyte is too small to disturb the measurement.

Following Avesta's proposal, the polarisation curves are recorded at constant temperature, starting at cathodic potentials (e.g. - 100 mV vs saturated. calomel electrode), and varying the potential until either transpassivation region is reached or pitting occurs. If the specimen reaches the transpassivation region without pitting at given temperature, it is regarded as pitting - resistant at this temperature.

A round - robin - test in various European countries which was guided by the CITU - Institute of Borlänge University in Sweden, produced very close results. The measured "critical pitting temperatures" of steel 316 L of all participants were within a temperature interval of 5° C. This variation is result of the statistics which arise from the stochastic nature of the pitting process itself.



The Avesta Cell produced by Bank Elektronik - Intelligent Controls has a volume of 0.5 litres. It is surrounded by a heating jacked providing to be heated by an external thermostat. If sea water is used as electrolyte, the temperature can be varied between freezing point and boiling point. Other electrolytes can be used, too, e.g. to determine the pitting resistance of passive materials in their determined natural environment.



Bottom of the Avesta Cell

The cell is mounted on a stainless steel stand (316 L), which also bears both the fixtures for pump and inlet- and outlet connectors for gas and heating fluid. Included are all required peripherals, as peristaltic pump, reflow - condenser, and reference electrode.

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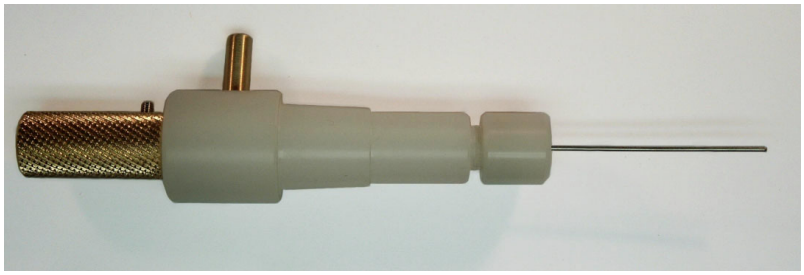
Specimen holder for wires (0.5 to 2.5 mm dia)

Further options (not included in the standard cell package) are special specimen holders for cylindrical specimens and for wires. These special holders contain the water flushing system, and can be used in connection with the cell stand and the pump.

A suitable potentiostat for this cell might be our electrochemical work station MLab, which can be operated from any personal computer under Win98 or higher.

Further reading:
R. Qvarfort, E. Alfonsson, "An Improved Cell for Electrochemical Pitting Corrosion Testing", 11th Scandinavian Congr., Stavanger 1989
R. Qvarfort, "New Electrochemical Cell for Pitting Corrosion Testing", Corr. Sci. 28, (1988), p. 135

Specifications

Stand	316 l, PE powder coated (white) 220 x 420 x 300 mm (W x H x D)
Specimen dimensions	active area 11.3 mm diameter = 1 cm² min. 25 mm total diameter (smaller on request) max. 85 mm total (diameter or diagonal extension) any shape allowed which can be enscribed between the two limits max. height 40 mm (optionally up to 80 mm)
Cell	0,5 l double wall, laboratory glassware (Duran/Pyrex)
Top	PTFE, 5 bores NS 14.5 for Haber - Luggin capillary, counter electrode, gas inlet, condenser and thermometer
Bottom	PTFE
Sealings	Viton
Cell Cage	Al and 316 with mounting rig for working electrode
Pump	2 - rolls peristaltic pump, 1 to 20 ml/h
Reference electrode	container 100 ml, with AgCl reference electrode, electrolyte bridge and Haber - Luggin - capillary
Counter electrode	1 x 2 cm platinum
Condenser	200 mm reflow condenser
Spare parts	10 filter rings, 2 sleeve adaptors for thermometer or other plug-ins