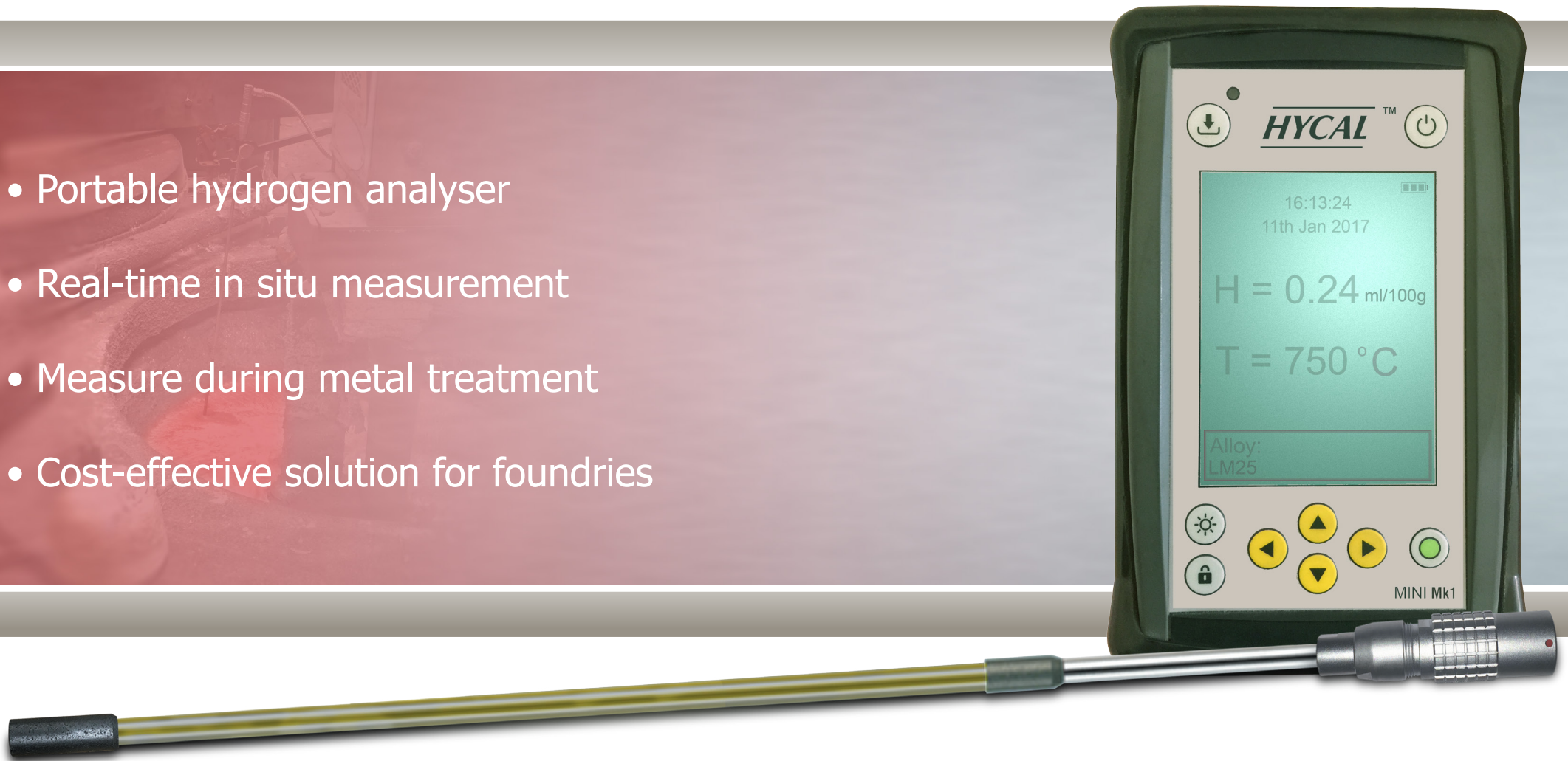




- Portable hydrogen analyser
- Real-time in situ measurement
- Measure during metal treatment
- Cost-effective solution for foundries



DIRECT MEASUREMENT OF HYDROGEN IN ALUMINIUM ALLOYS

HYCAL *MINI*



What is Hycal Mini?

Hycal Mini is a portable analysis system for the in-situ determination of dissolved hydrogen content within molten aluminium alloys.

The system comprises a Hycal Analyser, Probe Adaptor (including connection cables), the consumable Hycal Probe and customised PC software for the processing and back-up of results.

A patented electrochemical sensor, housed at the tip of the probe, provides a signal which varies purely as a function of hydrogen partial pressure (pH₂) and temperature.

The sensor is housed in a robust, impact resistant probe constructed from sialon ceramic and special high temperature alloys, which ensures that the Hycal system is able to withstand the harsh conditions in the foundry.

The sensor and temperature signals are fed into the analyser, which when combined with the alloy calibration constants, outputs the hydrogen concentration in units of ml/100g.

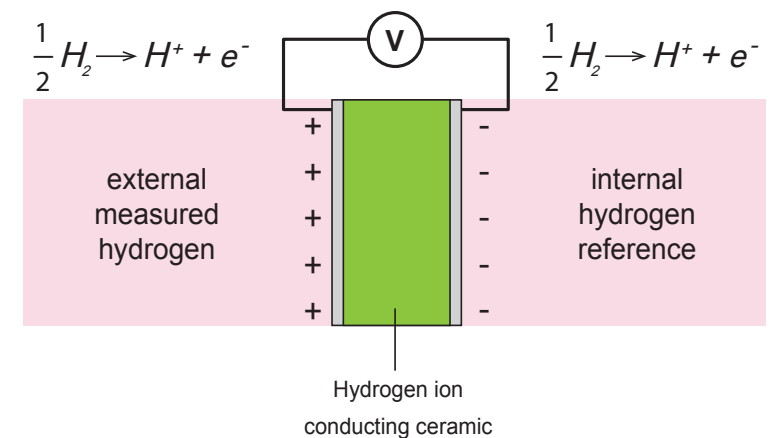
How it works...

The sensor is made from a doped calcium zirconate ceramic, which is able to conduct hydrogen ions.

A proprietary method is used to prepare the precursors and subsequently to compact and sinter into a small thimble.

The internal cavity of the sensor houses a patented solid state reference which provides a known pH₂ for a given temperature. Depending on the pH₂ difference between the external and internal chamber of the sensor, a sensor voltage is generated which, when combined with a temperature measurement, allows an accurate measurement of hydrogen to be determined.

The schematic diagram below shows how a voltage is generated across the wall of the doped calcium zirconate material exposed to a difference in pH₂.



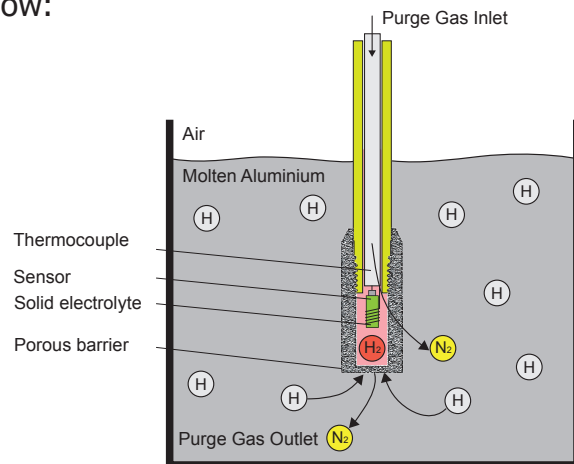
Probe Adaptor

In all circumstances, with the exception of measuring during metal treatment, it is necessary to purge an inert gas through the probe at the beginning and end of each measurement. This clears oxides and humidity from the probe measurement chamber and removes external sources of hydrogen prior to the start of the measurement.

The Probe Adaptor (shown to the right) enables this function by the simple open / close of a valve. The typical duration for the purge is between 10-30 secs.

The Probe Adaptor should be mounted close to the point of measurement. The inlet at the base should be connected to nitrogen or argon gas at 3-10 bar (typically teed off from degassing machine supply). One cable connects the adaptor to the analyser and the other connects the adaptor to the probe.

A schematic of the purge process is shown graphically below:

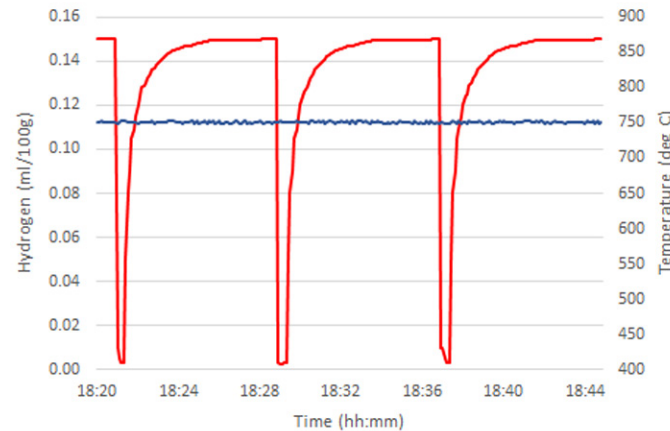


Accurate, Fast and Repeatable

Due to the cleaning action of the purge, the Hycal probe is able to reach a stable and accurate reading within 5-10 minutes.

The graph below shows multiple purges of a Hycal probe used in conjunction with a Probe Adaptor in a static melt.

Where the hydrogen content is 0.15 ml/100g, each successive reading is reproducible to within 0.01ml/100g and has stabilised within 5 minutes.



Hycal Mini Applications

Hycal Mini can be deployed in virtually every foundry application including the following:

- Spot check in the holding / melting furnace,
- Real-time measurement during metal treatment
- Continuous measurement within transfer launder
- Low Pressure Die-Casting Furnace



Continuous Measurement



Robust Connector



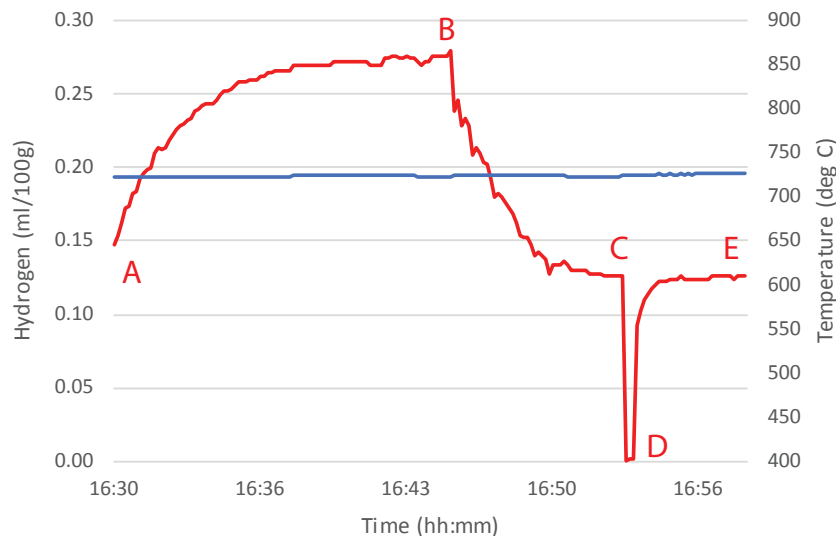
Probe Adaptor



Process Control

Traditionally, metal treatment is controlled by duration only and it is quite common that a foundry will have winter and summer settings which vary the treatment time in accordance with the varying humidity. However, due to the many uncontrollable variables it is possible to end up with a hydrogen content which is too high or even too low, leading to issues with shrinkage.

The graph below shows how this process can be monitored throughout a gassing up and degassing procedure:



- A The hydrogen level increases when feeding a hydrogen / argon mixture through the rotary degassing machine.
- B The hydrogen level rapidly decreases when switched to pure argon.
- C Degassing is stopped and a purge gas is passed through the Hycal probe - to verify the reading.
- D The purge gas is stopped and hydrogen enters the probe from the melt.
- E The Hycal probe reads exactly the same as at the end of the degassing procedure.

This procedure can be adopted to develop and optimise metal treatments independently of environmental conditions.

Other systems in the Hycal range may be integrated into the control panel of the degassing equipment, enabling direct control of the process during every treatment.

Hydrogen limits can therefore be maintained by Hycal - leading to greater productivity, lower consumable and gas usage and significantly reduced scrap.



Typical parts optimised by direct hydrogen control using Hycal.