EQUIPMENT FOR THE MEASUREMENT OF HYDROGEN CONTENT IN ALUMINIUM ALLOYS

INTRODUCTION

Substantial improvements in the quality and reliability of aluminium alloy castings can be achieved if the hydrogen content of the melt is controlled. Aluminium alloys absorb hydrogen in the liquid state and, unless it is removed, porosity will occur in the castings. Accordingly an accurate measurement of hydrogen in the melt before casting is essential to ensure that degassing operations achieve the specified quality acceptance value. This measurement is provided on the foundry shop floor by the HYSCAN Hydrogen in Aluminium Analyser. The instrument is robust, mobile and easy to use, and provides the operator with a quantitative measurement of hydrogen in the melt within five minutes of sampling. Apart from its use as a quality control tool, the instrument can be used for process investigation and for the evaluation of melt treatments.
Financial benefits also accrue from lower scrap rates and reduced energy and labour costs. These savings often allow the retrieval of the capital cost of the instrument in less than one year.

OCCURRENCE OF HYDROGEN IN ALUMINIUM AND ITS ALLOYS

Hydrogen in molten aluminium and its alloys is derived primarily from the aluminium - water reaction:

$2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$

A major source of water vapour is the atmosphere but other contributors include products of combustion (when melting is undertaken in gas or oil fired furnaces), the use of hygroscopic degassing or fluxing materials, the presence of reactive materials in the melt and hydrated corrosion products on feed material. The liquid aluminium absorbs the hydrogen formed and unless most of it is removed by degassing techniques, porosity will be observed in the castings.

Address: Viale Europa 60 - 20010 OSSONA (MI) - ITALY - Tel. +39.02.9010529 - 9010009 - 90296838 -90296632
Fax: 02.90296842 Internet: www.protecme.com - e-mail: protecme@tin.it

HYSCAN

METHOD

The instrument uses a reduced pressure technique to determine the hydrogen content. A sample of the molten alloy (100g) is poured into a small stainless steel chamber and the pressure reduced within several seconds to 10^{-1} mbar by a vacuum pump. The chamber and associated vacuum system is then isolated from the pump and the sample allowed to solidify. The operating pressure is 2-3 orders of magnitude lower than the traditional and qualitative reduced pressure tests and this ensures that during the controlled solidification of the sample, all of the hydrogen is released. As hydrogen is released during cooling a calibrated Pirani gauge measures its partial pressure, from which the hydrogen content in the sample is calculated. The results obtained are displayed in terms of cm^3/100g and can be printed or transmitted to an external data logging system. Calibration is achieved by simply introducing known volumes of hydrogen into the system and making appropriate adjustments to the Pirani gauge. The sensitivity of the measurement is 0.01 cm^3/100g and when the results obtained using the instrument are compared with those using the classical vacuum sub fusion test, a difference in readings of less than 5% is observed for standard aluminium - silicon casting alloys.

DESCRIPTION

The vacuum system, comprising a vacuum pump, desiccant chamber (to remove any residual moisture), solenoid valves, sample chamber and Pirani gauge, is mounted in a rigid steel framework supported by four heavy-duty castors. The sample chamber is sealed by a lid and Viton "O" ring and is situated adjacent to the control panel. It is heated to prevent quench cooling of the sample.

HYSCAN

SPECIFICATIONS

Overall dimensions:
600 mm × 600 mm × 1000 mm high (approx.).

Overall weight:
120 kg.

Power requirements:
240V, 50 Hz, single phase. The analyser is supplied with a 5 metre armoured power cable.

Sample weight:
100 g.

Measurement time:
5 minutes.

Range:
Up to 1.99 cm^3/100g.

Sensitivity:
0.01 cm^3/100g.

Accuracy:
Less than 5% difference between instrument method and vacuum sub fusion method.

Finish:
Blue hammer framework with white instrument control panel.