recent years, however, the intrinsic features of ultrasonic degassing stipulated comeback interest to this technology that may answer the current environmental challenges. In addition, new level of ultrasonic technology makes its application easier.

This paper reports the results of pilot-scale trials of ultrasonic degassing using a prototype specifically designed for the application, applied to two of major foundry technologies, i.e. high-pressure die casting and permanent mould casting.

A C

Ultrasonic degassing treatments were conducted for 20 min for AlSi7Mg and 10 min for AlSi9Cu3(Fe). The treatment was conducted in a crucible holding furnace with a capacity of 400 kg filled up with about 300kg. The temperature of the alloy was 690±20°C for AlSi9Cu3(Fe) alloy and 725±20°C for AlSi7Mg alloy during the degassing treatment. The experiments were conducted using a prototype specifically designed to treat large volumes of molten aluminium. An image of the prototype is shown in Fig. 1. The ultrasonic equipment used in the experiments was composed of: a 5-kW USGC-5-22 MS ultrasonic generator, a 5-kW MST-5-18 water-cooled magnetostrictive transducer, a titanium booster, all supplied by Reltec (Russia), and a niobium tip (Fig. 1). During the treatment the sonotrode was moved with the prototype over the surface of the melt. Between 4 and 4.5 kW of power in the range of 17-18 kHz were applied in the molten metal. Alternatively, a 20 min degassing treatment with a porous graphite lance bubbling N2 was introduced in the same amount of metal, with the same temperature and composition.

Fig.1 - Experimental set-up used in the experiments, general view of the prototype (left) and detail of the ultrasonic generator and wave-guiding equipment (right).

Measurements of the hydrogen with a Reduced Pressure Test (RPT) (MK, Germany) were made before and after the degassing treatment, 15 minutes and 1 hour after the treatment. Additionally, the hydrogen content was directly measured with an Hycal probe. After the degassing treatment, the melt was used to cast components using a High Pressure Die Casting (HPDC) unit (Bühler Evolution 53D), AlSi9Cu3(Fe) alloy, and a mould for Permanent Mould Casting (PMC), AlSi7Mg alloy.

One randomly selected part produced after each degassing treatment by PMC was inspected by computed tomography. Additionally, parts produced by PMC and HPDC were sectioned in order to control their tensile properties and microstructure. In Fig. 2 are presented pictures of the parts, indicating the regions where the specimens were extracted. The tensile properties were determined according to ISO 6892-1 standard.

Fig.2 - In[redacted]

T[redacted]

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1[redacted]

the contrary, ultrasonic processing, creates very small cavities that are turned into bubbles that practically do not break the oxide layer covering the melt surface [5].

Regarding the results of Hycal measurements (Fig. 3), it can be observed that the hydrogen content has a clear relation with the furnace temperature. The natural oscillation of temperature experienced by the melt, due to furnace heating system, is transferred into a similar oscillation on hydrogen value, and the effect of the degassing treatment is hidden by the temperature variation.

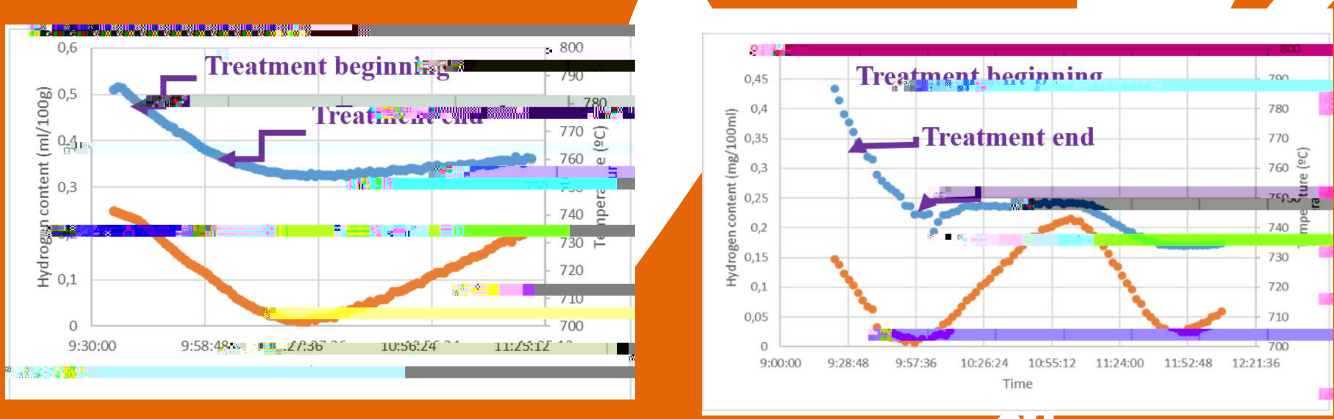


Fig.3 - Hydrogen evolution measured with Hycal equipment for the utrasonic (left) and lance (right). Blue curve belongs to measured hydrogen concentration and orange to measured melt temperature.

5 PMC parts of AlSi7Mg were selected from each batch for subsequent inspection. A tensile specimen was machined from each of the parts and tested in a universal testing machine. The results are summarized in Table 2.

As can be seen in Table 2, the results obtained with the ultrasonic degassed parts are slightly better than the nitrogen degassed parts. Nevertheless, the difference is in the level of the sum of both standard deviations, not allowing to infer any strong conclusion.

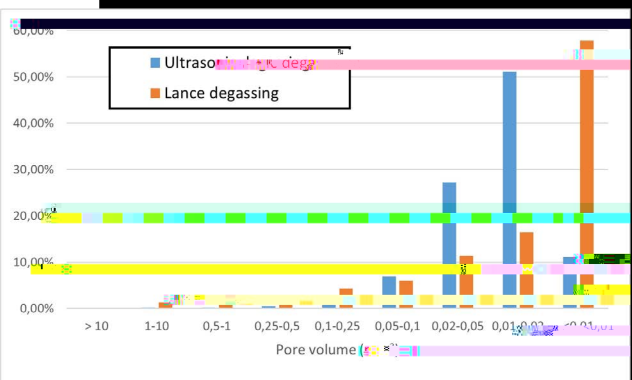
Tab.2[redacted]

Ultrasonic[redacted]

degassed[redacted]

A[redacted]

Two treatm[redacted]
min ultraso[redacted]
treatment.[redacted]
produced H[redacted]



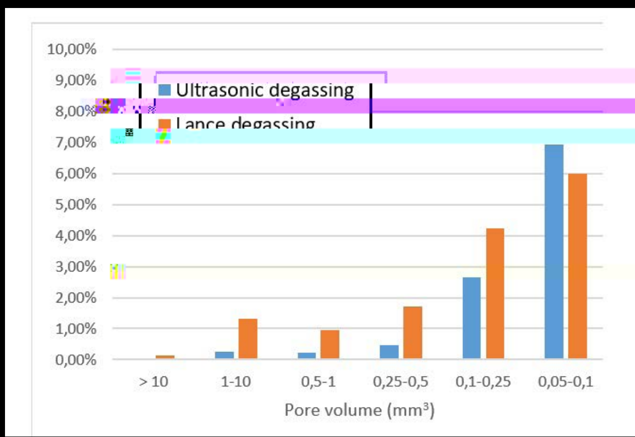


Fig.4[redacted]

Ta[redacted]

1[redacted]

1[redacted]

The lance degassing reduces the density index slightly after the treatment, and degassing continues after production has started. In the ultrasonic treatment a strange value of just 0.09 is obtained immediately after the ultrasonic treatment, but after that the other two remaining samples (3 and 4) shows similar D.I. values than the initial melt. With the obtained results, it seems that the effect of the 10 min ultrasonic treatment in the D.I. is insignificant. Nevertheless, it is observed that both treatments are not very effective with this AlSi9Cu3(Fe) alloy, having a very limited impact on the D.I. value. Regarding the dross formed during the treatment, lance degassing generates more than double of the dross that is created with ultrasonic treatment, increasing the dross rate from 0.08 % to 0.19 %.

As well, as for AlSi7Mg alloy, 5 HPDC components were selected from each production in order to characterize their mechanical properties. The values obtained in the tests for each lot of parts are summarized in Table 4. No significant differences in the obtained mechanical properties are observed between both degassing methods. All the samples present similar values of yield strength, ultimate tensile strength and elongation.

Part number	**$R_{p0.2}$ MPa**	**R_m MPa**	**$A_{t\,(corr.)}$ %**	**Part number**	**$R_{p0.2}$ MPa**	**R_m MPa**	**$A_{t\,(corr.)}$ %**

C[redacted]

[1] W. Es[redacted]

[2] G.I. E[redacted]

[3] M.B. [redacted]
Tekh[redacted]

[4] D. Es[redacted]
Mater[redacted]

[5] M. da[redacted]
produ[redacted]

[6] M. da[redacted]
press[redacted]

[7] A. Nik[redacted]
mech[redacted]
376-3[redacted]