HPI ForgeMaster – released now!

HPI's latest mould generation offers a new dimension in terms of product quality of horizontal cast aluminium. Especially for forging stock billets, the HPI ForgeMaster enables optimum solidification conditions, thus resulting in a homogenous strand formation with a uniform microstructure.

Highlights of the ForgeMaster are:

- No columnar rim (border) zone
- Peeling is not necessary, therefore complete use of cast material
- Direct forging of 6000-series wrought aluminium
- Reduced CO_2 footprint
- Painless mould maintenance due to removable wear parts.

For the first time, forging billets (6000-series wrought aluminium) are cast on a highly productive line with multiple strands without a classic rim (border) zone, as shown in Fig. 1.

Normally, an undesirable columnar microstructure forms in this rim (border) zone due to the solidification conditions. Moreover, conventionally produced billets show a rougher surface with partial oxide adhesion, making peeling unavoidable. However, this is not the case with HPI ForgeMaster. Modern manufacturing and simulation technology allow more complex mould geometries for the best solidification conditions.

Present technology requires about 2 mm to be peeled off around the billet. Considering the typical range of forging feedstock (40-130 mm), 3-10% of the aluminium is converted into chips, as shown in Fig. 2, next page.

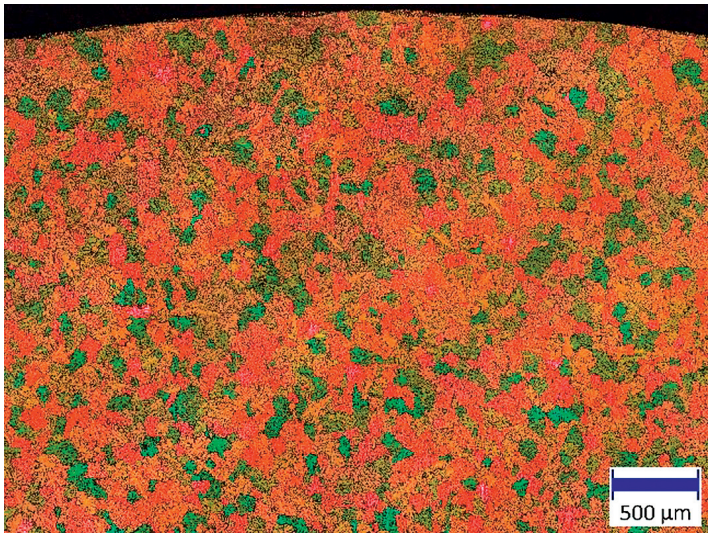

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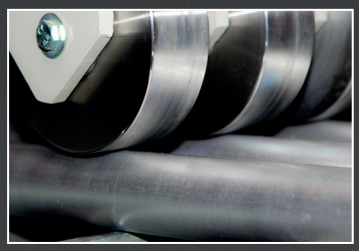
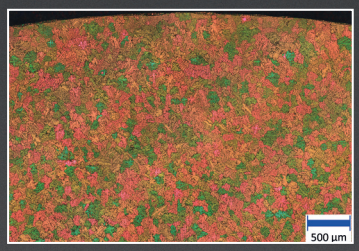
Fig. 1: Etched cross section (Barker's reagent) of 6082 (as cast – F), 54 mm diameter, cast with HPI ForgeMaster

Since the amount of generated chips is strongly dependent on the diameter of the billet, the potential savings are massive. Considering a





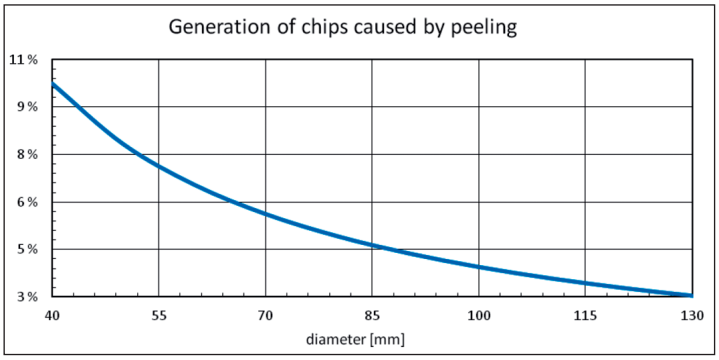


Fig. 2: Relationship between cast diameter and relative amount of chips caused by peeling

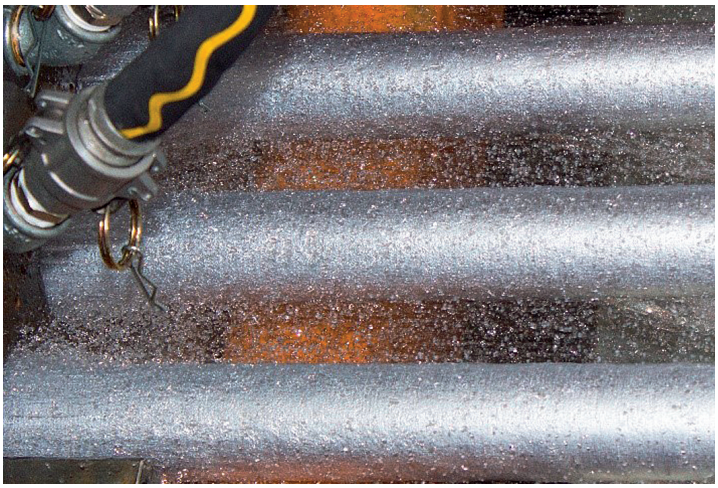


Fig. 3: Horizontal casting of 54 mm, alloy 6082, strands leaving the mould, section of secondary cooling

Fig. 4: Horizontal casting of 54 mm, alloy 6082, cast billets at the down holders

typical production line with 25,000 t/a with an average diameter of 90 mm, 4,4% of the cast material accumulates in the form of chips as in-house scrap, i.e. 1,100 t/a.

Besides the substantial economic value, the environmental impact needs to be considered as well. Depending on the technology used, a significant amount of emissions can be either reduced or avoided altogether using HPI ForgeMaster moulds. For illustrative purposes, two exemplary calculations are presented here:

A typical recycling process chain according to Das et al. [1] requires an energy amount of 2,8 kWh per kg aluminium and causes emissions of 0,6 kg CO_2 per kg aluminium to convert the chips back into billets. For a typical production line (25,000 t/a) this accumulates to 660,000 kg CO_2 and 3,080,000 kWh per year.

For an average European producer, based on the calculation method of the Federal Environment Agency (Austria) [2], and considering efficient processing (chips to cast billet) [3] with a demand of 1.2 kWh/kg Al (natural gas) and 0.4 kWh/kg Al (electrical), the consumption of 440,000 kWh electrical energy and 1,320,000 kWh natural gas still emits 418,000 kg CO_2 per year.

An additional advantage of material cast with HPI ForgeMaster is the possibility to directly forge the billets to high quality automotive components, making the homogenizing step obsolete. As evidenced by a research project [4], direct forging allows a particularly fine microstructure. Thus, the high requirements of the automotive industry are met while the energy consumption for the homogenizing process is reduced by 220 kWh/t Al (natural gas) and 40 kWh/t Al (electrically) – yet achieving the same or even better mechanical properties.

References

[1] Das, S.K., Green, J.A.S., Kaufman, J.G., et al. Aluminum recycling – An integrated, industrywide approach. JOM 62, 23–26 (2010). https://doi.org/10.1007/s11837-010-0026-6

[2] https://secure.umweltbundesamt.at/co2mon/co2mon.html (accessed: 19.07.2022)

[3] Boin, U., Linsmeyer, Neubacher, Winter. Stand der Technik in der Sekundäraluminiumerzeugung im Hinblick auf die IPPC-Richtlinie. Federal Environment Agency – Austria. Monographien Band 120 (2000).

[4]https://www.ait.ac.at/news-events/single-view/detail/ 7237?cHash=94d54e751f99adc272d6525a826a0a41 (accessed: 19.07.2022)

HPI High Performance Industrietechnik is an exhibitor at ALUMINIUM 2022, Stand: 6H42-01