

# Bone ash replacement product is safer

Bone ash, when in contact with molten aluminium, can be chemically reduced to form metal phosphides, which can react with water molecules to form toxic phosphine gas. Novelis are, according to John Courtenay and Michael Bryant of MQP, already eliminating their bone ash usage in light of this risk.

Bone ash, which in chemical terms is essentially calcium phosphate, has for many years been routinely used in the aluminium industry as a refractory sealant and a release agent. As a dry powder it can be used to seal gaps and cracks in refractory launders and as aqueous slurry it protects metal working tools and functions as an effective release agent for items such as sow pans and casting pins. The product Casiflux, marketed by MQP, enables aluminium casthouses to avoid the reported concerns that can arise with the use of bone ash. The potential problem with bone ash, highlighted by Novelis in a 2010 TMS paper, is phosphine gas generated as a result of a reaction between molten metal and bone ash coatings in some aluminium plant production scenarios.

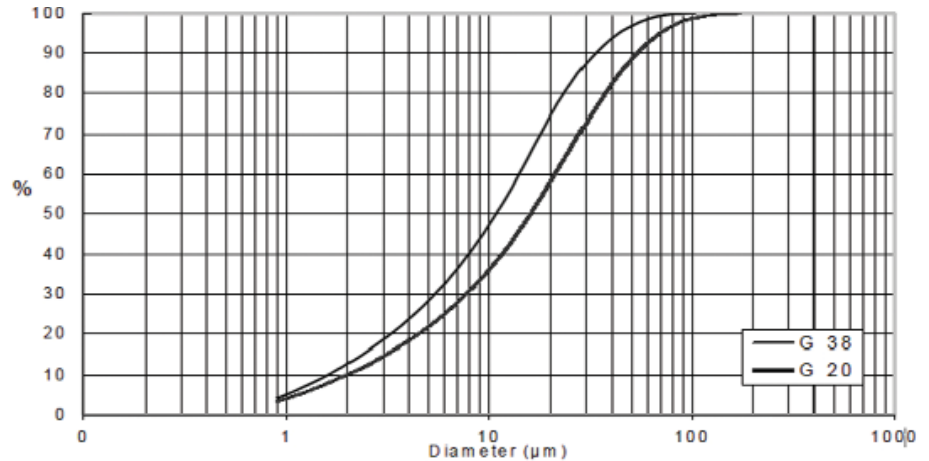
The popularity of bone ash in the aluminium industry, as a product for everyday use, lies in its combination of ease of application, low cost and non-wetting properties. In addition, the material itself is known to be non-toxic. However, as pointed out in an excellent and thoughtful 2010 TMS paper by Don Doutré of Novelis, bone ash when in contact with molten aluminium can be chemically reduced to form metal phosphides. These phosphides can then react with water or atmospheric water vapour to form phosphine gas, a toxic, unpleasant substance and potential hazard.

## Novelis investigations

The realisation that a potential hazard existed from the use of bone ash arose from a number of observations and detailed technical investigations carried out within the Novelis Group and described elegantly in the Doutré paper.

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The first substantive indications of a potential problem arose from examination of a metal control pin used for casting a 4.5% Mg alloy. The fused silica control pins were coated with dried bone ash slurry. During the casting process material adhered to the sides of the pin in contact with the molten metal. It was observed that the area of the pin in contact with the metal had changed to a dark yellow/green brown. A distinctive garlic odour was apparent when the sample bag containing the pin



Particle size distribution for Casiflux G20 and G38

was opened and this became more intense when water was introduced during sample preparation. EDX analysis revealed the presence of Mg, O and P with only a trace of Ca. This finding is consistent with the formation of a magnesium phosphide and its subsequent hydrolysis to phosphine gas, PH<sub>3</sub>, later identified with gas sensing tubes. Further evidence of a problem came from sampling of fibreglass bags used for molten metal distribution and samples taken inside dross bins and storage areas close to transfer launders. These all led to positive identification of detectable levels of phosphine.

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In addition, Novelis were concerned when it was reported by one of their dross trollers that the disposal of salt cake arising from the treatment of their dross had been associated with land fires. Further observation proved that salt cake from their drosses would emit flames when in contact with water and the gas responsible was confirmed as being phosphine. As an experiment, bone ash coating was replaced by wollastonite coating at a DC centre where the salt cake problem had occurred and tests showed that the salt cake did not produce flames or significant levels of phosphine. At this point, and on the basis of all the accumulated evidence, Novelis took the decision to

eliminate bone ash usage throughout their plants and instigated a detailed survey of alternatives.

A number of materials, including wollastonite, mica, talc, boron nitride, titania and kaolin were evaluated by exposing them to a molten 5% Mg alloy. All were found to react with the metal to some extent, some were eliminated on cost/availability and/or a tendency to form reaction clusters. One of the materials, which had previously been used as an alternative to bone ash, wollastonite, remained a possibility after the evaluation.

## A viable alternative

As MQP specialise in environmentally friendly flux products, it was natural to begin to market an alternative to bone ash known as Casiflux. This is based on specially selected grades of wollastonite, a natural calcium silicate, to give as near as possible the same effectiveness as bone ash as a dry sealant or an aqueous release agent, without the potential hazards of phosphine generation. The chemical composition and grain size distribution are of prime importance in determining the suitability of wollastonite to function as a bone ash replacement in Casiflux. The grain size distribution curves show two of the Casiflux grades found to be ideal by MQP for casthouse applications.

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## Bibliography

'Hazards associated with the use of bone ash in contact with aluminium', Don A Doutré, Light Metals 2010, pp797-800.



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