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Discussion
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Discussion: Use of recycled and secondary aggregates in foamed concretes

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The article on foamed concrete by Jones *et al.* (2012) is both interesting and timely. However, given the problems that have occurred with the use of incinerator bottom ash in foamed concrete, stronger caution should be given regarding its use. The UK Health and Safety Executive (HSE) updated its guidance in July 2010, making the following recommendations for incinerator bottom ash aggregate (IBAA) (HSE, 2010).

> Where use of IBAA is being considered it is advisable to adopt the following precautions:
>
> - Test the IBAA for the production of hydrogen by adding a sample to a solution of sodium hydroxide. If no bubbling is observed after several hours, the aggregate can be used in foamed concrete mixtures;
> - If aggregates which produce bubbling when added to sodium hydroxide solution are to be used in foamed concrete, further checks should be made for hydrogen evolution when the aggregate is included in a test sample of the intended concrete mixture. If no bubbling is observed after several hours on laboratory-scale, the IBAA can be used in applications of foamed concrete;
> - If concrete mixtures which produce hydrogen are to be used in civil engineering projects, the risk of fire and explosion must be assessed. Adequate natural or forced ventilation should be provided to keep the concentration of hydrogen in air well below the lower explosive limit. The ventilation requirements can be established using maximum rates of hydrogen production per unit mass measured in laboratory-scale experiments. In addition, sources of ignition should be avoided in the working area.

As is clear, the HSE guidance goes some way beyond the authors' suggestion of merely not using it indoors. In fact, one of the explosions that resulted from its use occurred while it was being used outdoors.

Those with an interest in foamed concrete are directed to the Concrete Society publication *Foamed Concrete: Application and Specification* (Concrete Society, 2009).

Authors' reply

Dr Barnes is thanked for highlighting this important new HSE guidance, which is commended to all producers/users of foamed concrete utilising incinerator bottom ash (IBA) as a filler. However, as noted, not all IBAs contain metallic aluminium and there is no problem using such materials when it is not present. Indeed, there is economic benefit for producers to recover metals from IBA and significant effort is being undertaken at incinerator plants to do so.

IBA most commonly has to be landfilled with the attendant economic and environmental costs and it is hoped that the paper demonstrated, at least at laboratory scale, that it can be used in a more sustainable manner. Furthermore, IBA is produced in regular quantities all year round rather than intermittently, as is the case with some recycled and secondary aggregates, making the development of supply contracts and its utilisation by foamed concrete producers more straightforward.

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