UNITED KINGDOM QUALITY ASH ASSOCIATION

3.1

Best Practice
Quality Protocol
Bound Applications

 # (Recommendations in this datasheet are given in good faith and are presented for consideration and adoption by the responsible engineer concerned)

Introduction

The Quality Protocol produced by WRAP and the Environment Agency for England & Wales and Northern Ireland defines End of Waste Criteria for PFA and FBA in specific applications. Customers are expected by the Quality Protocol to follow good practice. This Best Practice guidance is for the users of PFA and FBA within Bound applications. Further Best Practice sheets within this series provide advice on the use in Grouts (3.2) and Unbound (3.3) applications.

General

The user should ensure they comply with all the Health and Safety Executive requirements relating to the use of ash. Each producer should be able to supply detailed H&S information upon request and UKQAA technical Datasheet 9.0 gives generic Chemical and H&S Information on PFA/FBA.

There are two ways in which PFA/FBA may be supplied, dry or moist. Dry PFA will be supplied in cement tankers. Such materials should only be discharged into silos specifically designed for the purpose; Best Practice Guidance No. 4 gives recommendations for both the tanker driver and customer.

PFA may be supplied as a 'conditioned' material, depending on customer preference. Conditioned ash, ash in which a small quantity of water has been added to prevent dust, is delivered in sheeted vehicles similar to natural aggregates. Lagoon ash is also moist and should be treated in a similar manner to conditioned ash. The precautions that should be taken with PFA are no different than should be taken when stockpiling any fine grained material. The significant risks are dust blow and contamination of water courses or surface drainage systems.

When stored on stockpiles, conditioned PFA may require the surface addition of further water after delivery, especially in windy/drying weather conditions to prevent dust problems. Mist spraying is effective in maintaining the moist surface preventing dust blow concerns. Such stockpiles should be kept as small as is practicable and used as quickly as is possible. As with all materials stored outside, there should be suitable drainage systems in place to prevent water run off entering sensitive water courses or the PFA contaminating surface water drainage with the material following rain.

Depending on the nature and location of the construction being carried out, appropriate consideration should be given to the potential risks to the environment. With bound applications the PFA in likely to be one constituent used in combination with many others. Clearly it is the resulting product that could have an impact on the environment in the final construction, see the specific applications given below. However, temporary stockpiles of PFA could potentially contaminate groundwater or surface drainage systems in extremes of inclement weather. Consideration should be given to minimising such risks. In order to characterise a site and locate aquifers, reference should be made to the list of suggested sources of relevant maps given in Part 3 of the Environment Agency publication "*Underground under Threat. Groundwater protection: policy and practice.*" This would normally be done in conjunction with the main contractor, site owner or consulting engineer as appropriate.

Applications

The following are the specific suggestions for Best Practice for various bound applications.

Hydraulically Bound Mixtures (HBM) in Pavement Construction (PFA)

The PFA/FBA producer compliant with the Quality Protocol (QP) should supply the ash complying with BS EN13242: 2002+A1: 2007[i]. This should be marked on the delivery ticket. In addition the customer may request compliance with one or more other standards as listed in Appendix B of the QP, e.g. BS EN 14227-3[ii], BS EN 14227-4[iii], BS EN 14227-14[iv] and/or the Specification for Highway works[v]. This is subject to agreement of both parties, e.g. the producer and customer.

Methods of mix design, properties, etc are given in detail within UKQAA Technical Datasheet 6.0 through to 6.4. These should be consulted. HBM is normally used as a sub surfacing material in road construction and therefore should never be used in contact with drinking water. Further general information can be found on http://www.hydraulicallyboundmixtures.info/

Filler in bitumen bound materials (PFA)

The PFA/FBA producer compliant with the Quality Protocol (QP) should supply the ash complying with BS EN13055-2: 2004[vi] or BS EN13043: 200[vii]2 as appropriate. The former standard refers to lightweight aggregates to which PFA would normally be compliant. The appropriate standard which the PFA is complaint with will be marked on the delivery ticket.

Additions in concrete (PFA)

The PFA/FBA producer compliant with the Quality Protocol (QP) should supply the ash complying with BS EN 450-1: 2005+A1:2007[viii] as a Type II addition, which counts towards the cementitious content of the concrete. Where a Type I addition is needed, such as a filler aggregate, then BS EN 12620: 2002+A1:2008[ix] or BS EN 13055-1: 2002 are the appropriate standards. Normally PFA will be classed as a lightweight filler aggregate to BS EN13055-1, but some PFAs may exceed the limiting density values given and would therefore have to comply with the normal standard BS EN 12620. Where a bound material may be in contact with Drinking Water, for example concrete pipes, reservoirs, etc, the advice should be followed as given with DWI Advice Sheet No.7[x].

PFA supplied as a Type II addition is normally supplied dry in cement tankers. PFA as a Type I addition may be supplied as either dry or 'conditioned' material. For Best Practice advice on the use of PFA concretes, see UKQAA Best Practice Guide No.1.

Cementitious component in cement manufacture (PFA)

The PFA/FBA producer compliant with the Quality Protocol (QP) should supply the ash complying with BS EN 197-1: 2000[xi]. This should be marked on the delivery ticket. This standard has a requirement that PFA has a Loss On Ignition (LOI) up to 7.0% within the UK and for siliceous ashes there is a minimum value of 25% reactive silicon dioxide. There are a number of other cement related standards by which the customer may specify. In all cases these are final product standards that relate the constituent material back to the basic requirements within EN197-1.

For the manufacture of cement clinker, the QP would imply that compliance with BS EN197-1 is necessary, but then qualifies the requirement by stating "*Cement manufacturers may specify requests additional to these standards in order to balance the chemistry (e.g. silica and alkalis) in raw feed materials for cement clinker manufacture."* This by implication suggests that if an agreed producer/customer specification exists and complied with this can supersede the basic limit values with BS EN197-1. For example a higher LOI value could be supplied for PFA used as kiln feed if the alteration has been agreed and documented between the producer and customer.

Lightweight aggregate in concrete (FBA)

The FBA producer compliant with the Quality Protocol (QP) should supply the FBA complying with BS EN 13055-1: 2002[xii]. This should be marked on the delivery ticket. There are a number of other concrete related standards by which the customer may specify. In all cases these are final product standards that relate the constituent material back to the basic requirements within BS EN13055-1. FBA would normally be used in concrete for block making as both coarse and fine aggregates.

FBA is delivered in sheeted vehicles as with normal aggregates. Stockpile FBA should be treated as if it was 'conditioned' PFA and may require the addition of water after delivery, especially in windy/drying weather conditions to prevent dust problems. Such stockpiles should be

kept as small as in practicable and used as quickly as is possible. As with all materials stored outside, there should be suitable drainage systems in place to prevent water run off entering sensitive water courses or the FBA contaminating surface water drainage with the material following rain.

Aggregates in Road Construction (FBA)

The FBA producer compliant with the Quality Protocol (QP) should supply the FBA complying with BS EN 13342-1: 2002+A1: 2007. This should be marked on the delivery ticket. . In addition the customer may request compliance with the Specification for Highway Works, Series 600, as listed in Appendix B of the QP.

FBA is delivered in sheeted vehicles as with normal aggregates. Stockpile FBA should be treated as if it was 'conditioned' PFA as described above.

Ceramic tiles and brick-making

There are no specific requirements given within the QP for compliance. The producer and customer shall agree a specification and the reference to this specification should be marked on the delivery tickets.

Paints, plastics, rubber and similar (cenospheres)

There are no specific requirements given within the QP for compliance. The producer and customer shall agree a specification and the reference to this specification should be marked on the delivery tickets.

As cenospheres are particularly lightweight, the customer shall ensure that appropriate environmental protection measures are taken to prevent problems from dust and contamination of water courses.

Compliance

As shown in Figure 1 of the Quality Protocol (Page 7), compliance is partially the responsibility of the producer and partially that of the user/customer, see section 6 in the figure. The producer tests and assesses the PFA against the appropriate product standards, whereas the user/customer is responsible for carrying out good practice, as described above. While the PFA/FBA producer will provide as much assistance to the user/customer as practicable, ultimately it is the responsibility of the user/customer to demonstrate compliance as appropriate to the end use of the ash once it has been dispatched from the production site, e.g. the power station.

The producer cannot accept any liability if the PFA/FBA is misused or best practice is not followed.

In general usage the term 'fly ash' is used for pulverized coal ash but it can also cover ash from burning other materials. Such 'fly ash' may have significantly differing properties and might not offer the same advantages as ash from burning pulverized coal. UKQAA datasheets only refer to PFA / fly ash produced from the burning of predominantly coal in power stations.

References

NB: All British Standards are available from BSI, London at ***http://shop.bsigroup.com/***

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[i] BS EN13242: 2002 + A1: 2007 Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.

[ii] BS EN 14227-3:2004 Hydraulically bound mixtures. Specifications. Fly ash bound mixtures

[iii] BS EN 14227-4:2004 Hydraulically bound mixtures. Specifications. Fly ash for hydraulically bound mixtures

[iv] BS EN 14227-14:2006 Hydraulically bound mixtures. Specifications. Soil treated by fly ash

[v] The Specification for Highway Works in available for free download at http://www.standardsforhighways.co.uk/mchw/vol1/index.htm

[vi] BS EN 13055-2:2004 Lightweight aggregates. Lightweight aggregates for bituminous mixtures and surface treatments and for unbound and bound applications

[vii] BS EN 13043:2002 Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas

[viii] BS EN 450-1: 2005+A1:2007 Fly ash for concrete. Definition, specifications and conformity criteria.

[ix] BS EN 12620: 2002+A1:2008 Aggregates for concrete.

[x] Drinking Water Inspectorate (DWI) Advice Sheet 7 – Construction products for water retaining structures in water collection, treatment and distribution systems. See http://www.dwi.gov.uk/drinking-water-products/advice-and-approval/index.htm

[xi] BS EN 197-1: 2000 Cement. Composition, specifications and conformity criteria for common cements.

[xii] BS EN 13055-1: 2002 Lightweight aggregates. Lightweight aggregates for concrete, mortar and grout.