UNITED KINGDOM QUALITY ASH ASSOCIATION

CASE STUDY 6

PFA for embankments
Selby bypass, North Yorkshire

A bypass to Selby in North Yorkshire was first suggested in 1929 to relieve traffic congestion within the town. There is only one crossing over the river Ouse in the area, a swing bridge, which forced traffic through the town. Approximately 18,000 vehicles per day passed through Selby of which 40% were heavy goods vehicles. There are many reasons why the bypass wasn't built at the time of its inception. However, its construction was approved in 1993 and work finally started on the bypass in July 2001.

Figure 1 - Unloading PFA from the train

Selby bypass is a single carriageway road 10km (6.25miles) long, passing to the south of the town. It runs from Thorpe Willoughby in the west to Barlby in the east. Roundabouts have been built at each end and at the A19 and the A1041 where they cross the route. The civil engineering contractor was Skanska UK and the contract was valued at £42.6m.

The bypass was completed in June 2004. During its construction, Skanska ensured that local people were kept informed of progress by regular meetings and using a detailed and regularly updated web site.

Due to the local topography, much of the bypass was built on embankments. These were constructed using more than 390,000 tonnes of PFA from coal-fired power stations and minestone from the local colliery workings at Kellingley. The minestone was used as a fill material for embankments less than 2m high and as an encapsulating 'shoulder' to the outside faces of the PFA filled embankments which range from 2m to 10m in height. The PFA embankments are constructed on a sand starter layer which acts as a drainage/capillary break layer and approximately 100mm layers of compacted PFA up to the sub-formation level. PFA was preferred for the higher embankments due to its low density, reduced ground pressure and subsequent reduction in settlement. For comparison, minestone has a density of 2 tonnes/m^3, whereas the PFA from West Burton power station had a density of 1.53 tonnes/m^3. For full details of using PFA as a fill material, see Technical Datasheet 2.

Whilst the majority of PFA was brought in by road it was decided to opt for rail for the section of embankment between the River Ouse and Selby to Hull railway. This resulted in a significant reduction in traffic movements on the adjacent infrastructure. English Welsh & Scottish railway (EWS), Britain's leading rail freight operator, collected the material from West Burton power station, supplying approximately 105,000 tonnes of the material needed by rail. This supply was supplemented by road deliveries of PFA from Ferrybridge. Supplying by rail required a dedicated railhead. An agreement was reached with a local company, Potters Ltd, for the use of their private railhead which ran adjacent to the Bypass. At West Burton Power Station an existing railhead was adapted at a cost of £20,000 with assistance from EWS. Every day the 16 wagon train containing ~1,000 tonnes of PFA was supplied to the site and unloaded, which took about 4 hours, during the construction of the embankments. The single train operated on a 24-hour cycle. The wagons were unloaded using a special grab system developed by Rail Freight Services on contract to EWS, as shown in figure 1 and 2. Each wagon in the train was weighed separately at the power station to give control of the total train weight and material supplied.

Figure 2 - Dumpers take the PFA to the site

Figure 3 - Levelling the PFA

The PFA was supplied as conditioned material either from existing stockpiles or from the power station conditioning plant. The PFA was then adjusted for water content on site to obtain the optimum moisture content, about 27%, ensuring the material can be properly compacted. It was subsequently bladed into ~150mm layers, see figure 3 and 4, and then compacted using a Benford SP2012 vibrating roller, as shown in figure 5.

The PFA was capped using sand complying with the contract specification class 6F1A. The sand was taken from an area of the road where a cutting had to be constructed. This minimised the use of imported virgin material reducing the overall environmental impacts. The verge was also formed using minestone and topsoil. Agricultural lime was used to adjust the pH of the minestone to ensure continuing plant growth.

Environmental Considerations

As indicated above Skanska have a policy of minimising the environmental impact on any contract. Wherever possible they used secondary or recycled products. The use of PFA and minestone saved many thousands of tonnes of virgin aggregates that would have been required to construct the embankments. In fact, it is unlikely that an aggregate quarry could have supplied the quantities of materials required in such a short timescale.

Figure 4 - Levelling the PFA

An environmental assessment was carried out and the materials used were approved by the Environment Agency. A full analysis and leachate tests were carried out on the PFA, however, no significant leachate problems were found. Coincidently, in the locations where the PFA and minestone were used there were no important aquifers.

Figure 5 - Compacting the PFA

Conclusions

This project demonstrates the ability of PFA, a by-product material, to satisfy the demands of large scale construction, being readily available in large quantities, a lightweight material, with minimal settlement, environmentally friendly with many technical advantages over virgin materials.

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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 may 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.