UNITED KINGDOM
QUALITY ASH
ASSOCIATION

CASE STUDY

Millenium Coastal Park, Llanelli, South Wales

The use of PFA in land restoration

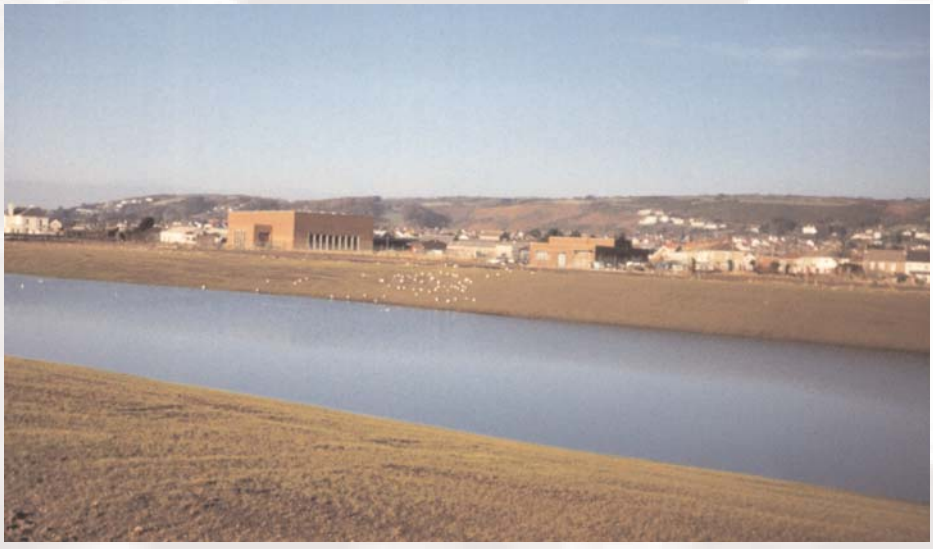
The creation of the Millennium Coastal Park at Llanelli in South Wales has led to the transformation of the old Carmarthen Bay power station site. In the year 2000 this was the site of the internationally famous Eisteddfod. In addition a number of civic amenity sites have been created for the local population and tourists. Pulverised Fuel Ash (PFA), or fly ash[1] as it is known in many countries, from the old power station lagoons has been utilised for a number of applications including:

* **Ground remediation** - capping of contaminated industrial sites in the Burry Port area.
* **Landscaping** - for creation of earth sculpture and a community woodland.
* **Lightweight engineering fill** - for backfill to land bridges and promenades.
* **Lime / cement stabilised PFA** - for sub-base in temporary roads and cycle ways.

Access bridge over the railway near Burry Port

Ground Remediation

PFA is a low permeability material, which can be used to cap sites where industrial contaminants must be contained. Typically compacted PFA has a permeability of 10^{-7} m/s, i.e. a low permeability material. When PFA is mixed with lime or Portland cement a pozzolanic reaction with time takes place that further reduces the permeability and strength of the capping material. Often such sites are returned to vegetation. This can again be achieved using PFA when blended with a source of fertiliser / nutrients.



The power station site after remediation

Landscaping

“Walking with the sea” earth sculpture at Burry Port

At Llanelli the old power station lagoons provided a readily available source of material, which was used as growing medium for landscaping many parts of the site. A series of pools, woodland, footpaths, cycle ways and general green and wooded areas have all been formed along a four miles stretch of the coastline using PFA blended with fertilisers. Both sewage sludge and silt extracted from Burry Port harbour have been used to provide a source of nutrients for such landscaping work. The harbour silt was used as a growing medium once the salts had been washed out through natural processes, e.g. rain. In many areas trees have been planted to form the Burry Port Community Woodland. Natural re-vegetation occurred so quickly that the grasses and wild plants were in danger of overwhelming the trees - showing the benefits of using PFA as a safe material for landscaping and remediation.

One site was filled with PFA up to a depth of 10m to bring it up to the desired level for future development. Approximately 100,000 tonnes of PFA was used.

The earth sculpture "Walking with the Sea" near Burry Port was formed from compacted PFA. A drainage system was formed in such a way as to be an integral part of the sculpture. This creative construction is a major feature of the coastline between Llanelli and Burry Port.

A pool created using fly ash as a fill material

Lightweight Engineering Fill

Approximately 300,000 tonnes of PFA was used as a lightweight engineering fill for the two bridges on site, which span the railway. They provide access to seaward land on the site. The bridges are segmental precast units that contain PFA, as a cementitious addition, to give added strength and durability to the structures - see UKQAA Datasheet 1 "Pulverised Fuel Ash for Concrete". They are the largest of their type built with the UK. The backfill to these bridges was PFA placed and compacted to form a lightweight fill - see UKQAA Datasheet 2 "Pulverised Fuel Ash for Fill".

Lime / cement stabilisation

For temporary haul roads PFA was stabilised with lime. These have proven to be durable during the contract period and one option proposed to use cement / lime stabilised PFA for cycle ways and footpaths. Trial areas have been produced of blends of PFA, lime and Portland cement based upon the recommendations given in UKQAA datasheets 6.0 "Fly Ash Bound Mixtures (FABM) for Road & Airfield Pavements" and 6.1 "Lime/Fly Ash Bound Granular Material (GFA) for Road and Airfield Pavements".

Granular fly ash material (GFA)

PFA and the environment

PFA has many potential uses for remediation and ameliorating industrial landscapes. Weathered PFA can be used as a suitable topsoil media when blended with a source of fertiliser. This may consist of nitrogen rich chemical fertilisers or nutrient rich materials like sewage sludge, chicken litter, etc. In the Millennium Coastal Park project sewage sludge has been used with great success.

Lime may be used in combination with PFA to stabilise some soil types increasing the soil strength parameters C_u and ϕ. PFA supports plant growth and particular species of grasses and shrubs have been shown to take root on freshly laid PFA. A wider range of species will grow on weathered PFA that is approximately two years old. Advice can be sought through the UKQAA on planting in PFA.

Removing the silt from Burry Port horbour

Facts and figures

* In excess of 400,000 tonnes of PFA used in landscaping and fill.

* A wide range of materials have been successfully recycled on the project:

  - **Silts from the harbour.**
  - **Sewage sludge.**
  - **Building materials from demolished structures on site.**
  - **Glass reinforced pipes recycled as drainage pipes.**
  - **Timber piles to be used on the Pembrey link and harbour.**
  - **River gravel's and subsoil's as capping for Eisteddfod caravan site.**
  - **Approximately 150,000 to 200,000 tonnes of colliery waste, from a nearby tip, will be used as a general fill.**

Acknowledgements

UKQAA would like to thank the Millennium Coastal Park Project, for their co-operation in preparing this case study.

[1]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 coal in power stations.