

This digest is one of a series produced by the Aggregates Advisory Service to provide information on aggregates efficiency issues.

The aim of this service, funded by the Department of the Environment, Transport and the Regions, is to assist the Government to achieve its objective of reducing the construction industry's dependence on landwon primary aggregates and increasing the contribution from secondary and recycled materials.

Further information on aggregates efficiency issues, whether relating to primary, secondary or recycled materials, can be obtained from the Aggregates Advisory Service on Freephone no.0800 374 279, or visit the AAS website at <http://www.planning.detr.gov.uk/aas/index.htm>



THE USE OF INCINERATOR BOTTOM ASH AS AGGREGATE

This digest briefly describes the use that has been made of MSWI Bottom Ash (IBA) as a replacement for natural aggregates.

Experience in the Netherlands, where the use of the ash is widespread, is described and example projects from the UK are included.

Contact Details

Address:

Energy from Waste Association
26 Spring Street
London
W2 1JA

Telephone: 0171 402 7110

Fax: 0171 402 7115

Contact: Ray Palin, Director

Further Information on Dutch Experience:

"Treatment and beneficial use of MSWI residues in the Netherlands - State of the art 1997"

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Introduction

The ash from Municipal Solid Waste Incineration (MSWI) has been used for at least twenty years in Europe as a substitute for valuable primary aggregate resources in the construction of roads and embankments. In some countries, such as the Netherlands, virtually all incinerator residue is reused. In the UK, an increasing supply of high quality bottom ash has led to it becoming accepted as a secondary aggregate with both environmental and cost benefits.

One tonne of input waste usually produces about 250kg of IBA. After processing, IBA can be put to good use in appropriate applications and locations.

Applications

IBA has been used successfully in Europe as:

- embankment fill;
- roadbase material;
- aggregate for asphalt;
- aggregate for concrete building blocks;
- daily cover material for landfills.

Why Use Incinerator Bottom Ash (IBA)?

In the UK, government policy for sustainability is promoting the reuse or recycling of industry by-products in order to minimise waste. The production of IBA is assisting Local Authorities in meeting their targets under Agenda 21.

IBA is produced from the raw ash from the MSWI after it has been cooled. At this stage, the raw ash contains ferrous and non-ferrous metals as well as a small quantity of unburnt material. These contaminants are removed during the production process and the ash is aged or “weathered” before being considered suitable as a secondary aggregate. Rigorous quality control procedures ensure that IBA presents no threat to the environment.

Dutch Experience

In the Netherlands, the use of IBA amounts to almost 100% of that produced. This is possible because of the positive approach adopted which is described below.

Working together through an industry association, MSWI companies have encouraged the introduction of **regulatory standards** governing the useful application of IBA. These regulatory measures have been endorsed by the Dutch government authorities.

Ash from hazardous waste incineration and air pollution control (APC) residues are not permitted for use in construction under this scenario. Standards have been set dealing with the weathering of the ash and maximum levels of contamination.

In addition, high standard upgrading techniques have been applied in order to obtain a consistent construction material which meets the physical and performance requirements demanded by the market.

The essential **physical characteristics** for IBA have been agreed with the Dutch road contractors association. Certification has been introduced to guarantee environmental quality and the physical characteristics of the ash. The association has set the following criteria for the re-use of the ash:

- crushing resistance factor ≥ 0.65 ,
- granule size as given in Table 1.

| sieve size | roadbase material | | embankment material |
|------------|--------------------|-------------------------|---------------------|
| | unbound % retained | cement bound % retained | % retained |
| 45mm | 0 | 0 | 0-10 |
| 22.4mm | 0-10 | 0-10 | - |
| 8mm | 10-40 | 10-40 | - |
| 2mm | 40-70 | 30-70 | - |
| 63µm | 92-100 | - | - |

Table 1 Granular characteristics of certified IBA

Some restrictions are applied to **the placement of the ash**. These are broadly similar to those for several other secondary aggregates and are set out in a code of practice.

It has been an important factor in the market acceptance of IBA that public authorities have acted as pioneers in its use. The guidelines and regulations have been shown to influence civil engineering decision makers to accept the ash in place of sands and gravels. Marketing has also proved vital in increasing awareness of the opportunities to use the ash which may otherwise be overlooked by designers and specifiers.

Minimising the Risk from Heavy Metals

In the Netherlands and United States, IBA is widely used. In some cases, to reduce the potential risk posed by contaminants, chemical stabilising agents have been used to reduce leachability. Some proprietary products such as WES-PHx® have been developed, but in most cases the mixture of chemicals needs to be adapted to the specific ash type and the given environmental conditions.

Cement stabilisation has been used in the United States and in France to achieve an environmentally stable product. In the United States a product called Rolite Aggregate is produced by mixing a water starved ash and cement mixture in a rotating drum, causing the material to be rolled into discrete round particles of sand and gravel size.

- Cleveland
- Coventry
- Deptford, south east London (SELCHP)
- Dudley
- Edmonton, north London
- Nottingham
- Sheffield
- Stoke
- Tyseley, Birmingham
- Wolverhampton

ALT-MAT Research Project

Within the framework of the European ALT-MAT project (Alternative Materials in Road Construction), the Ecole de Mines de Nantes is investigating the behaviour of old fills constructed using IBA. Their findings will be published in the Final Report of this project expected in December 1999. The results so far seem to indicate that the contamination of the underlying ground is very limited and that the mechanical behaviour of these old structures is satisfactory.

Further information on the ALT-MAT research project may be found in AAS Digest 041.

UK Experience

In the UK, the Energy from Waste Association (EWA) is co-ordinating the development of the use of IBA as a secondary aggregate. They consider that successful marketing and use of the product will be achieved through satisfying both the regulatory bodies (e.g. the Environment Agency) and customers that there is "no risk of harm to human health or the environment".

A subgroup of the EWA, the "Ash Working Group", has developed a protocol for characterisation and routine testing of ash. There is also an exchange of information on the uses of IBA.

There are currently 10 operating plants in the UK (as listed below) and others are under construction and planned:

UK Case Studies

Edmonton

Ballast Phoenix has a long term contract with London Waste Ltd to process and market the production of IBA at Edmonton, which is currently 140,000 tonnes per annum. Ballast Phoenix has a quality management system and processes the IBA to meet customer needs. The processed IBA is being sold to a broadening customer and applications base.

There are some pilot projects in existence which include:

- a joint venture project run by ONYX and Hanson Aggregates at Aveley, Essex using ash from SELCHP;
- a project between Bardon Aggregates and Dudley Metropolitan Borough Council using ash from the local incinerator;
- a project run by Ballast Phoenix at Tyseley.

The existing Aveley and Dudley projects and a future project at Cleveland are described in more detail below.

Aveley, Essex

At Aveley landfill site, a pilot project has been set up to process incinerator ash to produce secondary aggregates.

Various product sizes have been manufactured from the final screening plant to supply identified markets and include: 10mm aggregate for block manufacture,

20-10mm aggregate for coating and 40mm aggregate for bulk fill. These materials have been used in various trials.

The pilot scheme is also investigating the following issues:

- the processing operation required to manufacture aggregates acceptable to the industry;
- the application and implications of relevant planning, waste handling and licensing operations;
- the removal, recycling and disposal of metal contaminants;
- the mechanical and chemical properties of the processed aggregates;
- the monitoring of the products and potential leachates.

Netherend Lane, Dudley

Recently, Dudley Metropolitan Borough Council, in conjunction with Bardon Aggregates, has used IBA in road reconstruction. The ash was used in the base course layer of a half mile stretch of road (Netherend Lane) in a residential area of Dudley in the West Midlands.

The ash was obtained from Dudley's MSWI and taken to Castle Bromwich where it was processed by Ballast Phoenix. Then at Bardon's coating plant in Leicestershire, it was processed to produce a bituminous material called ASHphalt.

The amount of ash used was equivalent to several days of production at the incinerator. This had dual environmental benefits - avoiding the need to landfill the ash and reducing the requirement to use virgin aggregate for the road.

The percentage of ash allowable in the ASHphalt depends on local circumstances and the traffic category of the road. In this case, at least 50% of primary aggregate was replaced by ash.

ASHphalt is the subject of a patent application.

Cleveland

Construction of the Cleveland Waste Management facility will be completed during summer 1999. Ballast Phoenix has a contract to design and project manage construction of the facility followed by a long term contract to include the processing and marketing of 65,000 tonnes per annum of IBA.