

Furnace Bottom Ash (FBA) in Light Weight Aggregate (LWA) concrete blocks

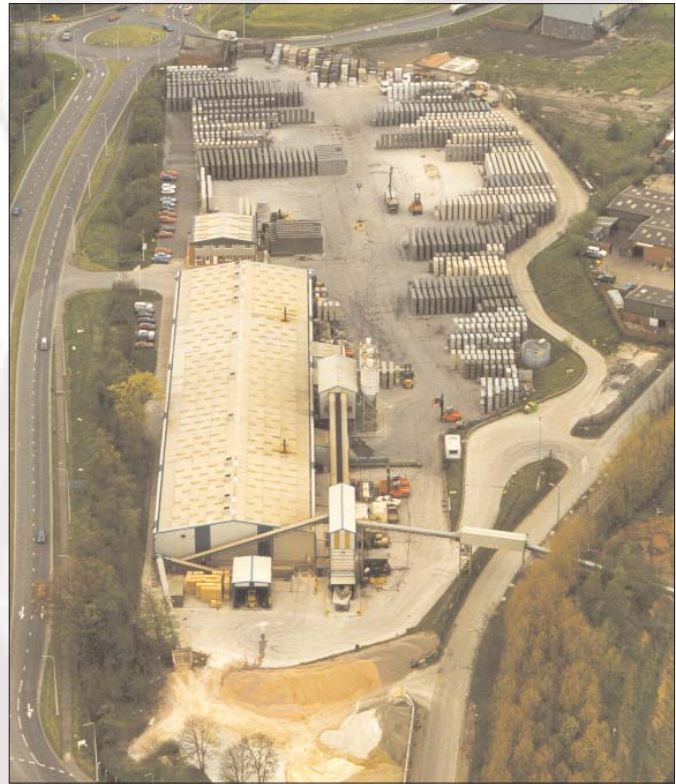
Introduction

Every year ~2 million cubic metres of LWA concrete blocks are sold in the UK for a variety of construction purposes in the concrete density range of 1000-1500 kg/m³. LWA blocks form cost-effective general-purpose load bearing or non-loadbearing masonry units with a proven track record for use above and below ground level. They can also be used as infill units in beam and block floor systems. Blocks can be produced in a standard face texture suitable for plaster and dry lining, a close textured finish suitable for direct decoration or 'fair face' where no decoration is required.

Manufacture

The majority of LWA blocks today are manufactured in modern highly automated and closely controlled factories using 'static' casting machines or mobile 'egg-laying' machines.

In a static plant cement, fly ash, aggregates and water are usually batched into and mixed in a horizontal pan-type mixer to an almost 'earth-dry' consistency which is then vibro-compacted into a mould onto a steel or wooden pallet. The blocks are immediately de-moulded and transferred on the pallet to a storage area for curing. Commonly this curing area consists of enclosed chambers that are heated at temperatures up to 80C, depending on the heat source, to accelerate the cement hydration and strength development to optimise the throughput of the plant. Blocks are then packaged into cubes of various configurations and further stored in a stockyard if required to achieve the final strength.



The use of PFA and FBA in LWA Block Production

Although many lightweight aggregates are suitable for use in LWA blocks, including sintered PFA lightweight aggregate, Furnace Bottom Ash (FBA) has been for many years and remains the most commonly used material in the UK, although the practice does not seem widespread in the rest of the world. The success of FBA and PFA in the UK may stem from their consistent range of chemical and physical properties.

FBA is collected from the base of furnaces within the power station, is usually water-cooled and transferred to stockpiles. The material is then either crushed or screened in different size fractions at the station or at the block manufacturer's site. Typical grades

used in block production are 14-0mm, 14-5mm and 5-0mm depending on the type of block being manufactured.

The density of FBA, in the range 800 -1100 kg/m³ depending on the grade used, is ideally suited to achieve the typical LWA block density range and the relevant technical properties. BS 6073 permits the use of FBA in blocks. The limits are suggested in the UK annex to BS EN 13055-1^a and the tests are detailed in BS EN 1744-1^b. Table 1 gives the important limits, which most modern power station FBA is well within.

Properties in BS EN 13055-1	Suggested Maximum Limits
Loss on ignition - masonry units	25%
Reinforced and high durability concrete	10%
Sulfate content - when expressed as SO ₃	1%

Fly Ash

BS 6073 permits the use of PFA to both BS3892 Part 1 and Part 2, though the latter material is generally used in LWA blocks. This is usually handled and transported to block plants in the dry powder form in tankers and silo-stored at the works. The function of the fly ash in this case is more as a fine filler to improve cohesion of the mix which gives benefits during mould filling, compaction and de-moulding and in modifying the texture to improve the finish of paint quality blocks. However, depending on the source of fly ash, the other mix constituents and the efficiency of curing, there can be some contribution to strength from the pozzolanic reaction with cement. The inclusion of fly ash also contributes to block durability, particularly with regard to sulfate resistance

Benefits

Overall, the use of FBA and PFA in LWA blocks has several benefits:

- The sustainable conversion of by products into a cost effective building material.
- Production of blocks with a wide range of properties and a flexible range of applications at a weight which is safe to handle manually.
- Both FBA and PFA are relatively inert materials ensuring that the units produced are stable and durable using raw materials which can be stored and handled safely during manufacture.
- The environmental impact of block production is reduced with the possibility of obtaining environmental credits e.g. when using the BREEAM assessment method.



^a BS EN 13055-1: Lightweight aggregates for concrete, mortar and grout, BSI, London, 2002

^b BS EN 1477-1: Tests for chemical properties of aggregates - Part 1: Chemical test, BSI, London, 1998