TECHNICAL DATA SHEET 7.1

UNITED KINGDOM
QUALITY ASH
ASSOCIATION

Pulverised Fuel Ash in aerated concrete blocks

Introduction

The UK market for precast concrete masonry units is approximately 8.6 million m^3 (DETR). Of this total market approximately 24% were lightweight aggregate blocks in the density range 1000 - 1500kg/m^3 (see datasheet 7.0) and 31% were autoclaved aerated concrete (AAC) blocks, also known as "Aircrete" within the UK, in the range 400-800kg/m^3. AAC blocks have high levels of thermal insulation, a high strength/weight ratio and the ability to meet acoustic and fire insulation requirements. The blocks, which conform to UK standards, contribute overall cost savings arising from a number of secondary savings. Lighter foundations and structural frames result and the need for less insulation all produce real benefits. They are easily cut, worked and laid, with minimum maintenance and low handling costs.

Manufacture of autoclaved aerated concrete

AAC is a lightweight building product used in the construction of domestic dwellings and commercial buildings. It is manufactured as blocks or steel-reinforced panels. Characterised by its fine cellular structure, with air pores ranging from 0.1 to 2mm, AAC has a high ratio of compressive strength to density. This property allows AAC to be used as a load-bearing unit where efficient thermal insulation is required. Within the United Kingdom, AAC is manufactured under quality management systems certified in accordance with BS EN 9002.

Typical AAC blocks produced with fly ash

AAC is made by reacting together finely divided calcareous and siliceous raw materials in saturated steam at temperatures above 100C (hydrothermal conditions). Steam curing of specimens within pressure vessels (autoclaves, as shown to the right) at several times atmospheric pressure ensures hydrothermal conditions are maintained. The curing process is termed autoclaving. The calcareous raw material is normally quicklime (calcium oxide), or a combination of quicklime and Portland cement. The siliceous component can be finely divided quartz, amorphous silica, or aluminosilicate glass. Fly ash, from coal burning power stations, is largely composed of aluminosilicate glass and is therefore a suitable raw material for the manufacture of AAC.

The use of fly ash in AAC block production

Most AAC made in the UK uses fly ash as a siliceous raw material. There are several advantages associated with the use of fly ash for the manufacture of AAC. Environmental benefits are achieved by using a by-product material, as an alternative to a primary aggregate such as sand. The autoclaved matrix that results from the use of fly ash, because of the influence of aluminium ions, has a high resistance to sulphate attack. A low thermal conductivity can be achieved for AAC made with fly ash, due to the low conductivity of the fly ash itself.

Manufacture of AAC is unlike that of conventional concrete or mortar. The raw materials are fine powders, without aggregate particles of any significant size and the starting point is water-based slurry. Three aspects of the process differentiate it from other concrete pre-casting methods. There is an initial "aeration" stage in which the slurry expands to form a stable cellular mass. Once stiffening of the mix has occurred and sufficient "green strength" achieved, the cellular mass is cut into individual masonry units. Finally, autoclaving at elevated temperatures (180 to 200C) promotes hydrothermal reactions, thereby forming a stable high-strength intercellular matrix.

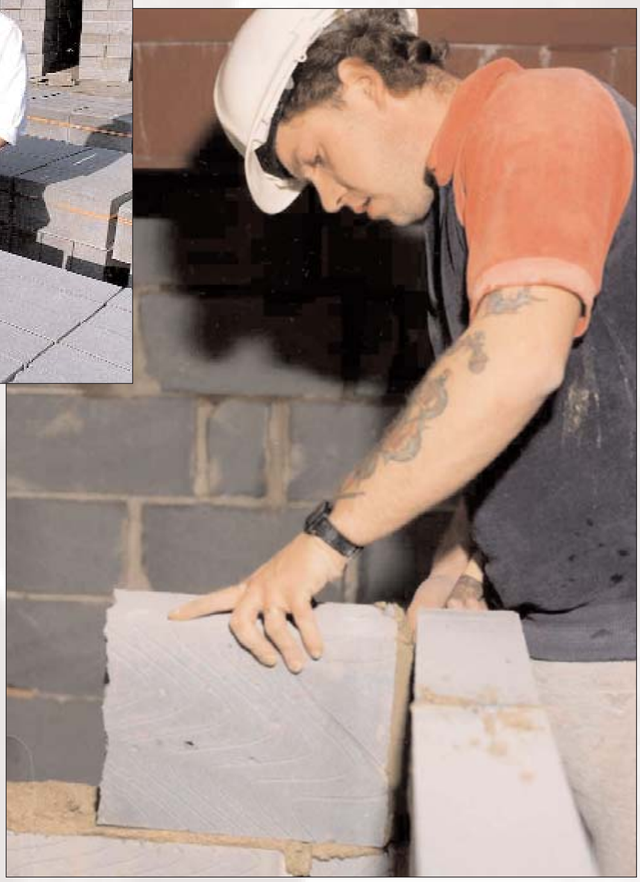
Fly Ash

Generally unprocessed fly ash, either dry or conditioned with fresh water, is used for the manufacture of AAC. The fineness specifications of BS3892: Part 1, or EN 450 are of limited relevance to autoclaved products. It is possible to use relatively coarse fly ash, because of the elevated temperatures and high alkalinity within the autoclaves. These conditions ensure the rapid dissolution of the aluminosilicate particles and increase the availability of silica for the formation of calcium silicate hydrates.

Properties of AAC

The thermal conductivity (λ) of AAC is directly related to density. Typically, λ values range from 0.1 to 0.2 W/m.K, within the density range of 400 to 800 kg/m^3 commonly produced in the United Kingdom. The high degree of thermal insulation provided by AAC enables the stringent energy efficiency requirements of the new Building Regulations to be achieved.

The compressive strength of AAC, as tested in accordance with BS 6073[a], ranges from 2.8 N/mm^2 to over 8 N/mm^2, depending on density. This satisfies the structural requirements of a wide range of building types. The drying shrinkage of AAC complies with BS 6073.



AAC blocks are resistant to frost damage and sulfate attack and have British Board of Agrément approval for use below DPC level in foundations. Soil or groundwater conditions, defined by BRE Special Digest 1[b] , up to Class DS 4 can be tolerated.

AAC is fire-resistant because of its calcium silicate hydrate matrix and is classified as non-combustible in accordance with the Building Regulations.

Manual handling guidelines prepared by the Construction Industry Advisory Committee specify block weights less than 20kg. Due to their lightweight structure, standard size AAC blocks are all within the limit.

[a] BS 6073-1: Precast concrete masonry units. Specification for precast concrete masonry units, 1981, BSI, London
BS 6073-2: Precast concrete masonry units. Method for specifying precast caoncrete masonry units, 1981,BSI, London

[b] Concrete in aggressive ground, BRE Special Digest 1, August 2001

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.