

## O1 – Aggregate-based Products

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The Other Products Zone of the Standards and Specification Area covers specialist uses of aggregates.

This Topic page covers:

- Agricultural limestone
- Armourstone
- Limestone powders
- Quicklime and hydrated lime
- Railway ballast
- Silica sands.

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### **Agricultural limestone**

The balance between available plant nutrients and the relative acidity of soil is an important factor in the development of plants and crops.

Limestone and chalk is ground and milled for sale because acid soil can be brought back to neutrality by applying alkaline agricultural limestone. Ground dolomitic and magnesian limestones are also used because the magnesium compounds they contain are beneficial to some crops.

The effectiveness of agricultural limestone depends on:

- Neutralising value
- Fineness – % passing the 0.150mm sieve
- Hardness of the aggregate
- Ease of spreading.

In the UK, the supply of agricultural limestone and other natural liming materials is controlled by the Fertiliser Regulations. The Regulations define a number of permitted names, each with a defined meaning.

Permitted names include:

- Ground limestone
- Screened limestone
- Magnesian ground limestone.

The producer must also formally declare:

- Neutralising value
- Fineness - % passing the 0.150mm sieve.

This declaration must be made in a way that complies with the Fertiliser Regulations.

A number of BS EN Standards are available for liming materials. They may be used in other countries.

Further advice can be obtained from the Agricultural Limestone Association (ALA) at [www.aglime.org.uk](http://www.aglime.org.uk). ALA is a constituent body of the Quarry Products Association (QPA).

Agricultural limestone has also been used to neutralise the effects on acid rainfall in forestry areas, upland areas, streams and lakes.

## Armourstone

Armourstone is coarse aggregate used in hydraulic structures such as sea defences and river bank protection.

Full details are given in:

Standard: BS EN 13383, Armourstone

Published as: Part 1, Specification

Part 2, Test methods

BS Guidance: PD6682-7

Guidance is also published by CIRIA as: C683, The use of rock in hydraulic engineering (2nd edition, 2007)

In the UK, work on armourstone is coordinated by HR Wallingford Ltd. The relevant websites are: [www.hrwallingford.co.uk](http://www.hrwallingford.co.uk) and [www.ciriabooks.com](http://www.ciriabooks.com)

The design of hydraulic structures armourstone is a complex topic. For large hydraulic structures, the mass of the lumps of armourstone is more important than their physical size.

The BS EN Standard uses five tables to define the size ranges for armourstone.

### Table 1 — Standard coarse gradings, defined by size (mm)

45/125	63/180	90/250	45/180	90/180
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### Table 2 and Table 3 — Standard light gradings, defined by mass (kg)

5 to 40	10 to 60	40 to 200	60 to 300	15 to 300
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### Table 4 and Table 5 — Standard heavy gradings, defined by mass (tonne)

0.3 to 1	1 to 3	3 to 6	6 to 10	10 to 15
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Table 2 and Table 4 also include requirements for the average mass of particles.

The Standard specifies other criteria, including:

- Length to thickness ratio
- Particle density
- Compressive strength
- Wear resistance
- Chemical properties.

The criteria for wear resistance use a modified form of the micro Deval test.

## Limestone powders (calcium carbonate)

Processed limestone can be used as an industrial mineral – a raw material for manufacturing industries.

Generally, limestone used as an industrial mineral is carefully selected to ensure low levels of chemical impurities such as lead and other heavy metals. It is often given its chemical name of calcium carbonate.

The production method is usually to pulverise and then grind dried limestone aggregate, followed by screening and/or air classification. The details of the production process are often chosen to suit a particular range of products for key customers.

The coarsest products usually lie in a size range between 1mm and 3mm. They are often known as granules and grits. Coarse limestone powders can be as an inert carrier of plant nutrients, and as an important source of calcium for poultry (bird grit).

A wide range of powders is available with a size below 1mm, often with a particle size distribution tailored to suit a particular customer and manufacturing process. Fine powders passing the 0.063mm sieve are usually known as fillers.

Powders and fillers have a wide range of uses, including animal feeds, paper making, glass, plastics, paints and coatings.

Very fine calcium carbonate particles are used for specialist applications in the plastics, food and pharmaceutical industries. These high-grade products are often produced as precipitated calcium carbonate, in a chemical process that involves the recarbonation of calcium oxide (burnt lime).

The trade association for limestone powders is the British Calcium Carbonates Federation (BCCF). Omya UK Ltd acts as the secretariat for the Federation.

BCCF are members of IMA-Europe, a grouping covering many uses of industrial minerals. Background information about the use of calcium carbonate as an industrial mineral can be found on IMA-Europe at [www.ima-eu.org](http://www.ima-eu.org)

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## Quicklime and hydrated lime

Quicklime and hydrated lime are the products of an industry that uses limestone and dolomite (magnesian limestone) as a raw material for a process known as 'lime burning'.

The main chemical reactions can be summarised as:

- Calcium carbonate (limestone)
- Heat at 1,100°C to give: Calcium Oxide (quicklime)
- Hydrate (slake) with water to give: Calcium hydroxide (hydrated lime)

Similar reactions occur with dolomite lime to give a mixed (calcium-magnesium) oxide and hydroxide.

The chemical properties of quicklime and hydrated lime mean that they have traditional uses in:

- Building lime – masonry mortar
- Water treatment
- Road construction – soil stabilisation, capping and subbase.

Relevant BS EN Standards include:

BS EN 459-1	Building lime. Definitions, specifications and conformity criteria
BS EN 459-2	Building lime. Test methods
BS EN 459-3	Building lime. Conformity evaluation
BS EN 12518	Chemicals used for treatment of water intended for human consumption. High-calcium lime
BS EN 14227-11	Unbound and hydraulically bound mixtures. Specifications. Soil treated by lime

Quicklime and hydrated lime are used as a chemical raw material in many industries.

The trade association for quicklime and hydrated lime is the British Lime Association (BLA), a constituent body of the Quarry Products Association (QPA). Further information can be found on the British Lime Association (BLA) at [www.britishlime.org](http://www.britishlime.org)

The use of quicklime and hydrated lime in road construction is detailed in the Specification for Highway Works - Series 600 for earthworks and capping; Series 800 for subbase layers.

The BLA website includes guidance about soil stabilisation and road construction, as does the WRAP website: [www.aggregain.org.uk](http://www.aggregain.org.uk)

Guidance on the use of hydrated lime in masonry mortar is given in the data sheets published on the Mortar Industry Association (MIA) website at: [www.mortar.org.uk](http://www.mortar.org.uk)

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## Railway ballast

Railway ballast is unbound coarse aggregate used to form the foundation of a railway track. The aggregates used in railway ballast are selected to be very hard and durable.

The BS EN Standard specifies two sizes – 31.5/50mm size and 31.5/63mm size.

Full details are given in:

Standard:	BS EN 13450, Aggregates for railway ballast
BS Guidance:	PD6682-8

Network Rail publishes a specification for track ballast that details the requirements routinely used in the UK. 31.5/50 mm size is generally used.

The Network Rail specification also has requirements for:

- Los Angeles (fragmentation)
- micro Deval (attrition/wear)
- Particle shape – Length to thickness and Flakiness.

The BS EN Standard contains a series of Annexes that detail modified test methods for use with railway ballast. This means that the property values used to assess aggregate for traditional uses cannot be applied to aggregates for railway ballast.

For example:

Los Angeles (fragmentation)	31.5/50mm size fraction tested (instead of 10/14) 12 steel balls (instead of 11) 1000 revolutions (instead of 500)
micro Deval (attrition/wear)	31.5/50mm size fraction tested (instead of 10/14) 400mm long drum (instead of 200mm) No steel ball charge; more water 14,000 revolutions (instead of 12,000)

Used railway ballast is often used as a source of recycled aggregate. Further details can be found on the WRAP website: [www.aggregain.org.uk](http://www.aggregain.org.uk)

## Silica sands

Silica occurs as the mineral known as quartz. Quartz is the main constituent of silica sands.

Quartz is a very durable mineral that is resistant to high temperatures and chemical attack. These properties mean that silica sands have many uses as an industrial mineral including:

- Glass making
- Foundry casting
- Water treatment
- Sports and leisure.

Relevant British Standards include:

BS 2975-1	Sampling and analysis of glass-making sands. Methods for sampling and physical testing of glass-making sands
BS EN 12904	Products used for treatment of water intended for human consumption. Silica sand and silica gravel

Specifications and guidance for silica sand used in golf courses and with sports turf are published by the Sports Turf Research Institute (STRI). Details can be found on: [www.stri.co.uk](http://www.stri.co.uk)

The trade association for silica sand producers is the Silica and Moulding Sands Association (SAMSA), now a constituent body of the Quarry Products Association (QPA). Further guidance can be found on: [www.samsa.org.uk](http://www.samsa.org.uk)

The amount of processing required to produce silica sand varies with the end use. Production techniques can include screening, washing and classification, fluid-bed drying and removal of heavy metal traces. Silica sand can be ground to a fine powder for some applications.

Glass making — Silica is a major ingredient of all types of glass.

Foundry casting — Molten metals can be poured into moulds made out of silica sand because the sand has a melting point above 1,600°C. Silica sand used in foundries is often treated with resins.

Used foundry sand is often used as a source of recycled aggregate, but quantities are often small. Further details can be found on the WRAP website: [www.aggregain.org.uk](http://www.aggregain.org.uk)

Water treatment — Silica sand can be used a filter medium to remove solids.

Sports and leisure — Silica sand is used for equestrian surfaces and in golf course bunkers. Significant quantities are now used in the root zone and as a top dressing for grass and turf used on golf courses, tennis courts and sports pitches.

Sports sands are often mixed with selected soils such as loam, and other additions such as cellulose fibres.