mortar industry association

Learning text part 07

mpa essential materials sustainable solutions

Production, delivery and storage of mortar

Contents

Health and safety

All mortar mixtures, both wet and dry, are abrasive and alkaline. When working with wet mortar, waterproof or other suitable protective clothing should be worn. Guidance on the use of these materials can be found in MIA data sheet No. 20.

Introduction

This learning text looks at mortar production, including the types of plant used, factory batching, transport to site and any subsequent final mixing. A glossary of terms and a bibliography are included and a section providing self-assessment questions and answers.

Major types of factory-produced mortar covered are:

- Ready mixed lime: fine aggregate (sand) mortar
- Wet ready mixed mortar, (wet ready-to-use mortar)
- Dry ready mixed mortar delivered in silos, (dry ready-to-use mortar)
- Semi dry multi compartment mortar delivered in silos
- Dry ready mixed mortar in bags, (also known as dry ready-to-use)

Within these categories are further sub divisions and other mortar types. All share the major properties of factory-produced mortars in that they have consistent quality assured properties and conform to the requirements of relevant British and European standards.

Production and mixing using a transit or truck mixer is also covered, as is storage on site.

Types of plant

There are many types of mortar production plant but this learning text covers two overall categories;

- fixed plant, where the mortar plant or factory is in a permanent location, often a quarry or industrial site;
- mobile plant, where the mortar is mixed either in the delivery vehicle or on site.

In the case of dry silo mortars, although the final water addition is gauged and mixed on site, the raw materials are accurately batched and proportioned and batched at the fixed plant or factory prior to despatch.

Fixed production plant

Fixed mortar plants are designed for the production either of wet or dry mortar. These two plant types share many features but those for dry mortar production are more sophisticated and complex. Some produce only dry mortars for bulk delivery, others only bagged dry mortars but some are able to produce both products. Most modern dry mortar plants have basic similarities, whether designed primarily for the production of bulk mortar delivered in silos or in bags.

Plants for the production of lime: sand mortar and wet retarded ready-to-use mortar

Historically within the UK, Ireland and much of mainland Europe, the most commonly occurring fixed mortar plants have been those designed for the manufacture of lime: fine aggregate (sand) mortar. In the 1970s however, wet retarded ready-to-use mortar evolved and some of these plants produced both products. Whilst still numerically greater in plant numbers, the production of mortars containing some, or all, of the final water requirement is declining while that of dry ready mixed mortar is increasing.

Mortars containing water are therefore either semi-dry, requiring the addition of cement

and some water on site, or wet ready-to-use, where the material requires no further additions or mixing. Plants in which these wet mortars are manufactured are now generally similar to or even based on a normal ready mixed concrete plant with a number of components common to the production of both concrete and mortar.

There is at least one but more commonly, two or more silos, to contain the binder or binders. For ready-to-use mortars these will typically consist of Portland cement, almost certainly supplemented by an additional material such as fly ash, (formerly known as pulverized fuel ash), or ground granulated blastfurnace slag. There may also be a silo for hydrated lime. For further details of these materials please refer to MIA Learning Text Part 2 on cementitious materials. In the case of older plant used solely for the production of lime: fine aggregate (sand) mortar, there may be just a lime silo. However, some of these plants, as well as many newer ones, also now produce retarded floor screeding mortars which contain cement and so will require at least one further binder silo.

A small number of modern plants also have a silo for hydraulic lime, but as this material begins to set in the presence of water and is not manufactured in retarded form, its use is confined to dry mortar plants. Binders will generally be stored in separate, free-standing silos but in some designs one large silo is split or sub-divided vertically to form a number of self-contained compartments.

This use of a sub-divided silo is quite acceptable in theory. In practice, ensuring that the two binder types remain separate can be a problem if the integrity of the divider or its fixing is compromised, making individual silos preferable. Silos are equipped with fill pipes to enable the binder bulk delivery tanker to link up its discharge pipe. The discharge process is often referred to as "blowing" the binder into the silo. Because large volumes of air are involved, which have to be dispersed or vented, it is necessary to provide an exit to the atmosphere.

Air that needs to be vented is dust laden and has to be cleaned of powdery material prior to release. It is therefore passed through a filter system that contains cloth, fabric or similar, often in the form of bags. The dust-laden air is forced through with the dust being trapped in the fabric while the air escapes through the fine holes. Filters rapidly become clogged and it was common practice to mount them on a frame that

could be shaken, in order to remove the dust that was filling the mesh and clogging the filter. A typical filter housing would be positioned on top of the silo so that the excess material shaken out fell back into the main body of the silo. Alternative designs, with the filter at the bottom of the plant, had the benefit of allowing easier access for cleaning and maintenance but the disadvantage that the recovered material still had to be returned to the silo.

Modern filter designs often use jets of air rather than mechanical shaking to clean the mesh. This has the advantage of relative mechanical simplicity and reliability. These systems are known as reverse air jet filters. Jets of air clean the filter medium and blow the binder in the reverse direction to that when filling and hence back into the storage silo.

A pressure relief valve is fitted to all silos. Although silos are not designed to be pressure vessels and should never be used as such, the incorporation of a pressure relief valve is a safety measure in the event of excess pressure developing. Pressure relief valves used to be retained in the closed position by means of a large spring on the inside of the cap. These have been found to stick and jam in some cases and some mortar manufacturers favour valve designs that rely on a simple counterweight, sometimes adjustable, pressing
down on the valve cap for closure. These are simple and generally require little attention.

Silo entry pipes should be clearly labelled with their contents and locked off by a lockable hatch, padlock or similar. Keys should be kept in the personal possession of the plant manager and only operated by him. Increasingly, automatic locking systems operated from the control panel are being installed. It is important to observe appropriate health and safety precautions when blowing bulk binders into storage silos and it is recommended that the publications on safe delivery of cement (see bibliography) be obtained and read in conjunction with this learning text.

Silos are equipped with access hatches and ladders. They are invariably fitted with fill level indicators in order to show when they are full during a delivery, enabling the tanker operative to cease discharge. Again, these are available in different designs, with some relying on mechanical impeding of rotation of a small rotor, others on an electrical property. Whatever type is installed, care is needed in selecting the level at which they operate, having in mind the need to allow a margin of safety when discharge is stopped. Silos may also be equipped with low level indicators to show when they require filling and some are even completely suspended on load cells so that gross weights are constantly shown and monitored.

Binder passes from the silo into a weigh hopper or, in a minority of designs, onto a continuous belt weigher, and then into the mixer of fixed mixing plants, or the back of the truck in the case of truck or transit-mixing plants. Occasionally, as in the case of a compartmentalised silo, the cement will fill one section of the silo for delivery to site. These systems are discussed later in this text.

The other major part of the plant is used for storing and weighing the second key mix component, the fine aggregate (sand). This may be kept at or below ground level in bins or hoppers, or in conveyor-fed overhead bins at the top of the plant. The use of overhead bins allows discharge of the fine aggregate (sand) simply into the weigh hopper or truck by opening a gate and relying on gravity. With ground storage, the aggregate is conveyed directly up into the mixer, Ground storage is simpler but generally requires constant mobile plant availability to keep the ground bins charged.

Admixtures are used in all factory-produced mortars. These are stored in 25 or 205 litre drums, one or two tonne polybins or in purpose-made steel or plastic tanks or silos. Admixture container tanks should be bunded with spillage protection provided by a double skin, walled enclosure or similar. Many modern storage tanks are designed with built-in integral bunds. Liquid admixtures should be protected from freezing and for this reason their storage vessels are often situated within clad parts of the plant.

Pigments are invariably finely divided iron oxides and are added as dry powders, either from silos, small bags, or via feeder/powder conveyor systems. Where silos or feeders are used, automation is possible. Alternatively, they may be suspended in water and pumped into the batch as liquids. This method leads to easy automation but needs care and probably re-cycling or stirring/agitating systems to avoid settlement and segregation. Many liquid pigments incorporate glycols during winter periods to prevent freezing which, at the levels used, are not harmful to the properties of the final mortars. The use of powders in granulated form makes them easier to handle with less dust and contamination to the working environment. Pigments are discussed in a later section of this learning text and in Part 4 of the Learning Text series.

Water is dispensed into plant via water meters or other mechanical or electronic measuring devices. Where plants use recycled water, mechanical meters may need more frequent maintenance.

Plants for the production of bulk dry mortar

Dry mortar is also ready-to-use, with the exception of the mixing water which is added on the construction site. Production utilises similar plant to that for wet mortar although the units are invariably much more sophisticated. They generally incorporate a fine aggregate (sand) drier, although this is not essential if the aggregate feedstock has been pre-dried.

Plant design for dry mortars must take account of the need for cleaning between batches and the avoidance of cross contamination. Design must also address dust control, covering initial minimisation and perhaps vacuum extraction. The risk of segregation must also be considered, particularly where materials and mixes are being transported within the plant.

In modern plants, fuel-efficient fluidised bed driers are used to dry the necessary fine aggregate (sand). These contain dust emissions and are insulated against heat loss.

Although for dry mortar it is possible to use a pan mixer like those used in plants for wet mortar production, it is usual to use a mixer that has clamshell gates. These pivot from a horizontal axis, longitudinal to the long axis of the mixer and open outwards. They are usually large so that when they open fully, the whole lower section of the mixer effectively opens outwards and downwards. This ensures that every time they are opened the complete mix is discharged, with no residual risk of cross contamination of a fresh batch.

Alternatively, air pulse mixers like those in the pharmaceutical mixing industry have been used successfully for the production of dry mortars. Most dry mortar plants also contain provision for the storage of a number of alternative binders, as well as a greater number of admixtures than would be the case for a wet mortar plant.

Plants for the production of bagged dry mortar

Historically, some bagged dry mortar production was from small, simple plants not greatly different from some wet ready mixed mortar plants, the production being largely uncomplicated basic mixes. Now, most dry bagged mortars are as sophisticated as the bulk materials and are often produced at the same plants, which are designed with provision for final discharge into either a bagging plant or bulk silos.

Site batching and mixing

Within the UK and Ireland it is rare to see anything other than a free-fall drum mixer on site. (These are so called because as the drum rotates in a vertical plane, material is carried to the top by the blades and the body, where it then falls to the bottom, to be carried back up to the top and so on in a continuous

process). In North America and continental Europe, forced-action mixers are widely used. Free-fall mixers are far from ideal. They are sensitive to the order in which materials are loaded into them and in some situations cement or other fines can adhere to the mixer, effectively changing the cement content. Once material has adhered in this way, it is difficult to remove. Ill -judged removal attempts made by banging the outside of the drum with a shovel for example, often cause distortion of the drum with the result that even more material tends to build up when the mixer is next used.

Free-fall mixers are also unsuited to the production of materials of low consistency such as semi-dry lime: fine aggregate (sand) mortars.

Primarily for the purpose of floor screed production, mixers with a horizontal shaft and attached mixing arms and blades are sometimes used on site. Such designs are usually excellent for mixing mortar, although little used at present.

Whatever the mixer type, if it is used on site to mix mortar from its separate binder and fine aggregate (sand) constituents it is desirable that the capacity is calculated so that full bags of cement may be used. Weigh batching facilities are rarely in place on site and splitting bags of cement or other binders is not accurate. If a mixer is sized to produce the desired mix proportions by using one bag of cement, followed by sufficient fine aggregate (sand): lime mix to fill the mixer volume, then there is a higher probability of achieving correct mix proportions and batch-to-batch consistency.

Mixer types

Mixers may be broadly categorised into two types:

- those in fixed locations, usually quarries or industrial sites;
- those able to travel by road to the construction site where they are required.

Fixed plant mixers

There are a number of different mixer types that are designed for use in fixed mortar plants and these have varying features and applications.

Pan mixers

Pan mixers are probably the most used. They have a vertical shaft, which carries horizontal arms, tipped with blades that rotate in the horizontal plane. In general they are simple and easy to maintain and relatively easy to

clean. Unless they are perfectly adjusted, they usually fail to discharge every trace of material when emptied. This can lead to batch cross contamination. In one form of pan mixer, the whole assembly rests on wheels or rollers and rotates. This has the potential to produce a good mixing action but is complex and can be difficult to maintain.

Twin shaft "compulsory" mixers

Twin shaft "compulsory" mixers are used quite widely and have two parallel contra-rotating

shafts equipped with arms and blades. They are robust and with externally mounted motors and gearboxes appear easy to maintain. However, they are not easy to keep clean and may not always discharge fully. They were originally designed for mixing coal slurries and do not mix as efficiently as pan mixers or purpose-made mortar mixers. They also suffer from the disadvantage that the efficient maintenance of the large gates and apertures so that there is no water leakage can be difficult, if not impossible.

Drum mixers

Drum mixers are a similar shape and operate in a similar way to the well-known free-fall site mixers. They have the great advantage of simplicity and are available in very large batch sizes, but are probably better suited to the production of concrete as opposed to mortar, However, as they have not been widely used for mortar production to date, it is possible that further experience would result in their greater utilisation. Experience shows that they do appear to suffer from the disadvantage of producing balling when used for semi-dry mixes.

Continuous mixers

Once widely used for mortar production, continuous mixer plants are now used much less. They mix continuously as opposed to batch by batch and rely on continuous belt weighers attached to the fine aggregate (sand) feed conveyer. The plant takes longer to commission and requires further calibration on a routine basis. Raw material variability may also give rise to batching accuracy doubts.

Truck mixing

Not all wet plants contain integral mixers, some merely weigh the constituent materials and discharge them into a truck with a rotating drum mixer. Mixing in this way can be effective for high-workability mortar mixes. Indeed, they can be ideal as the absence of a mixer means that there is no possibility of contamination arising from a failure to wash out after the preceding batch. This is a problematic process for busy plants because it can lead to large amounts of liquid waste that are generally difficult to dispose of economically.

Although apparently similar externally, the internal design, construction and state of repair or wear varies greatly for different truck mixers. Well maintained drums with generous "T" bladed configurations mix very well, less well-designed drums with worn blades mix far less efficiently.

Inlet design and configuration are also important. Some inlet hoppers are small and/or poorly designed and several designs rely on the presence of aggregate in the concrete mixes, for which they were originally designed, to aid the passage of fine aggregate (sand) through the hopper and into the drum. In the absence of aggregate, when used for mortar, these designs can prove prone to blocking and overflowing whilst being charged. Overall drum capacity is also an issue and the rated capacity of the unit for its primary design purpose of concrete production is unlikely to be achieved in the case of mortars of high workability.

Mobile mixing plant

Mobile plants are available where the truck chassis carries an arrangement that is similar to a very small scale fixed mortar or concrete plant. They carry fine aggregate (sand) in one hopper or compartment, cement in another and have a water tank. There are screws to move each of the raw materials and a mixing chamber so that the precise amount of material required at one time may be batched and discharged for use. The disadvantages of these machines are their cost and complexity and relatively limited capacity.

Mobile storage and mixing plant (dry mortar)

Ready mixed dry mortar that is delivered to site and stored in silos is mixed with the required amount of water by means of an integral mixer positioned at the bottom of

the silo. Because the throughput time for these mixers is very low, in the order of only a few seconds, the design of the mixer screw and chamber is critical. These mixers perform very effectively in practice and the dry mortars require careful mix design to take account of the reduced mixing energy input during the brief mixing process.

Mobile plant (compartmentalised silos)

These silos store the fine aggregate (sand) in one compartment and the cement in another with, in a minority of cases, lime or indeed any other binder in the third compartment in the case of three compartment machines. The mixing requirement is therefore more complex, as

there is a need to feed all of the materials into the mixer simultaneously.

Clearly, any interruption or change in the flow of one or other has to be avoided by careful design and consideration of their flow properties. The mixers are designed to handle damp fine aggregate (sand), with a constraint placed on the maximum moisture content, but this may prove difficult to comply with and if exceeded may result in material sticking, with the potential for inaccurate batching.

The problem of the fine aggregate (sand) sticking may also occur when dry screened or very fine materials are used. Various mechanical modifications and enhancements have been made in an attempt to control sticking and regularise flow, and silos have been fitted with vibrators and agitators, but no solution has yet been found that is perfectly adequate.

Below freezing temperatures may also cause problems when these occur for protracted periods of time with the potential for fine aggregate (sand) to freeze in the silo overnight.

Compartmentalised silos mixers

Most of these silo mixers work on the basis of volumetric batching, with the constituents being fed into the mixer at controlled rates. This concept may be adequate so long as the material flow properties are satisfactory. Variability in this area, caused for instance by the freezing or excessive moisture content issues described above, may be an issue.

These may be overcome by the compartmentalised silo systems that utilise weight batching, but these are more complex and expensive and subsequently little used.

Transport of silos

Silos of dry ready mixed mortar are delivered to site on specialist vehicles, some of which have a dual or multi-functional role. This means they are able to carry other materials and objects, such as waste skips, when not hauling mortar silos.

Silos are not usually delivered full because the gross weight would be in excess of statutory legislation. They are subsequently filled on site by blowing in refill material from a tanker.

Transport of wet ready-mixed mortars

There are many types of vehicle for use purely in delivery, as opposed to mixing and delivery of mortars and the most widely used of these are described below.

Agitators

Agitators of exactly the same type used for concrete delivery may be used for mortar, although if the same vehicle is used for both purposes, care must be taken to ensure that the drum is washed out properly after carrying concrete and prior to being used for mortar.

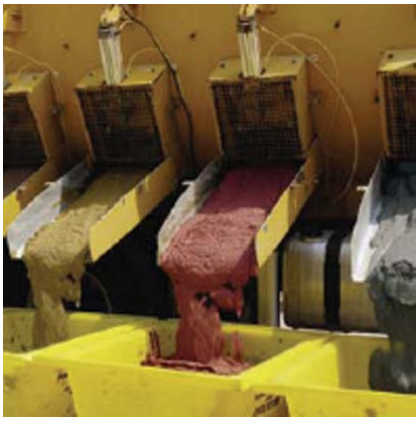
Utilisation of the full rated truck capacity can be an issue with agitators as many sites will not want to take a full load. This need not be a problem, as a "milk run" can be established with the delivery vehicle travelling from one site to another until the load is completely discharged. Clearly, discharge on site must only be made into accurately calibrated vessels in order to comply with relevant Weights and Measures legislation.

Adjacent sites may require mortar of different workability if, for example, one site is laying dense units of low suction while the next, lightweight units with much higher suction. If this means that one delivery requires additional water and mixing from the truck's own tank, then the delivery route will need to be planned accordingly.

Some agitators incorporate a small mixer at the discharge chute which allows pigmented mixes to be produced individually on a site by site basis. This enables one vehicle load of standard mortar to be delivered to several sites with a different coloured mix for each.

Multi-compartment delivery trucks

There have been a number of specially designed mortar delivery trucks, with several compartments, varying in number from two to four. These allow the delivery of mixes of different mix designs and/or workabilities on



one vehicle. Some of these are designed as demountable units, so that the delivery truck may be used as an ordinary tipper vehicle when required by removing the mortar mixing/delivering modules. Some designs allow agitation en route, with others this is not possible.

Although all of these innovations appear to be beneficial, in reality, due to their low production numbers, they are usually found to be costly both in terms of initial purchase and in running costs.

Single screw tippers

Some tipper bodies have been modified by the addition of a transverse screw to the rear of the vehicle, thus providing a rear discharge to one side, powered by a hydraulic power from the vehicle engine. These are robust and

enable the vehicle to revert to its ordinary use as a tipper when provided with a simple removable cover plate, but are unable to agitate the mortar en route, which can lead to segregation issues.

Flat bed delivery vehicles

Mortar can be discharged from a plant into vessels that are then delivered to site by Hiab or similar light crane offload vehicle. This method of delivery has the advantage of simplicity and lack of capital investment, and is robust, but offloading is slow and tedious. In addition, segregation cannot be taken account of as it can in a vehicle that is able to re-mix en route.

Site storage

Storage of mortars on site may involve a variety of plant.

Silos

On-site storage of ready mixed dry mortars is carried out in silos of various sizes. Commonly

used silo sizes are from 18 to 22m³, which hold between 27 and 35 tonnes. Various smaller sizes are also available, which are available in sizes as small as 6m³, with a capacity of 9 tonnes. These smaller silos may be delivered by crane offload vehicle, with two per vehicle allowing a delivery vehicle to visit two sites.

Twin compartment and multi compartment silos also allow storage on site but care must be taken at low temperatures that the wet fine aggregate (sand) does not freeze.

Tubs

Wet retarded ready mixed mortars may be stored on site in a variety of ways but small

tubs, with capacities of 0.2, 0.25, 0.3 or 0.33 m³ are generally used. Some of these may be transported by crane but they are not all suitable for this application. Great care must be taken to follow health and safety guidelines, to ensure that the particular skip is designed for craneage, that it does not need any special slings, grabs or related devices and that only properly trained personnel are involved.

Dry bags

Ready mixed dry mortar is produced in 25kg bags and where these are stored on site it is essential that they are covered and stored in a dry environment.
Bags should also be used in rotation and care taken to comply with the usage dates printed on each.

Wet bags

Wet bagged ready mixed mortars are produced in small amounts, primarily for the DIY and related small-user markets. The bags are closed by heat sealing or similar and should remain closed until the end of mortar working life, generally about seven days after manufacture.

Bulk wet storage

Various bins and hoppers have been used to store wet retarded ready mixed mortar on site. These have included many designs, with typical capacities of from 0.5 to 2m³, provided with a gate or similar for discharge into a wheelbarrow. The aim has been to provide a means of storing material after discharge from the delivery vehicle, with a convenient way of discharging small amounts as and when required. None of these methods has succeeded in being widely adopted. They tend to suffer from fragility and/or excessive weight and to require careful moving around the site, using large mobile plant, in order to re-position them at convenient usage points.

Stockpiles

Stocks of ready mixed lime: fine aggregate (sand) for mortar should be stored on a clean, hard, level surface, for example a concrete slab or similar, and preferably sheeted to protect the material from extremes of sun and rain. If the surface few centimetres harden due to carbonation, they may be discarded and the remainder used in the normal manner.

On-site care and mixing of factory-made mortars

The requirement for mixing on site varies according to the type of factory–produced mortar being used. Regardless of type, all dry cementitious mortars should be used within the dates indicated as a function of the maximum cement storage times. These dates will be indicated on the silo or bag.

Dry silo mortars

These require no extra equipment on site as the mixers are provided as an integral part of the silo machinery. The mortars cannot

freeze, as they do not contain any water, but in extremes of cold weather the water inlet and any water storage facility may need some protection.

Compartmentalised (multi-compartment) silos

As one of the compartments in these pieces of equipment contains wet fine aggregate (sand), freezing is a possibility. Electrical tracer wiring has been used to warm vulnerable parts but is unlikely to prove cost effective and often fails to be reinstated after maintenance or repair.

Dry bagged mortars

Storage of these mortars should be in a dry place, off the ground. Shrink-wrapped palletised bags provide a good method of storage if kept inside a structure. Care should be taken to use in rotation, according to date of delivery/production.

Ready-mixed retarded wet mortars

These materials should be used within the period of time covered by their manufacturer's stated length of retardation time. Stored quality is improved if the mortar in the bins is covered with a layer of plastic or similar. In hot weather and in the absence of plastic, a thin layer of water will suffice. If water is lost due to evaporation, which may occur to uncovered tubs, particularly in hot weather, it is permissible to replace this and to remix by hand with a shovel. It is not advised to remix mechanically or to add any further water than that lost by evaporation. If freezing occurs, this will generally only affect the top few centimetres of material, and this can be discarded and the remaining material used as normal.

Ready-mixed lime: fine aggregate (sand) for mortars

This material may be stored for several months at least, so long as it is properly protected by covering with an impermeable sheet of plastic or similar. Smoothing down the surface with a shovel prior to covering will ensure that the storage life is maximised, by reducing the surface area available to potentially carbonate. When mixing for use, it should be gauged with cement, preferably by weight but if not using a volumetric measure. Gauging by the shovel-full is not recommended as it is unlikely to be accurate.

Coloured mortars

Where a coloured mortar is specified it is preferable to ensure the use of factory-produced mortar in order to obtain a consistent result. Although some alternatives exist, it is usual to use iron oxide based

pigments, as these are stable and non-fading. Alternatives, in particular those based on carbon in the case of black and some blended browns, may well lack colour stability and are likely to lose their colour over time. Correctly chosen pigments may be handled efficiently by mechanical means and have the potential to produce coloured mortars that do not fade in service.

Dry powdered pigment

Pigments may be added to the mixer as powders, granules or liquids. These are the same in terms of their active ingredients, but represent different ways of handling. The basic powders are very fine and are therefore dusty and difficult to handle whilst maintaining a clean working environment.

Granular pigment

Granulation, achieved either by the use of small amounts of polymer, or by freeze drying or similar processing of slurries, produces much larger particles that are easier to handle mechanically and are also much cleaner to use.

Liquid pigment

Powered pigments may also be made into a slurry, that may be handled within the plant by pumping. Liquid pigments are very well suited to automated batching but care must be taken during cold weather that they do not freeze.

Health and Safety

Production and delivery of mortar involves personnel coming into contact with moving machinery and vehicles. It is essential that company safe working practices are fully observed.

Glossary of Terms

Continuous mixer
A mixer that discharges its contents in a continuous flow.

Drum type mortar mixer
Batch mixer, with a drum fitted with a series of blades that rotates about a horizontal or inclined axis.

Fluidised bed dryer
A fluidised bed dryer is an item of equipment where solid particles are made to behave as a fluid by having pressurized gas forced through them. The materials are transported easily across the bed, achieving a high rate of heat exchange without overheating.

Forced action mixer
A mixer where the material is physically pushed around by blades.

Free fall mixer
A mixer where blades inside the drum lift the materials to the top of the drum, from where they fall or cascade under gravity promoting mixing.

Gauge
The process of measuring or adding constituent materials.

High level indicator
A device to measure and indicate the full point in a silo.

Mortar mixer
Machine that combines the constituents to produce mortar.

Pan mixer
A mixer that has a horizontal pan revolving about a vertical axis.

Pigment
A substance, generally in the form of fine particles, which is practically insoluble in the application medium and for which the sole purpose is to colour cement- and/or lime-based building materials. An alternative definition is: Material used for imparting various colours to a mortar mix.

Pressure relief valve
A valve attached to a silo that monitors the pressure whilst it is filling, an audio and/or visual alarm is activated if the safe working pressure or volume in the silo is exceeded. Some systems incorporate an automatic shut off valve to the silo inlet.

Silo
A cylindrical structure for storing bulk material.

Tilting drum mixer
Drum type mortar mixer that discharges its contents by tilting the drum.

Tub
A container usually made of plastic, to hold mortar on site.

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Mortar Industries Association Data Sheet: No: 9.
Mortar Industries Association Data Sheet: No: 20.
Mortar Industries Association Learning Text: Parts 1, 2, 3 & 4.
All available free of charge via www.mortar.org.uk/resources.php

Self-assessment questions

1 What is the function of a filter within a silo system?

A .....

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2 What is a reverse air jet filter and what are its advantages?

A .....

.....

3 What is a high level indicator?

A .....

4 What is a clamshell gated mixer and what are its advantages?

A .....

.....

5 Where can guidance be found on cement deliveries and safety?

A .....

6 What is a bund?

A .....

7 What type of product should fall mixers not be used for?

A .....

8 What are the advantages of granulated pigments?

A .....

9 What is the disadvantage of a mechanical water meter?

A .....

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10 Name three advantages of a fluidised bed drier.

A .....

.....

Answers to self-assessment questions

1 To remove particles of dust (material) prior to the air being vented to the atmosphere.
2 A filter where the cleaning is carried out by jets of air directed in an opposite direction to that of filling. It has less moving parts and is therefore more reliable than mechanical alternatives.
3 A device to visually and/or audibly indicate when a silo is full.
4 A mixer with two gates that move apart and open like a clamshell, it enables complete emptying of the mixer without the need to wash out.
5 British Cement Association publications.
6 A wall or other protective barrier to control any spillage or leakage.
7 Products with a low level of consistence (workability).
8 They are cleaner, with less dusting.
9 It may become blocked if used with recycled water unless regular maintenance is undertaken.
10 They produce less dust, a lower exit temperature and are more fuel efficient.

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The Mortar Industry Association is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, lime, mortar and silica sand industries

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There is a real danger of contact dermatitis or serious burns if skin comes into contact with wet mortar. Wear suitable protective clothing and eye protection. Where skin contact occurs either directly or through saturated clothing wash immediately with soap and water. For eye contact immediately wash out eyes thoroughly with clean water. If swallowed wash out mouth and drink plenty of water.

The relevant codes of practice, standards and statutory regulations must always be observed.