INGEOSA® is an engineering company whose activity is focused on Silo Technology and Systems & Components for the cement and allied industries, operating at national and international levels in both areas. The good name of our company comes with the endorsement of our broad experience, technical expertise and a policy of constant review. When it comes to looking after our customers, quality, service and professionalism have always been our watchwords.

References

**Cement Industry · Spain**
- Financiera y Minera (Italcementi)
- Tudela Veguín
- CEMEX España
- Cementos Portland Valderrivas
- Uniland Cementera
- Cementos Leoma
- Cementos Alfa
- Holcim España
- Lafarge Asland
- Cementos Cosmos (Cimpor)
- Materiales del Atlántico (Cimpor)
- Cementos Especiales de las Islas
- Cementos Molins

**Cement Industry · Other countries**
- Cimpor Portugal
- Asment de Témara · Cimpor Maroc
- Ciments de Jbel Oust · Cimpor Tunisie
- Cimpor Moçambique
- Lafarge France
- Lafarge Cement UK
- Lafarge Cementos · Honduras
- Lafarge Malayan Cement
- Lafarge România
- SCB Lafarge Benin
- Ciment de Mauritanie
- Nghi Son Cement Corp. · Vietnam
- CEMEX Dominicana
- Sotacib Tunisie
- Continental Cement · USA
- Cementos La Cruz Azul · México
- Cementos Lima · Perú
- Titan Cement Greece

**Engineering Companies**
- Taiheiyo Engineering Corporation
- FLSmidth
- Polysius
- Sthim Maquinaria
- PHB Weserhütte
- Taim Weser
- Metral
- Vidmar
- Christian Pfeiffer
- Fredenhagen
### SILO TECHNOLOGY

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVERTED CONE SILOS</td>
<td>4</td>
</tr>
<tr>
<td>DOME SILOS</td>
<td>10</td>
</tr>
<tr>
<td>SILO MODERNIZATIONS</td>
<td>12</td>
</tr>
<tr>
<td>SILO CONVERSIONS</td>
<td>14</td>
</tr>
</tbody>
</table>

### SYSTEMS & COMPONENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRSLIDE CONVEYING</td>
<td>16</td>
</tr>
<tr>
<td>SILO EQUIPMENT</td>
<td>18</td>
</tr>
<tr>
<td>BULK LOADING</td>
<td>20</td>
</tr>
<tr>
<td>PNEUMATIC CONVEYING</td>
<td>22</td>
</tr>
<tr>
<td>SCREW CONVEYORS</td>
<td>23</td>
</tr>
</tbody>
</table>
During the last few decades, inverted cone silos have become the standard of silo technology. With the constant increase in size of the production facilities in the cement industry, there has been a corresponding increase in silo capacity. Large scale silos with dimensions of up to 28 meters diameter, heights of 55 meters and capacities ranging up to 30,000 tons, must be so designed that they can be efficiently emptied. Although filling of silos never presents noteworthy problems, much attention has been paid over the years to the development of silo bottoms. Inverted cone silos can ease the problems connected with an undisturbed discharge of material. The substantial feature of this design is a cone whose apex is arranged steep upwardly and the basis is located centrally at the silo bottom. An annular space between the cone and silo walls is maintained. The silo base itself is divided in aeration sectors and covered with air-pads that have an air-permeable fabric on the upper surface. The aeration air is introduced under the fabric at a determined pressure and specific velocity to fluidise the stored material. These sectors are automatically aerated in sequence one after the other during discharge operation so that all of them are activated in a complete cycle. This creates the so-called flow vortices above each sector which, if controlled, secure an even lowering of the material level over the total cross-section of the silo. Only a small amount of air is required for enlivening the material of each sector, which results in a low specific power consumption. The inverted cone displaces the descending material from the centre towards the silo wall avoiding the formation of dead zones. More than a 99% recovery is possible with this technology. Further to process benefits, the cone-shape of the silo bottom offers static structural advantages and free space under it to accommodate the necessary machinery and equipments. In cement plants having lack of space or if two or more materials need to be stored in the same silo, the erection of a multicompartment silo should be consid-

**WHAT WE OFFER**

- Project support
- Single source responsibility
- Engineered systems
- High performance
- Reliability and versatility
ered. These storage facilities offer the same benefits as single compartment silos, but with the advantage that it is possible to unload simultaneously several materials or by choice only one type each time. Raw meal blending technology has also benefited from inverted cone silos. With modern quarrying methods and efficient blending beds, a substantial degree of homogenization is achieved already before the raw meal is supplied to the mill. Although this improves the chemical uniformity of the material, it is still not enough to comply with the strict requirements of present day burning processes. Raw meal composition shows some residual variation which needs to be reduced as far as possible. Inverted cone silos allow for a continuous blending of the material with a low specific power consumption. The working principle is the storage of horizontal layers with different qualities, followed by the vertical blending of these layers when discharging the silo. To avoid segregation during loading, the raw meal is fed into the silo through a parallel distributor. Compared to a conventional storage silo, the number of airslide arms is increased and thus the formation of repose slopes is avoided. When discharging the silo it is possible to generate several flow vortices that go through the entire charge of raw meal. The material reaches the control bin where a constant level is maintained. This ensures an even discharge behaviour and an optimal feed flow of material.

▲ Three chamber multicompartement silo · Rezola Arrigorriaga (Italcementi), Spain
◄ Aeration section and silo outlet
◄ Silo recovery of more than 99%
Control bin extraction lines

Control bin bag filter

External chamber extraction system
INVERTED CONE SILOS

▼ External chamber extraction line

▲ Control bins corresponding to external chambers
Thin-shell concrete dome structures are becoming more popular as a method of storing bulk materials. An efficient use of land and space, strength, durability, a better protection of stored materials, a rapid construction schedule and cost are some of the reasons why companies select these type of structures. New technological advances in pneumatic reclaim systems have made dome storage an economical storage solution for cement, fly ash and other materials that can be fluidised. By dividing up the dome’s floor into sectors, the power consumption for withdrawal can be as low as for conventional silos. INGESOA® offers complete loading, discharge and bulk loading systems for dome silos. Our reclaim systems include innovative solutions such as central discharge with extraction tunnel, inverted cone, internal dome, radial discharge or extraction ring.
Dome bottom airpad distribution ▼

Double extraction line ▼

Cement loading into buffer hoppers ▼

Tanker loading station ▼
A silo of an older and outdated design no longer complies with modern production and dispatch requirements. Interruptions in material loading, unnecessary waiting times and even production stoppages always mean a cost penalty. Modern reclaim systems require the re-equipping of existing old silos, mainly to avoid discharge problems, dead zones and an excessive energy consumption. Further to the cost issues, dead zones in inefficient old silos require a periodical clean out to remove hardened material. These kind of works are very dangerous and can even lead to death. At INGESOA® we offer silo revamping solutions to avoid the aforementioned problems. By working closely with our clients, we design systems that comply with modern requirements. Engineering and equipment supply from a single source ensure unproblematic functioning of the complete system.
Articulated airslide conveying line for barge loading · 600 tph of cement

Bulk loading system
Frequently grain silos in ports are converted into cement import or export terminals. These facilities require a different technical approach in comparison with their previous function. After a structural assessment has been carried out, the lay-out and capacity is defined taking into consideration all the constraints.

As for conventional silos, INGESOA® supplies the entire range of solutions required to convert an existing grain storage facility into a state of the art cement, fly ash or milled slag logistic terminal.
Further to conventional silos, liquid tanks can be converted into cement or fly ash storage facilities after a structural assessment is completed. Our flexible solutions meet the specific needs of our clients.
Airslide conveyors have been used extensively in cement industry for decades. In situations where the flow of material can be downwards, they reduce significantly plant capital and operating costs in comparison with conventional pneumatic or mechanical conveying systems.

This technology allows for a wide range of fine-grained bulk solids to be conveyed at a very low velocity. They are widely used for materials such as cement, fly ash, raw meal, milled slag or iron powder. At INGESOA® we offer complete engineered airslide conveying systems provided with a complete range of accessories.

THE IMPORTANCE OF AIRSLIDE VALVES

The flexibility of airslide conveying systems depends fundamentally on the diverter valves employed. In many cases the conception of these valves has not been carefully done, resulting in undue material leakage.

It is not easy to find a supplier with a wide range of airslide conveying in-line valves and even more difficult if full tightness is essential. Many problems in cement plants may appear when leakages through this type of valve occur.

The first case is typically found in multiple silo systems or in multi-compartment silos. The individual member silos of these systems or the individual compartments are generally filled one after the other rather than simultaneously. Mixing or contamination due to material leakages through the diverter valves generally means a cost penalty.

The second typical case is found when feeding bucket elevators. The load on the belt results from the weight of product lifted added to the dredging drag as the bucket scoops up the product. This dredging load for fine-grained materials such as cement is relatively low. When two or more elevators are fed with material coming from a common airslide conveying line, leakages through the diverter valves may overfill the boot of the elevators that are not in motion. When these elevators start-up, the dredging drag is too high and the system bogs down. If the elevator is conveniently

INGESOA® AIRSLIDE SYSTEMS BENEFITS

- Economical and energy-efficient
- High capacity and long distance
- Reliable and versatile
- High performance
- Dust-tight
- Engineered system
- Single source responsibility
- Project support
- Well proven technology
protected, a sensor connected to the non-drive pulley stops the motor and the in-feed system. The immediate solution is to manually access the boot for cleaning, resulting in both wasted time and money.

The third problematic situation can be found when feeding screw pumps. Where possible, many silo loading systems provided with these devices have been substituted with bucket elevators due to their high energy consumption. In many cases, the pneumatic conveying line is not removed and it is used when the bucket elevator fails or maintenance operations need to be carried out. This generally means that both bucket elevator and screw pump are fed with material coming from a common airslide conveying line.

It must be emphasised that screw pumps are designed to rotate against an offset load, not to instigate shear in the inlet. For this reason, if leakages of material through the diverter valves occur when the screw pump is shut down, then the supply hopper is fed with material, and in the inlet region the torque required to first initiate movement has to overcome the shear strength. This torque in extreme cases is more than ten times the ‘normal’ running one. Consequently, the motor is not able to start up under load. Once again, we can see the importance of using completely tight airslide conveying in-line valves. The same issue is also applicable to screw conveyors.

**INGESOA® INNOVATION**

The INGESOA® patented leak-proof seal for powdered products has been designed to solve these problems. This leak-proof seal is applied on a metal rotor and is made up of a strip of felt pressed by a support arm, which is pushed by disc springs. A leak-proof seal is thus obtained, maintaining the predetermined desired pressure, as well as a guarantee of tightness even if the felt wears down, since the springs correct it constantly. This feature ensures leakages in cement plants can be avoided and the benefits of airslide conveying can be fully realised.
In the cement industry powdery materials are treated in silos. The most cost effective solution to resolve discharge problems in silos is actually to fluidise powders in order to promote flow by insufflating low pressure air. Integral features of such silos comprise aeration equipment for enlivening the material to assist its discharge and flow regulating devices. At INGESOA® we dispose of a complete range of equipments capable of discharging silos in a simple and clean way.

FLOW CONTROL GATES

INGESOA® Flow Control Gates provide precise and continuous adjustment of the bulk material flow from silos and/or quick dust-tight positive shut-off. The typical materials handled are cement, fly ash, raw meal and milled slag. These units consist of a complete enclosed body and a bottom air pad to prevent tearing off or deceleration of the material. The main part of the flow control gate is a roller-shaped rotor supplied with a specific aperture. Depending on the position of the drive, a certain cross-section is open for material discharge from the silo. Different operating conditions require specially shaped apertures. The standard triangular cross-section is the most appropriated for nearly all the metering applications of average accuracy. The trapezoid aperture with an extended cross-section is particularly indicated when higher flows are required and the linear aperture when a linear dosing is needed.

▲ Typical silo extraction lines
◄ Flow Control Gates with Electropneumatic Positioner

INGESOA® SILO EQUIPMENT FEATURES

- High capacity - 70 to 1000 m³/h
- Reliable, versatile and trouble free
- High performance
- Dust-tight
- Engineered system
- Single source responsibility
- Project support
- Well proven technology
Various drive options are also offered for different functions. Manual gates offer the most basic on/off and flow regulating capabilities. Flow control gates with pneumatic piston provide positive cut-off or unrestricted flow. Three position control may also be achieved with this type of drive. Motor actuated gates provide a continuous flow control of material. Other options with electropneumatic positioners or servomotors are specifically indicated for a precise control of the material throughput quantity.

All types of INGESOA® Flow Control Gates are provided with a switch box with two or three limit switches and optionally with a potentiometer for remote control indication. Another interesting feature is the manual override to disengage the actuator in case of emergency closure.

Disintegrated before reaching the flow control gate, so that the crushed lumps pass without problems. These units consist of a rotating shaft with blades arranged radially and displaced longitudinally. The blades draw the lumps against a grate where they are crushed. An integrated rotary sensor indicates the correct functioning of these equipments. An over-engineered design and sturdy construction ensure trouble free long life.

**SLIDE GATES AND AERATION EQUIPMENT**

Further to the equipments described before, our product range also includes all the ancillaries required for silo discharge, such as air pads, aerated boxes and slide gate valves. These valves are mainly used to prevent material penetrating the rest of the extraction system when maintenance activities are carried out on flow control gates or other units. The modular concept of the INGESOA® Slide Gate Valves allows for a quick an easy exchange of the different drives available, within the same valve.

**LUMP CRUSHERS**

Specific types of cement show a certain degree of stiffening during storage in the silo, which is mostly caused by prehydration. Parts of the stiffened cement break loose sometimes and flow together with the fresh cement, which is easy to convey, in the direction of the silo discharge, where they create disturbances. By using a lump crusher the solidified cement is being
The most important requirement applicable to bulk loading systems is that they must enable the material to be fed into bulk carrier vehicles under dust-free conditions. Further to this requirement the system must be reliable and simple to operate, so that it can be worked by the vehicle drivers themselves. The INGESOA® Loading Spouts for enclosed vehicles have been designed to cope with the environmental issues and intensive use to which they are subjected in the cement industry. These units use a solidly constructed telescopic steel tubing, housed within an external de-aerated flexible duct. By using a telescopic tubing instead of guided cones, the wear on the spout is dramatically reduced. A cardan mechanism at the inlet of the aforementioned telescopic tubing allows for the spout to be manually positioned in the horizontal plane by the plant operator or the vehicle driver. These units are equipped with a sealing cone which covers the entire discharge mouth - de-aeration ring included - and a false air inlet to avoid damages to the flexible sleeve.

At INGESOA® we also offer Loading Spout Positioners capable of up to 9 meter travel. Positioners increase speed and efficiency in any loading operation. These equipments use a flexible casing provided with a self-tensioning system, which permits the appearance of a vacuum environment inside the hopper that allows for dust-free operation. The dust is drawn through the spout and positioner and can be vented with a central dust collector. Operational reliability is achieved by avoiding the use of articulating airslide arms.

---

**INGESOA® BULK LOADING FEATURES**

- High capacity - 250, 440 and 700 m³/h
- Heavy duty construction
- High operational reliability
- Dust-free
- Engineered system
- Single source responsibility
- Project support
- Well proven technology
Further to the bulk loading equipments described before for outloading powdery materials, the product portfolio of our company also includes Open Storage Loading Spouts. These units have been specifically designed for clinker handling. The use of a telescoping system instead of guided cones reduces significantly the wear on the spout. A three cable hoist system ensures maximum stability. These spouts include an outer flexible sleeve and a rubber skirt that contains the dust emissions produced during loading. Two connections for an extraction system are provided on the inlet frame. A signal from the indicator mounted in the outlet, automatically actuates the incremental raising of the chute during outloading so as to keep the outlet tracking the product feed.
INGESOA® Screw Pumps have been specifically developed to transport dry, fine-grained, bulk materials as are found in the cement industry. Such pump systems are suited for conveying fluidizable materials from mills and filters to silos, for kiln feeding or for ship loading and unloading at long distances. In order to reduce costs, the maintenance intervals are shortened by considering wear protection in the design of these units. Appropriate materials and surface qualities are selected for each part and an optimal pressurized sealing is applied to the bearings.

The specification of components for pneumatic conveying systems does not end with the pump, pipeline, air mover and filtration system. There are likely to be many bends and diverter valves on the plant and their importance is significantly magnified if the material to be conveyed, such as cement, is abrasive at high velocities. Both bends and diverter valves represent major issues in pneumatic conveying and are responsible for the majority of operating problems. INGESOA® Spherical Bends and Two-Way Diverter Valves have been specifically designed to minimize operating issues in pneumatic conveying systems. The working principle of our bends rests on the air velocity reduction due to a larger section and the appearance of turbulences to avoid material blockage. On the other hand, the internal mechanism of the two way diverter valves works on the principle of a Ni-Hard sliding disc that provides a seal against the inlet to either pipe._

INGESOA® PNEUMATIC CONVEYING

- Conveying capacity to 323 m³/h
- Heavy duty construction
- High operational reliability
- Continuous conveyance
- Engineered system
- Single source responsibility
- Project support
- Well proven technology
In many situations the use of bucket elevators is not possible due to space constraints. In other cases the required lifting height is too low to justify the installation of one of these devices. If the material to be conveyed is not extremely abrasive, the use of a Vertical Screw Conveyor may solve these issues. The conveying effect starts when the friction between material and screw conveyor housing is higher than the friction between material and the helix. Below a certain number of revolutions, vertical conveying is not possible. **INGESOA®** Vertical Screw Conveyors have been designed to provide maximum reliability by using wear resistant metal carbide intermediate bearings. They are easily replaceable and no additional lubrication unit is required. The loading box is permanently fluidized and no direct dedusting system is needed. Lifting heights of more than 25 meters and capacities of up to 350 m³/h are achievable. Further to these equipments our product range also includes the traditional Horizontal and Inclined Screw Conveyors and Feeders.

**INGESOA® SCREW CONVEYORS**

- High conveying capacities
- Heavy duty construction
- High operational reliability
- Dust-free
- Engineered system
- Single source responsibility
- Project support
- Well proven technology