



# Clinker Storage Systems



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# Clinker Storage Systems

The AUMUND Group Equipment for the Cement Industry is being applied world-wide in more than 10,000 plants.

Design, implementation and modernisation of clinker storage installations, customised as per requirement, achieve maximum customer benefit.

- Adapted to the customer's specific requirements, all transport processes are constantly optimised based on innovations and the latest technical know-how.
- Combining economic and ecological aspects including future demands, balanced solutions are considered.
- High safety standards in all functions and under all conditions have been proven world-wide in technology, quality and reliability.

To receive an optimum overall conveying and storage layout, early involvement of AUMUND's experienced layout engineers is recommended.



Circular storage hall 150,000 t



Circular storage hall 60,000 t



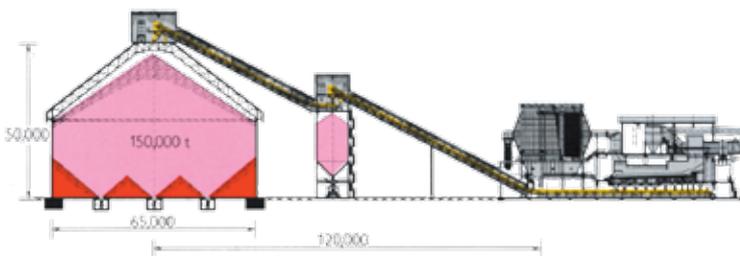
Circular storage hall 2 x 75,000 t

# Circular Storage Hall without Central Column

Storing capacity from 50,000 to 250,000 t

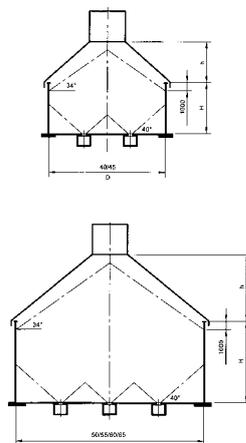
These circular storage halls consist of a pretensioned reinforced concrete cylinder with a diameter of 40 to 80 m and a height from 10 to 25 m. A cone-shaped roof structure is arranged above the concrete cylinder. The roof is a self-supporting steel frame covered with trapezoidal plates. Special sealing elements at the joints of the trapezoidal plates make the roof structure dust-tight. For compensation of thermal stresses, the roof structure is arranged on special sliding bearings which are installed in the upper edge of the concrete cylinder.

The roof structure supports the headhouse with the drive station of the pan conveyor and the filter systems for dedusting of the storage hall. The diameter and height of the headhouse are determined to suit the dimensions of these systems. For all circular storage hall diameters, the main dimensions of the roof structure and headhouse are standardised. The storing capacity of these circular storage halls ranges from 50,000 to 250,000 t. Larger capacities can also be realized. Due to the reduced system height and the large diameter, it is also possible to build these circular storage halls on soils with a low bearing capacity. A minimum of approx. 500 kN/m<sup>2</sup> is required.



Circular storage hall without central column

D m	H m	h m	Storing capacity		Discharge rate %
			t	m <sup>3</sup>	
40	15	14.1	34,900	23,250	80
	20	14.1	44,300	29,500	84
45	15	15.8	45,500	30,300	76
	20	15.8	57,400	38,800	80
50	25	15.8	69,300	46,200	84
	15	18.7	57,800	38,500	81
55	20	18.7	72,500	48,300	84
	25	18.7	87,200	58,200	87
60	15	20.5	71,900	47,900	79
	20	20.5	89,700	59,800	82
65	25	20.5	108,000	71,700	85
	15	22.1	88,000	58,700	81
70	20	22.1	109,000	72,800	84
	25	22.1	130,000	86,900	87
75	15	25.0	106,000	70,700	83
	20	25.0	131,000	87,300	86
80	25	25.0	156,000	104,000	89



The material is discharged to two to four discharge tunnels, depending on the storage hall diameter. A discharge rate of approx. 85% is achieved.

During the loading process, the clinker segregates and forms cones according to the particle size. A homogenous clinker mixture is, however, an essential condition for the performance of cement mills. Therefore, it is recommended to systematically shift the silo discharge gates in order to blend the different particle sizes in the silo. In addition, regular shifting of the discharge openings ensures that the stored clinker level in the silo lowers uniformly, thus avoiding early discharge of fresh clinker.

Circular storage hall with concrete cylinder and steel roof without central column

Preferred sizes

For total residue discharge, additional evacuation equipment is required.

Storing capacity in t with a bulk density of 1.5 t/m<sup>3</sup>.



2 x 60,000 t silo

## Cylindrical Concrete or Steel Silos

**Storing capacity from 30,000 to 60,000 t**

These silos are made of reinforced concrete or prefabricated special steel. Due to the comparatively small basis, a high discharge rate of approx. 75 % is reached by means of one discharging conveyor only. This implies that the complete material stored in the silo can be extracted to a large extent by gravity discharge, without using mobile evacuation systems.

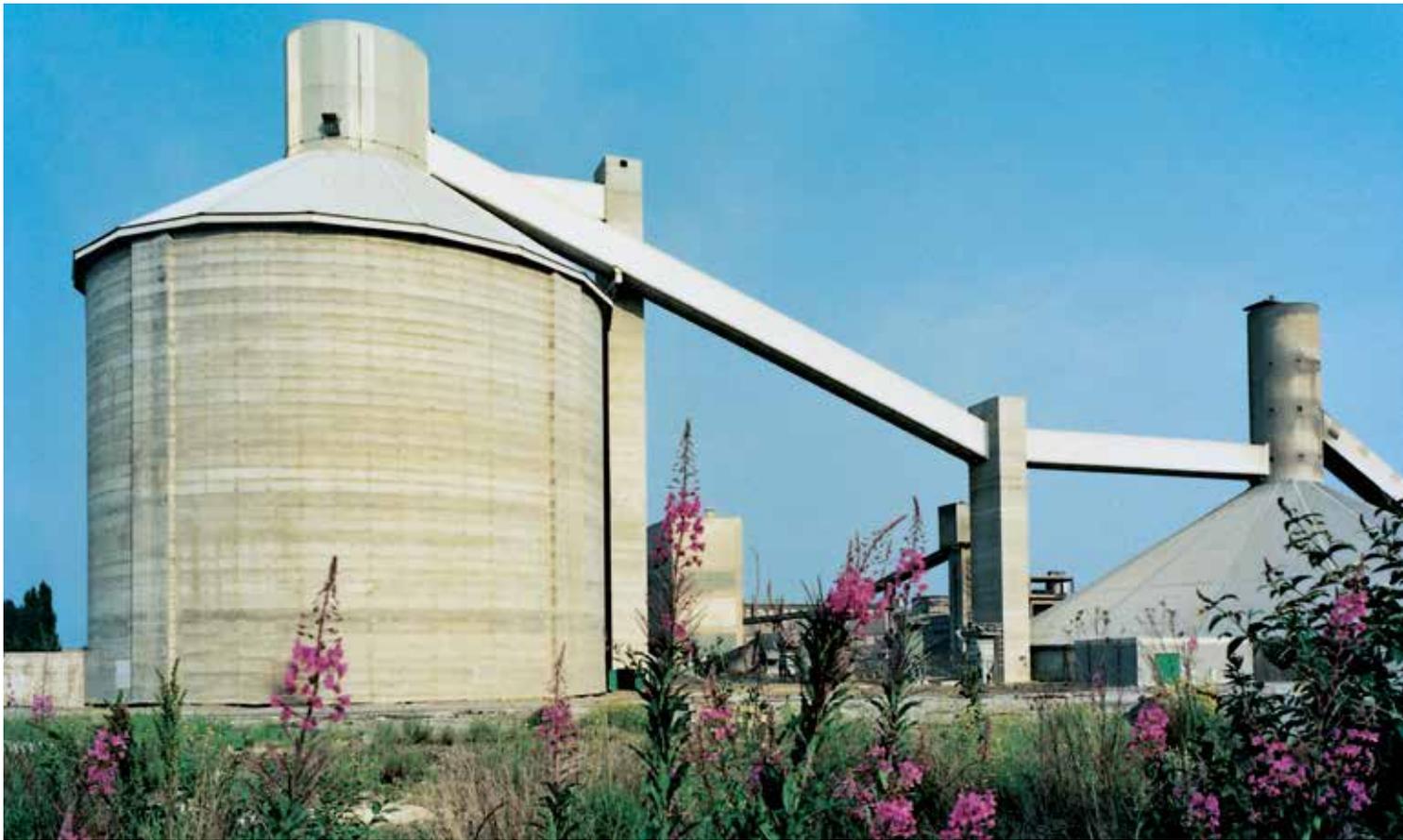
After several years, a total residue discharge of the silos should be effected, as the material particles lying on the floor tend to consolidate and form a steep cone. Therefore, it is recommended to equip all silos with lockable entrance doors.

With clinker cooler problems, extremely high clinker temperatures exceeding 400 °C must be expected. For these high temperatures, clinker silos are preferably made of steel; otherwise the choice of steel or concrete depends on economical aspects. In certain regions steel plate silos can be produced at more favourable prices.

In general, the storing capacity of these silos ranges from 30,000 to 60,000 t. The largest cylindrical concrete silo designed by AUMUND has a diameter of 45 m and offers a storing capacity of 80,000 t. In view of the chosen diameter, the roof had to be designed as a self-supporting

steel framed structure with trapezoidal cladding – a design standard which is also applied for the large circular storage halls without a central column.

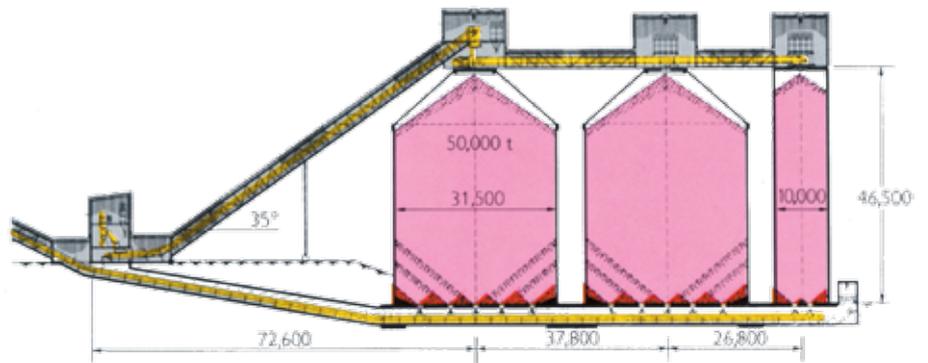
For automatic silo operation, a reliable level control system is of primary importance. A proven solution is the combination of an electro-mechanical silo pilot system to measure the material level in the silo. Several rope probes monitor the maximum filling level and several rod probes arranged in the area of the loading chute activate the emergency shutdown of the conveyor lines.



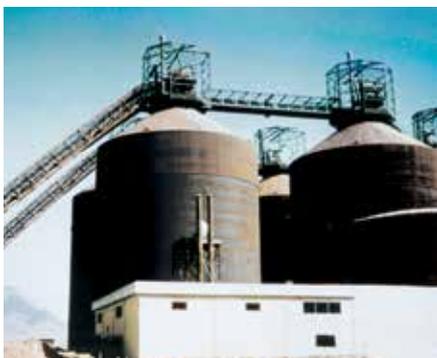
80,000 t silo with steel roof



Silo group for different clinker types

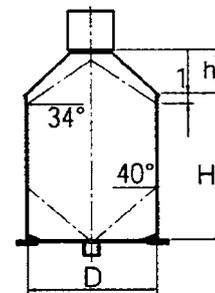


Clinker silos in series



Steel silos, 30,000 t each

D m	H m	h m	Storing capacity		Discharge rate %
			approx. t	m <sup>3</sup>	
15.00	18.20	5.10	5,000	3,330	78
17.50	19.80	5.90	7,500	5,000	77
20.00	20.00	6.80	10,000	6,660	74
22.50	23.60	7.60	15,000	10,000	75
25.00	25.30	8.40	20,000	13,330	75
27.50	26.00	9.30	25,000	16,660	73
28.75	28.60	9.70	30,000	20,000	74
30.00	30.60	10.10	35,000	23,330	75
31.50	31.70	10.60	40,000	26,660	75
33.00	32.40	11.10	45,000	30,000	74
34.00	33.90	11.50	50,000	33,330	75
35.00	35.20	11.80	55,000	36,660	75
36.00	36.30	12.10	60,000	40,000	75



Cylindrical silos  
made of concrete  
or steel with one  
discharge tunnel

Storing capacity  
in t with a bulk  
density of 1.5 t/m<sup>3</sup>.



Oval storage hall with internal silos



Circular storage hall with internal silo and earth cone



Covered stockpile with MOLEX®

## Covered Stockpile with Central Column

### Storing capacity from 50,000 to 190,000 t

The salient features of the covered stockpile with a central column are the low system height and the large diameter. The roof structure covers the material's angle of repose and only a low, circular retaining wall is required.

The central column is provided with slot-shaped outlet openings (stockpile) and supports the simple roof structure, consisting of the steel frame and the trapezoidal cladding. The platform above the central column is designed to receive the conveyor bridge with conveying equipment and the filter system.

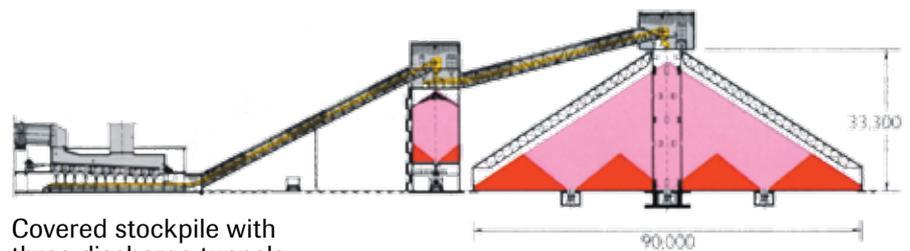
A discharge rate of 40 % to 60 % is reached by installing one to three discharge tunnels. For total residue discharge, mobile evacuation systems will be required.

The standard storage diameters range from 70 to 110 m. Storing capacities of 50,000 to 190,000 t can thus be reached.

A special storing facility with a capacity of 230,000 t could be created by combining two storage halls. An essential condition for this project was the load distribution on a surface of 90 m x 126 m. Due to the bad soil with a relatively bad specific soil bearing capacity, special measures were required in order to avoid damage from differential settlement. The bridge structure was thus supported on special bearings and the roof fitted with a jacking system for repeated adjustment.

The two central columns with a diameter of 12 m provide a storing capacity of 4,500 t special clinker each. The storage hall is equipped with three discharge tunnels, ensuring a discharge rate of approx. 60 %.

The large roof surface of this storage hall offers another advantage: the cooling effect on the stored clinker.



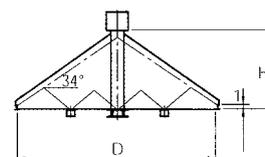
Covered stockpile with three discharge tunnels

D m	H m	Storing capacity t	m <sup>3</sup>
70	26.6	51,200	34,100
80	30.0	75,300	50,200
90	33.3	106,100	70,700
100	36.7	144,200	96,100
110	40.1	190,500	127,000

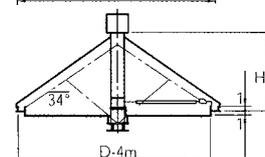
Discharge rate approx. 60 %. For total residue discharge, auxiliary equipment.

Preferred sizes			
70	26.6	48,300	32,200
80	30.0	71,700	47,800
90	33.3	101,600	67,700
100	36.7	138,800	92,500
110	40.1	184,200	122,800

Discharge rate 100 %



Covered stockpile with three discharge tunnels



Covered stockpile with mole

In case of irregular filling, a reduced output factor of 0.9 will have to be considered.  
Storing capacity in t, with a bulk density of 1.5 t/m<sup>3</sup>.



MOLEX® with central column



MOLEX® without central column

## Covered Stockpile with MOLEX®

### Total and automatic residue discharge

The actual live capacity secured with gravity discharge only amounts to a maximum of 85 %, presuming an optimum geometry of the storage facility. The discharge rate of covered stockpiles, although equipped with several reclaim tunnels, is even less.

Total and automatic residue discharge of this storage type is achieved with the automatic discharge system MOLEX® and just one discharge tunnel.

The MOLEX® mainly consists of a scraper chain installed in a bridge structure either turning around the central column or, if the stock is built without a central column, on a support base above the central discharge. The scraper chain drags the clinker which cannot be discharged by gravity to the central discharge hopper. PLC controlled drive systems drive the radial movement of the bridge truss and the scraper chain.

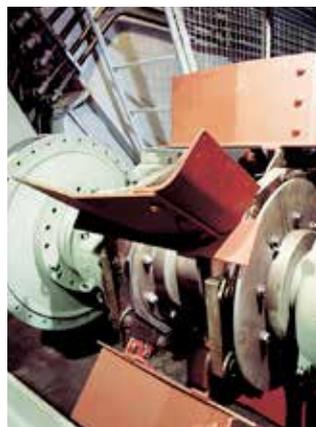
The opposite sketches explain the working principle of the total residue discharge system. The clinker is first discharged by gravity through the central discharge and additional openings in the reclaim tunnel. A level sensor installed in the central hopper monitors the lack of clinker and activates the scraper chain of the MOLEX®. When the scraper blades have cleared the clinker piled against the bridge truss, the travel units for radial movement of the MOLEX® are started.

The power absorbed at the scraper chain drive controls the radial travel movement of the MOLEX® and allows clearing the stock without manual intervention being required.

A further positive aspect complementing the automatic residue discharge is the blending of coarse and fine-grained clinker particles obtained when operating the storage with the MOLEX®, thus allowing the grinding mill to be fed with an almost consistent mixture.



Internal ring with thrust bearings and travel unit



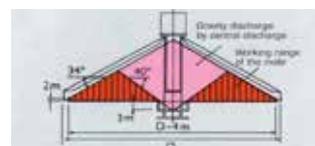
Scraper chain drive



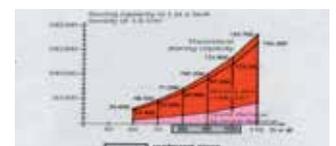
Covered stockpile with MOLEX® and central column



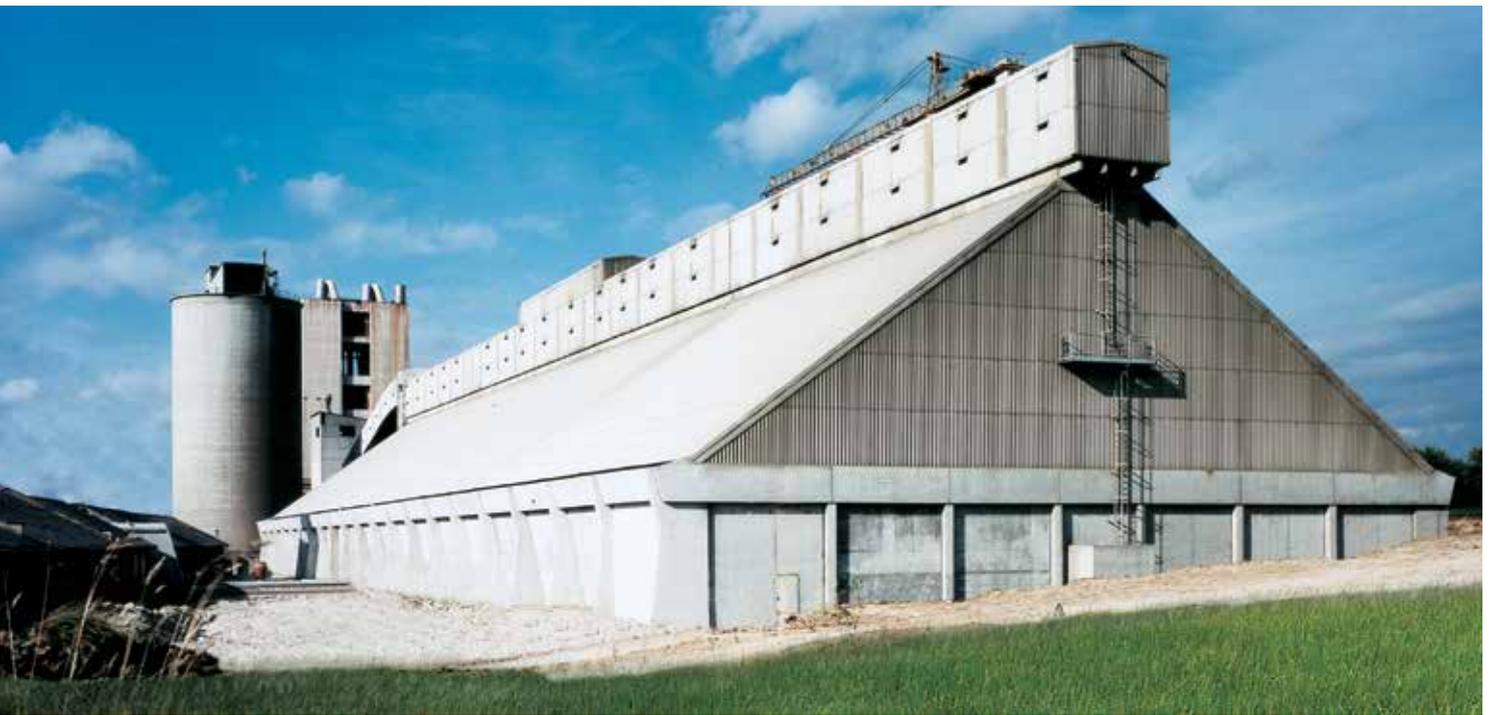
Covered stockpile with MOLEX® without central column



Working range of the MOLEX®



Storing capacity depending on the storage diameter



Clinker storage hall with earth cone

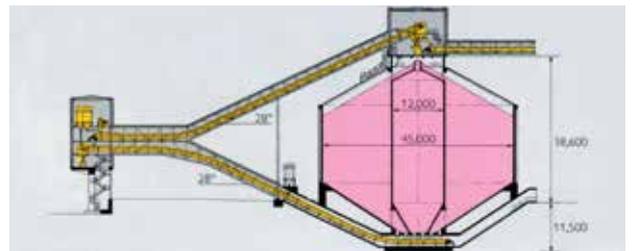
## Storage Hall with Earth Cone

### Essential increase of storing capacity

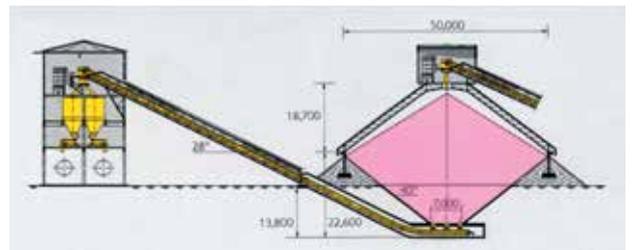
The storing capacity of longitudinal and circular clinker storage halls can be essentially increased by the installation of an earth cone. In addition, the discharge rate is considerably improved by this measure. The earth cone is usually provided with an inclination of  $40^\circ$  to  $45^\circ$ . Untreated surfaces simply blasted out of the rock did not prove to be reliable in practice. Despite a low groundwater level, it has to be considered that surface water may penetrate into the earth cone through fissures and gaps. Therefore, the surface of the cone has to be covered with a concrete or steel shell. It is also recommended to install a drainage system in order to ensure that water accumulations can flow off.

For the roof and headhouse, a steel frame with trapezoidal cladding is preferred, as for circular storage halls without a central column.

Clinker discharge from the earth cone is effected through central discharge openings. For safety reasons, at least three silo discharge devices should be provided. These clinker storage halls can also be equipped with a central column, which is then used for storing special clinker. A rotating feed chute is required for feeding the central tower as well as for the symmetrical feeding of the main storage hall.



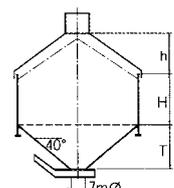
Circular storage hall with internal silo and earth cone



Circular storage hall with earth cone and without central column

D m	H m	h m	T m	Storing capacity	
				t	m <sup>3</sup>
40	15	14.1	13.8	45,350	30,200
	20	14.1	13.8	54,750	36,500
45	15	15.8	15.9	60,400	40,300
	25	15.8	15.9	84,300	56,200
50	15	18.7	18.0	78,300	52,200
	20	18.7	18.0	93,050	62,050
55	25	18.7	18.0	107,800	71,850
	15	20.5	20.1	99,300	66,200
60	20	20.5	20.1	117,100	78,100
	25	20.5	20.1	134,900	89,950
65	15	22.1	22.2	123,500	82,350
	20	22.1	22.2	144,700	96,500
70	25	22.1	22.2	165,900	110,600
	15	25.0	24.3	151,250	100,850
75	20	25.0	24.3	176,150	117,400
	25	25.0	24.3	201,000	134,000

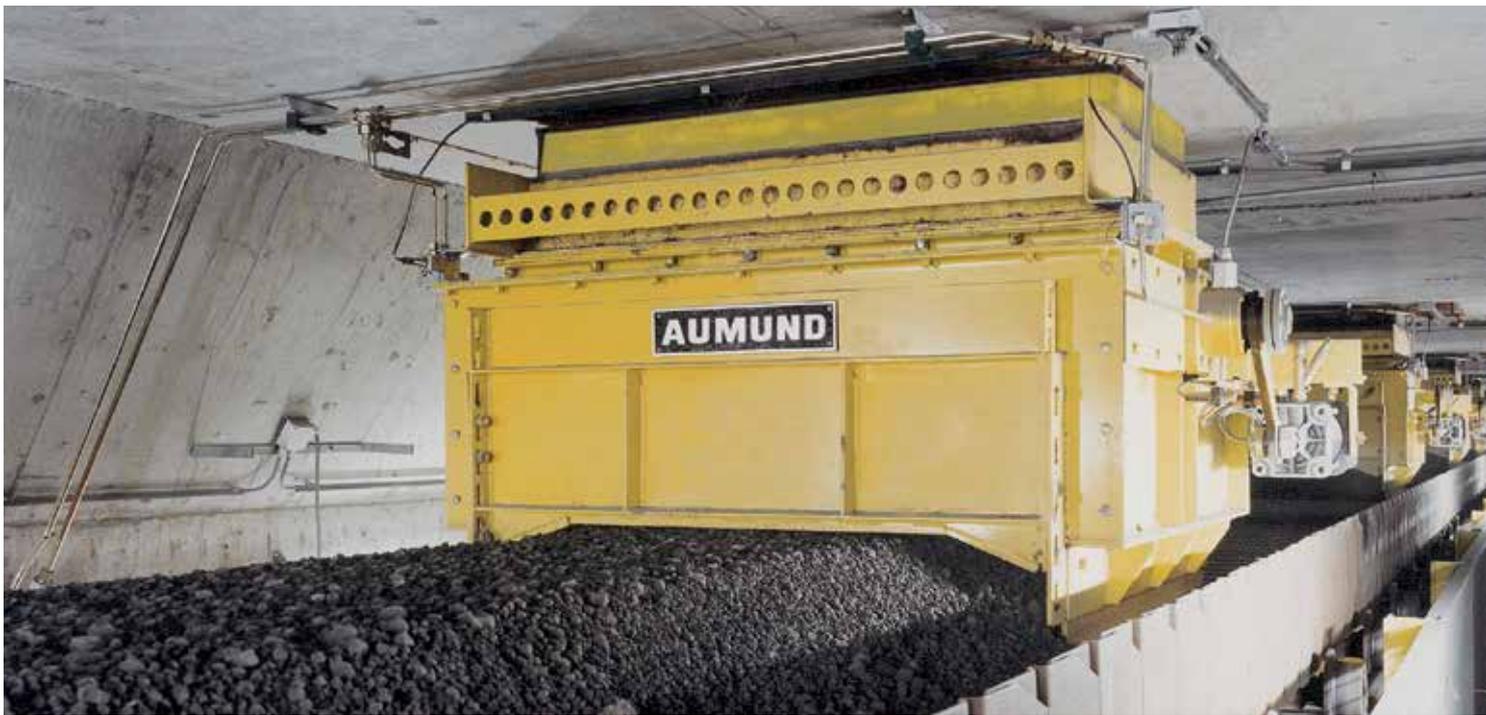
**Circular storage hall with concrete cylinder, earth cone and steel roof without central column**



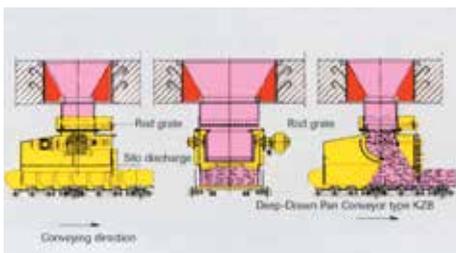
**Discharge rate approx. 95 %**

**Preferred sizes**

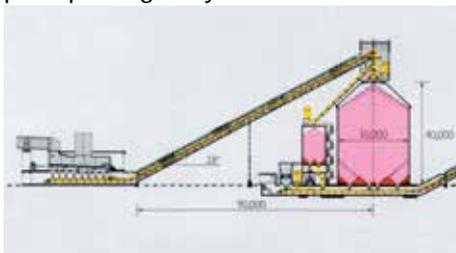
Storing capacity at a bulk weight of  $1.5 \text{ t/m}^3$ .



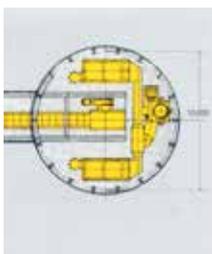
Silo discharge by remote control – discharge capacity 750 t/h



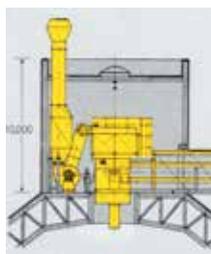
Silo discharge according to the principle of gravity



Plant planning – Clinker silo with proportional addition of low-burnt clinker and truck loading



Filter and blower arrangement



Headhouse with conveyor drive station and filter

## Clinker Discharge

### Minimising dust generation without the use of dust filters

To reclaim the clinker, discharge systems which can be operated without the use of dust filters, are the preferred equipment for all kinds of clinker storage facilities.

The gravity discharge gate, combined with a pan conveyor reclaiming the clinker at low speed minimises dust generation. The conveying capacity is defined by

the adjustable discharge cross section and the pan conveyor speed. Frequency controlled drive units allow adapting the conveying capacity to operational requirements.

Deep-Drawn Pan Conveyors are the ideal equipment to combine with the gravity discharge system. With an optimum plant planning the Deep-Drawn Pan Conveyor allows for direct feeding of the mill hoppers in the grinding section.

## Dust Suppression

In order to avoid dust emissions from the clinker storage hall, negative pressure needs to be created in the feeding area. For this purpose, the filter system must be designed for an operating temperature of 100 °C. The air volume required depends on the storage diameter and the clinker temperature, which essentially influences the buoyant forces.

About 12,000 m<sup>3</sup>/h are required for small cylindrical silos and up to 60,000 m<sup>3</sup>/h or more for large-sized circular storage halls.

Vent hopper and compact filter systems proved to be a space sparing solution. A favourable load distribution is achieved if two filters are served by one blower.



Installation of new bucket strand

## Conversions and Refurbishments

- Upgrading of existing plant components
- Targeting increased efficiency
- Higher output
- Improved availability

With our expert team of engineers planning selective modernisation measures, we pay special attention to the upgrading of existing plant components, targeting increased efficiency, higher output rates and improved availability.

Upgrading of your materials handling and storage equipment to state-of-the-art technology is achieved through a tailor-made refurbishment process under optimum utilisation of time and budget.

Most of the existing components are re-used in the refurbishment process to save cost.

Engineered conversions and refurbishments for increased efficiency and output are performed on AUMUND equipment as well as on the equipment of other manufacturers.



Pre-assembly of chain strands

# AUMUND Services

## Customer Proximity around the World

At AUMUND, service does not end at the sale of the equipment. It's the beginning of a long-term partnership. AUMUND offers you a full range of services – from commissioning to the delivery of quality spare and wear parts to customized preventive maintenance programs and equipment upgrading. The benefits for you: Maximum equipment efficiency at lower operating cost.

## Spare and Wear Parts

A comprehensive range of genuine spare parts is available for our entire product range from stocks in Germany, Hong Kong/China, Brazil, the USA and Saudi Arabia. Our product specialists provide assistance and respond instantly.

## Preventive and Predictive Maintenance PREMAS 4.0

Knowing beforehand that service will be needed allows you to schedule downtime and save money with timely repairs. Repairs or retrofits can be accurately anticipated allowing for the downtime to be at the most convenient times and at the lowest possible cost.

## Retrofits & Modernisation

Aged and worn equipment? Capacity increase needed? Too high operating cost? AUMUND “just as new” retrofits are economical and tailor-made solutions for improving your existing equipment at reasonable cost.

## Errection & Commissioning

Today, presence “on the spot” is an absolute “must”. Therefore, the AUMUND Group Field Service engineers are available on all continents to guarantee immediate and competent support.



# AUMUND Group Spanning the Globe

The AUMUND Group offers efficient solutions for conveying and storage of bulk materials. A particular strength is the technologically mature and extremely reliable machinery for handling all kinds of bulk materials, even hot, abrasive or sticky. More than 22,000 installations worldwide substantiate the excellent reputation and market position of the Group. The AUMUND Group is active in more than 150 countries with 19 locations all over the world and a global network of almost 80 representatives.

## The AUMUND Group Sales & Services worldwide

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<b>AUMUND</b>	Fördertechnik GmbH Branch Office Wroclaw / Poland
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<b>AUMUND</b>	Machinery Trading (Beijing) Co. Ltd / China
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<b>AUMUND</b>	Ltda / Brazil
<b>AUMUND</b>	Engineering Private Ltd / India
<b>AUMUND</b>	Group Field Service GmbH / Germany
<b>SCHADE</b>	Lagertechnik GmbH / Germany
<b>SCHADE</b>	Lagertechnik GmbH Branch Office Moscow / Russia
<b>SAMSON</b>	Materials Handling Ltd / UK
<b>SAMSON</b>	Materials Handling Ltd Branch Office Bristol / UK
<b>PREMAS</b>	Preventive Maintenance Service AG / Switzerland
<b>TILEMANN</b>	Chains & Components GmbH / Germany

The AUMUND Group operates Service Centres and Warehousing for spare parts in Germany, the USA, Brazil, Hong Kong/China and Saudi Arabia. Almost 60 dedicated Supervisors tend to clients' needs across the globe and a specialized Team provides PREMAS® Preventive Maintenance Service and PREMAS 4.0 Predictive Maintenance Service including inspections and consulting.



AUMUND headquarters in Rheinberg, Germany



**AUMUND Foerdertechnik GmbH**  
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