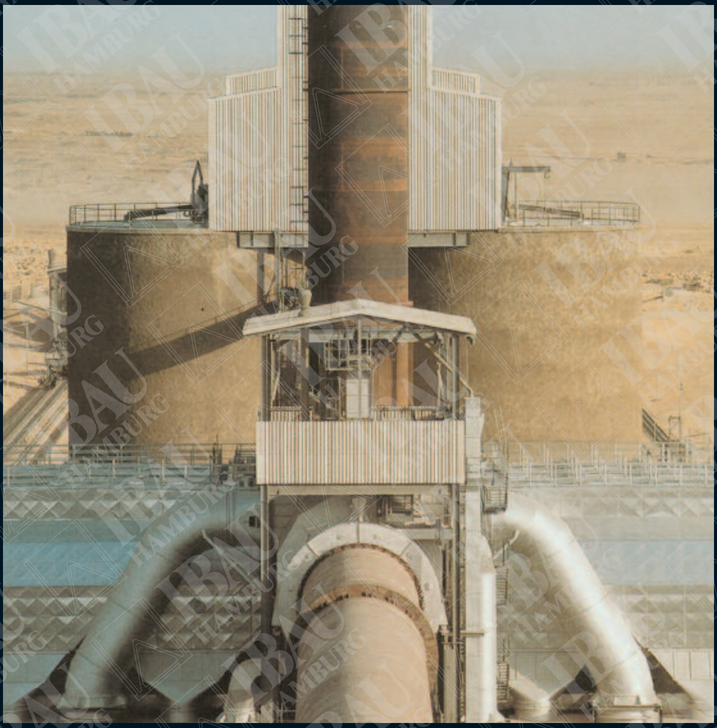
IBAU HAMBURG

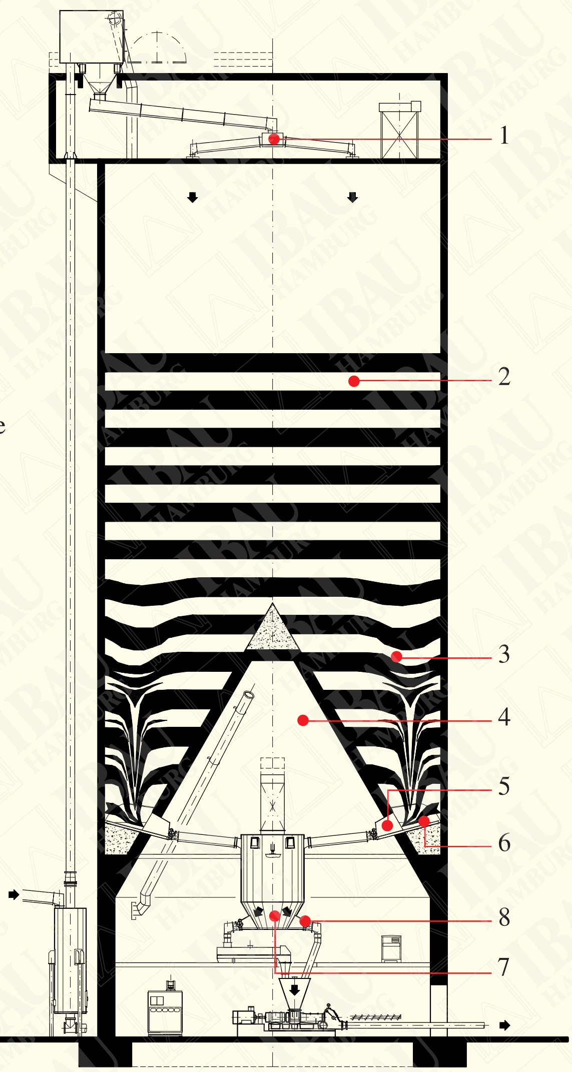
A MEMBER OF THE HAVER® GROUP

Information



IBAU HAMBURG
Central Cone Blending Silo

The original IBAU HAMBURG Central cone blending silo



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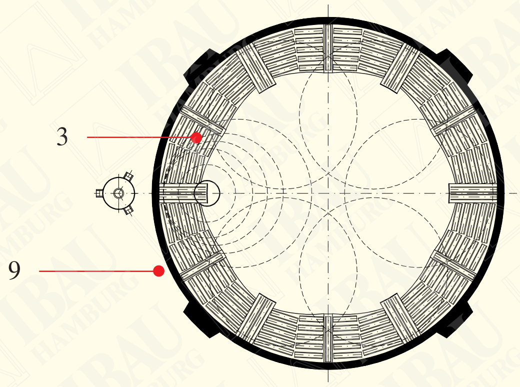


The construction of the IBAU HAMBURG Central cone blending silo

The blending silo is simultaneously used for a continuous blending process as well as for raw meal storage.

The feeding of the silo takes place via a novel type of parallel distributor (1) ensuring a controlled build-up of the different material layers.

Homogenizing of the raw meal is achieved by causing the layers of different $CaCO_3$ content (2) to flow together by funneling (3) flows and thus merging with one another.

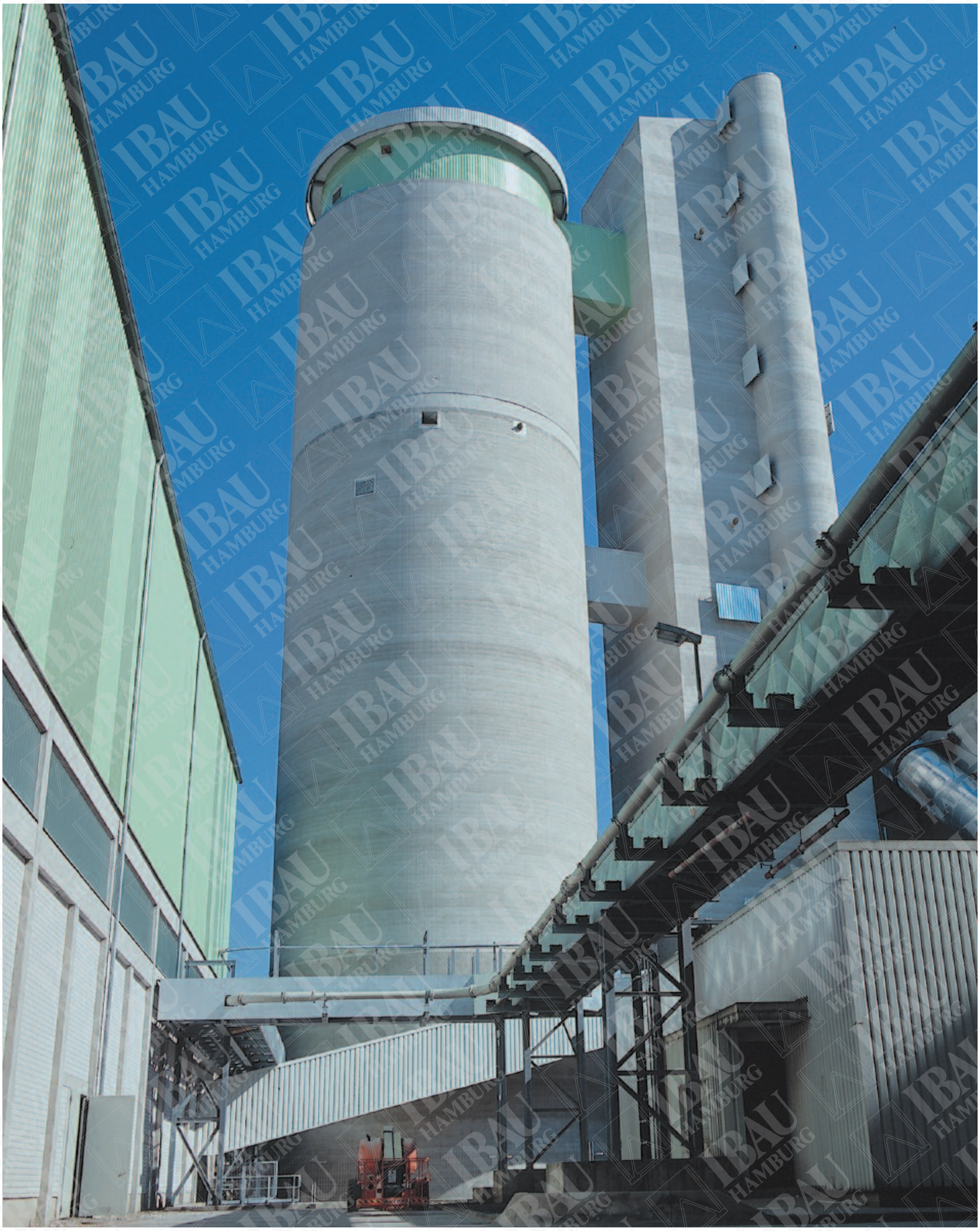
The gravity flow in the funnels produces the blending effect.

The bottom of the silo is divided into aeration sections (9).

Each section has a flow control gate and an air valve assigned to it. Blowers are available for aerating the silo bottom.

As a result, funnels are formed simultaneously developing relatively slowly from the silo bottom to the upper surface of the stored material.

The controlled funnel formation process avoids that the fresh raw meal which has just been fed into the silo cannot rush straight through to the silo outlet. The power consumption amounts to 0.1 - 0.3 KWh/t of raw mix.



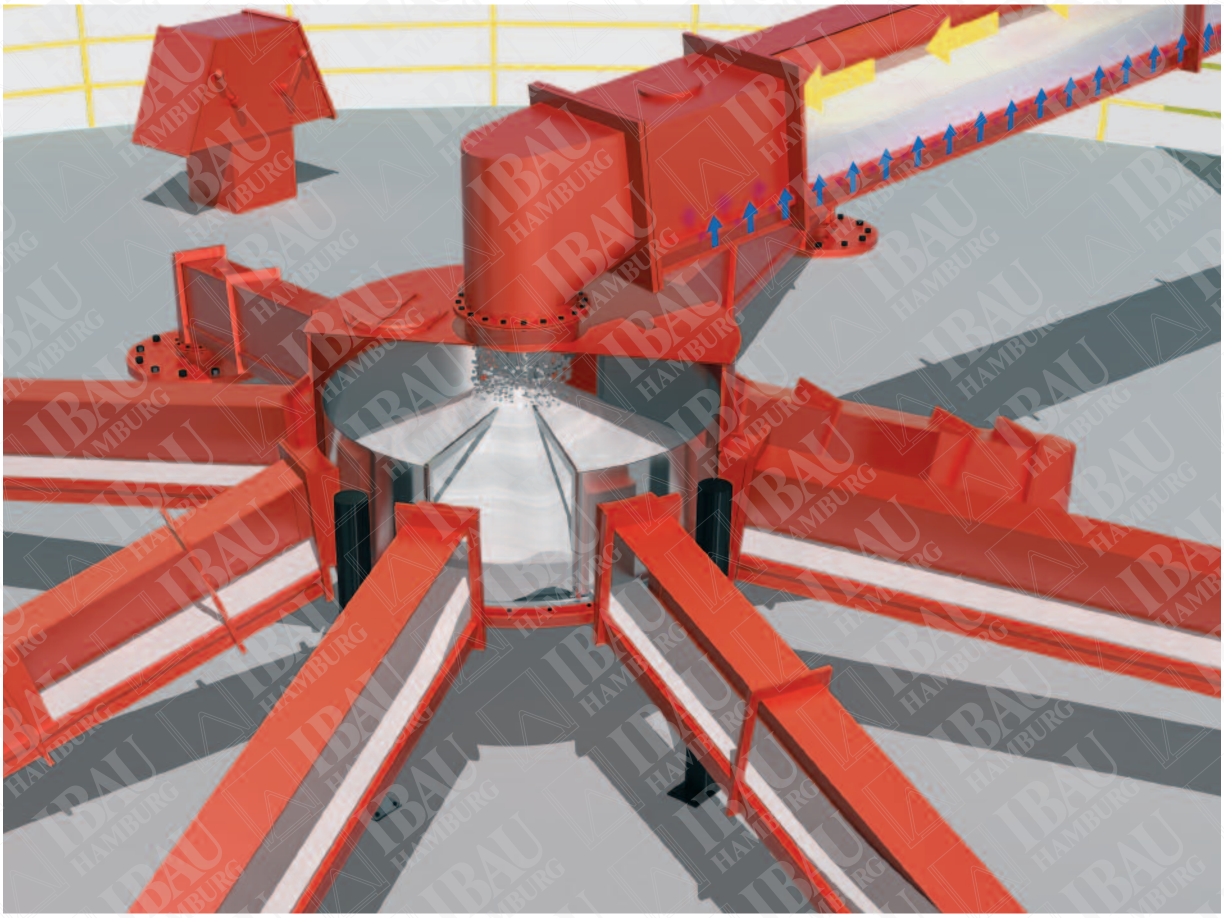
Raw meal silo for Dyckerhoff Cement works, Lengerich, Germany

The original IBAU HAMBURG Central cone blending silo

View into the original IBAU Central

cone silo with aeration sections

The original IBAU HAMBURG Central cone blending silo

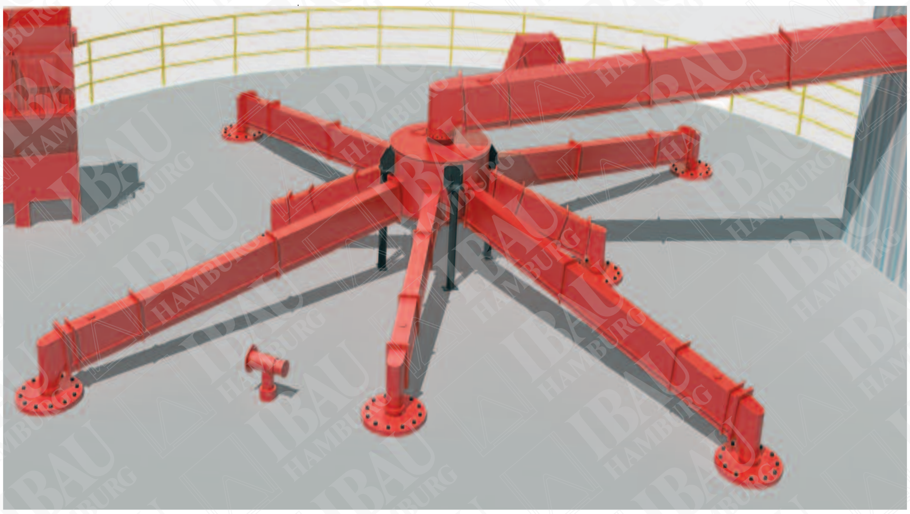


Material distribution during feeding

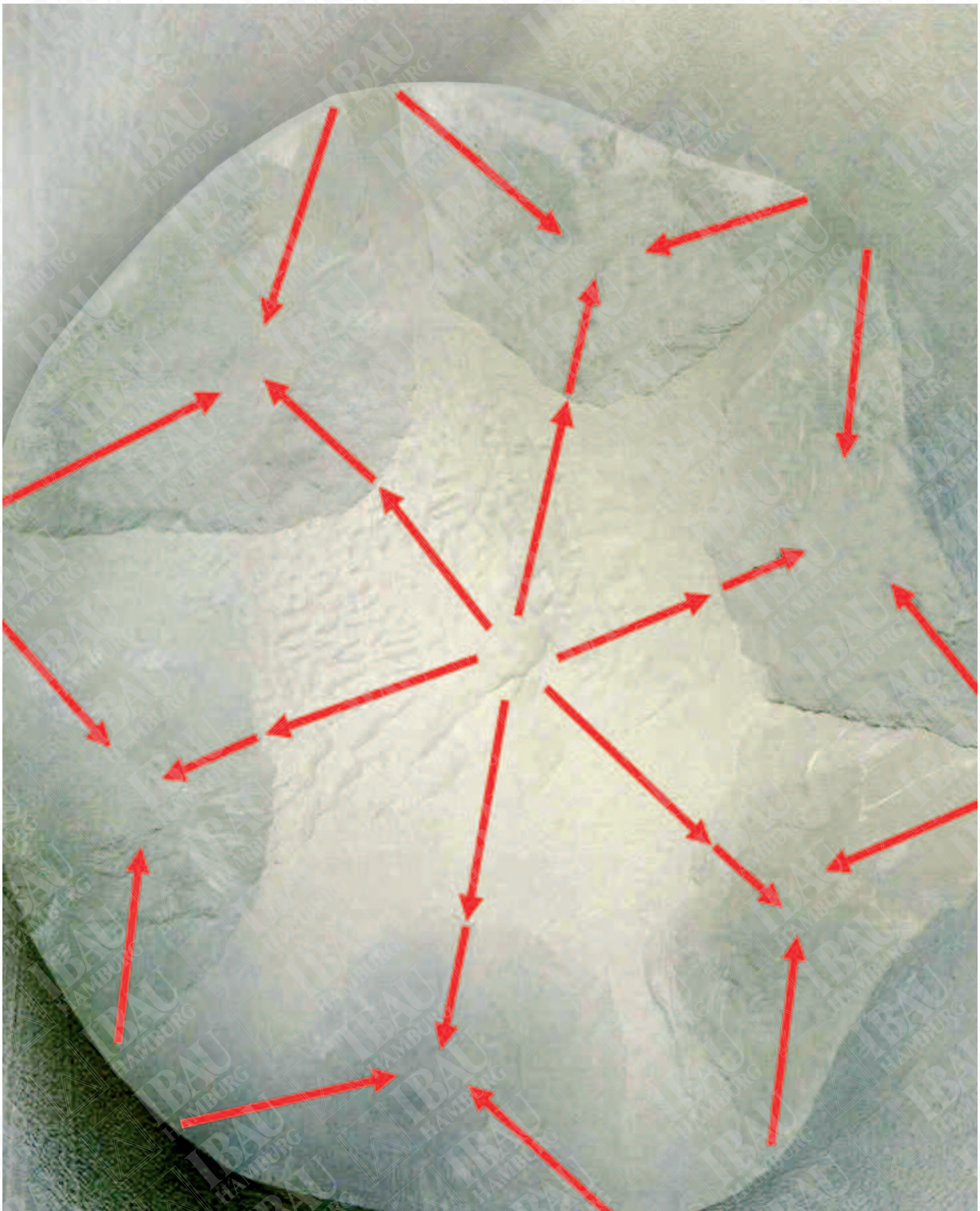
Advantages of the IBAU Central cone blending silos:

IBAU Central cone blending silos reduce the chemical and physical material variations in fluidizable products such as cement raw meal down to values within the measuring tolerance range.

The silos are operated in a continuous flow-through mode, also serving the purpose of raw meal storage. The blending process is based on experience in statistical



Parallel distributor on the silo top



Funnel creation during the discharge process

The original IBAU HAMBURG Central cone blending silo

Aeration section with silo outlet

material distribution. As many separate material layers as possible are built up horizontally in the silo.

Feeding of the central cone blending silo is carried out via a parallel distributor which distributes fluidized raw meal evenly over the entire silo cross-section. The blending process takes place during discharge operation. The central cone diverts the gravity flow of the stored product outwards to the annular aeration bottom.

During the discharge process, the flow control gates which are installed on the inner circumference of the central blending silo cone, are activated in combination with the adjacent aeration section. A programmed controller will start the operation in an alternating mode.

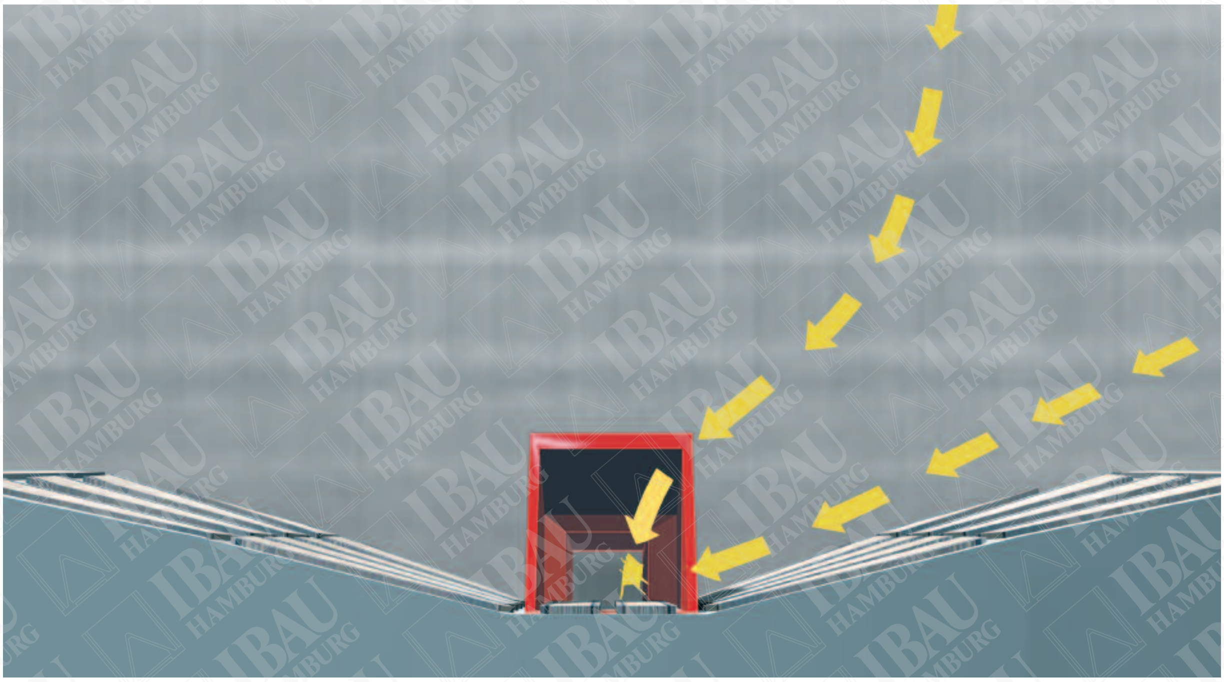
During the discharge process a funnel flow is created, the layer structure is broken up and an active material exchange takes place resulting in material blending. The central bin is used to collect the different material flows. The design of the roller opening is directly connected to the linear function of the flow control gate.

With this type of gate, the material flow can be metered very accurately. This flow can be controlled via belt weigher or flow-through meter.

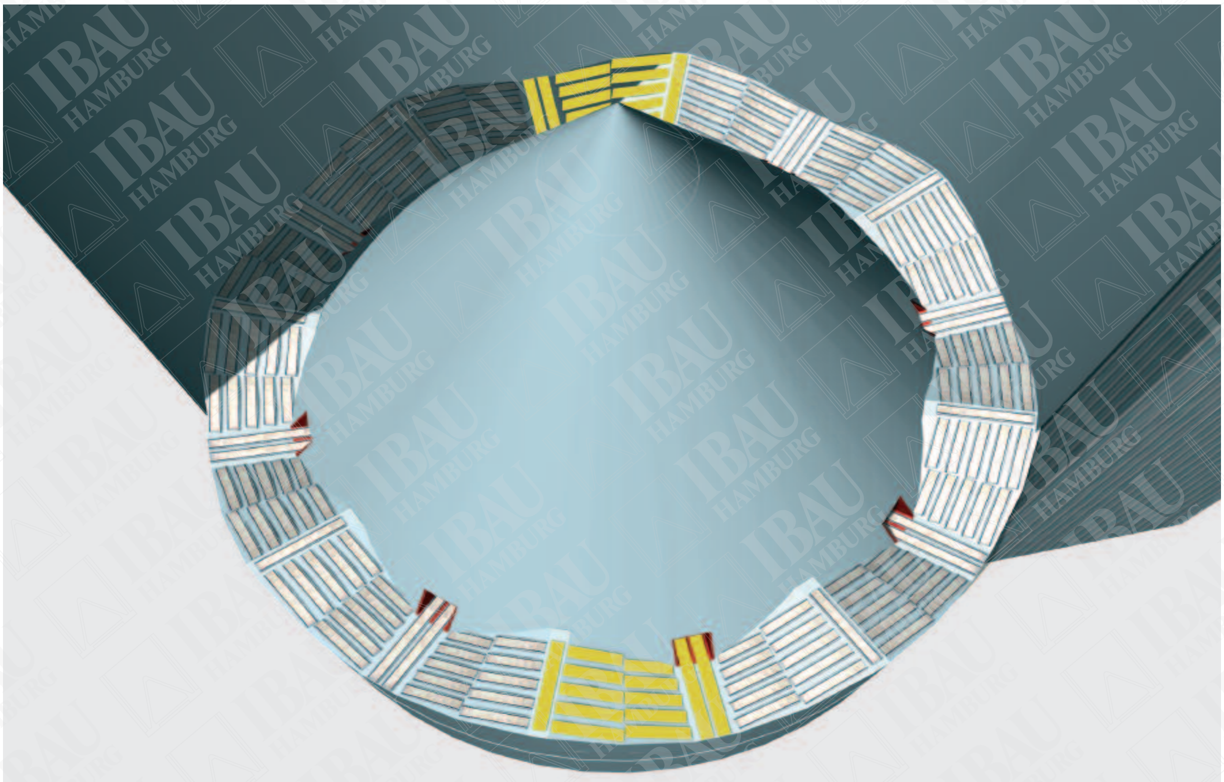
The blending effect is defined by the ratio of a standard deviation of $CaCO_3$ at the silo inlet and the silo outlet. The degree of the blending effect depends on variations in the layer structure, size of the silo in relation to throughput volume, filling height of the silo and the number of silo units involved.

Depending on these factors, blending results of 5:1 up to 15:1 can be achieved.

The specific power consumption amounts to 0.1 - 0.3 kWh/t. For the aeration of the silo, single-stage rotary piston blowers are used.

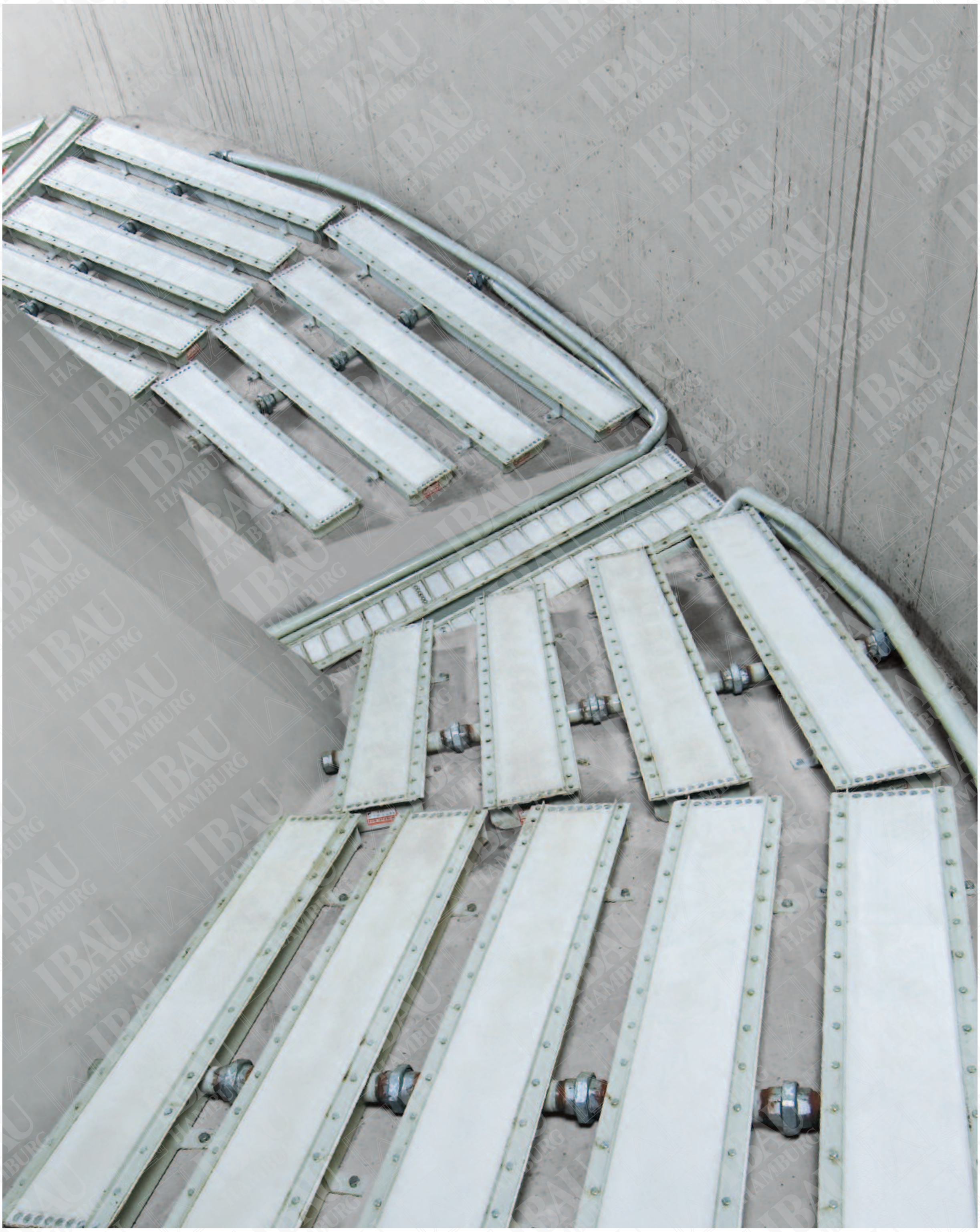


Material flow from an active section to the IBAU Flow control gate



Simultaneous aeration of two sections

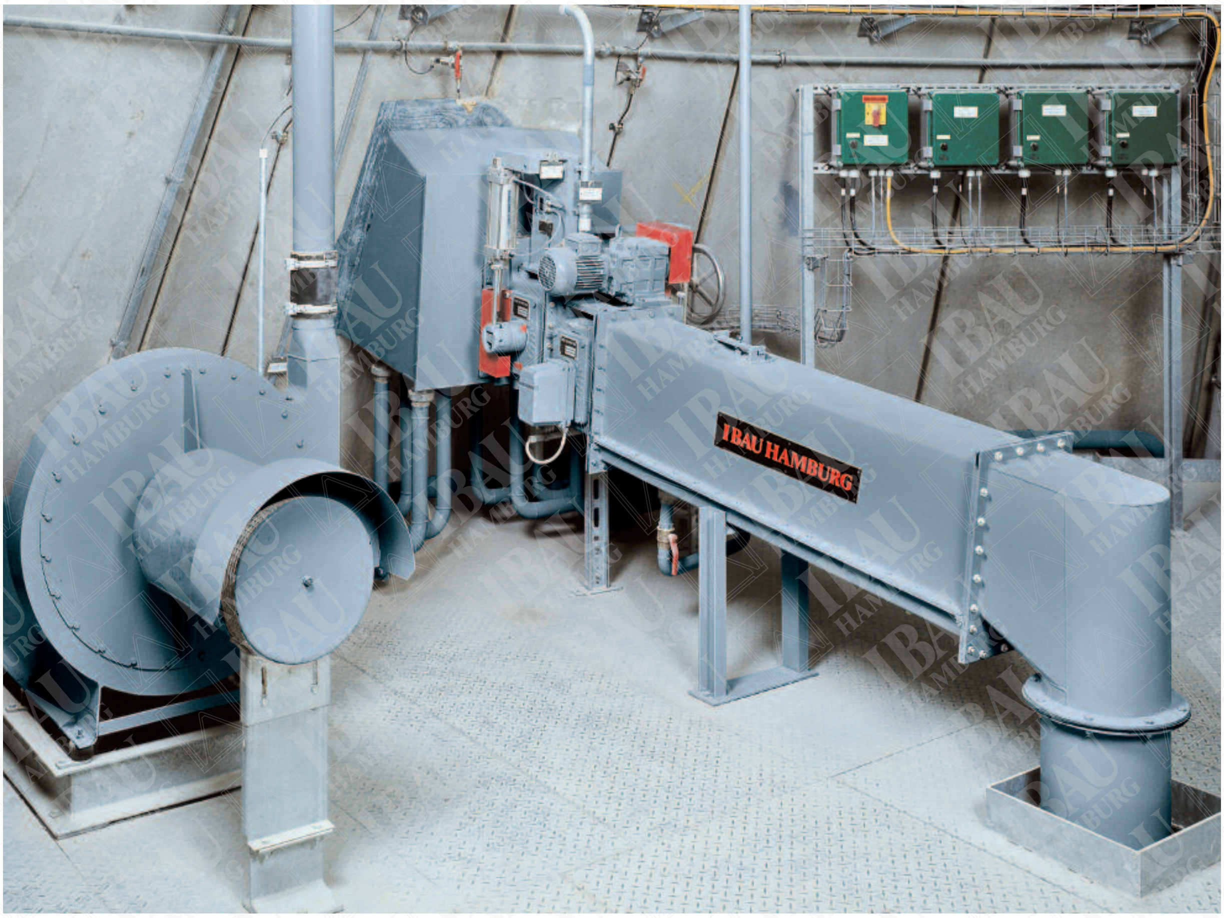
The original IBAU HAMBURG Central cone blending silo



Airslide system at the silo bottom

Material discharge from the complete aeration area

The original IBAU HAMBURG Central cone blending silo



Silo discharge via IBAU Flow control gate

The IBAU Flow control gate Type IBN

The IBAU Flow control gate type IBN shows all advantages and features of the worldwide renowned IBAU Flow control gate, which has been installed more than 500,000 times.

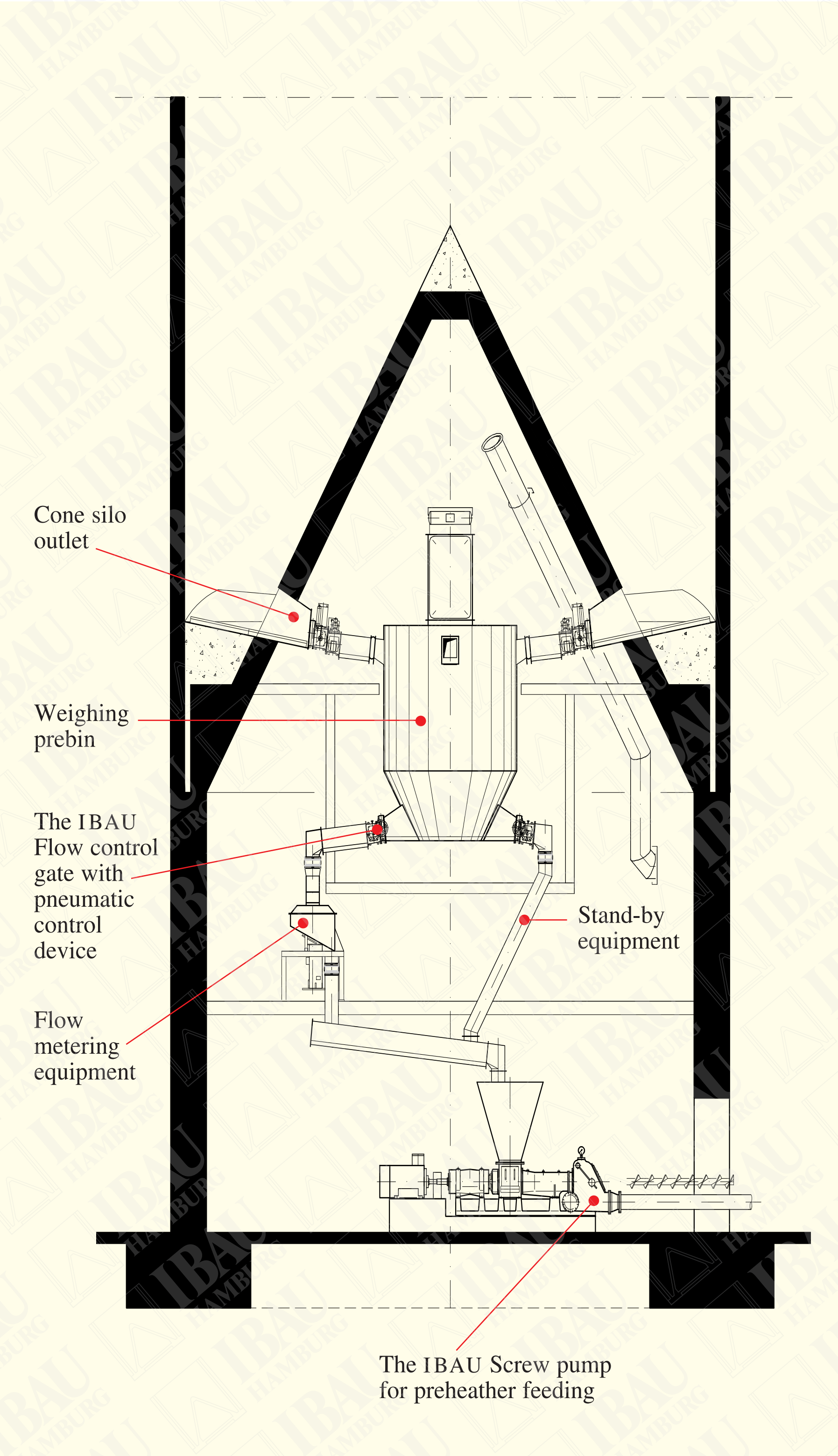
The variations of the basic type with different actuators have in common the extremely high accuracy of a controlled flow of pulverized bulk goods with reproducible results. They require practically no maintenance. However, even good things are subject to wear after many years of good service under severe conditions.

Different designs of other flow control gates may make it necessary to disassemble the complete unit. However, thanks to the design of the IBAU Flow control gate, a complete disassembly becomes unnecessary. Maintenance can be carried out without dismantling the complete unit. After having taken off one of the side plates the roller can be removed.

The gasket is then accessible and can be replaced if required. Reassembly is carried out in reverse order.

Controlled weigher feeding equipment

Raw meal metering equipment plays an important role in the cement production. Prior to feeding the preheater of the kiln, raw meal extracted from a blending or storage silo is continuously weighed by means of flow meters. Often, a weighing prebin installed on load cells is used. This prebin allows the control of the weighing system and makes it possible to



keep a constant level which in turn ensures a permanent height of raw meal above the aerated bottom.

Flow control gates monitor the flow of raw meal between the prebin and the weighing equipment. For this type of application pneumatic operated flow control gates with electro pneumatic control device are used. The material flow is controlled by a signal exchange with the flow meter.

The pneumatic actuators operate according to the principle of rotary paddle pneumatics without the use of lever arms, toothed racks and gears. This allows the pure torque to be transferred, with no interfering side forces acting on the square drive.

The actuators, which are characterized by a compact and weight-saving design, require little or no maintenance. The actuator device also comes equipped with ventilation options, enabling it to be also moved manually (hand lever).

The flow control gates of the stand-by equipment can be set via remote control exactly to the current operating position of the main line.

The figure on the left illustrates the arrangement of a weighing station with flow metering equipment.

The original IBAU HAMBURG Central cone blending silo

IBAU Flow control gate with pneumatic actuator and control device

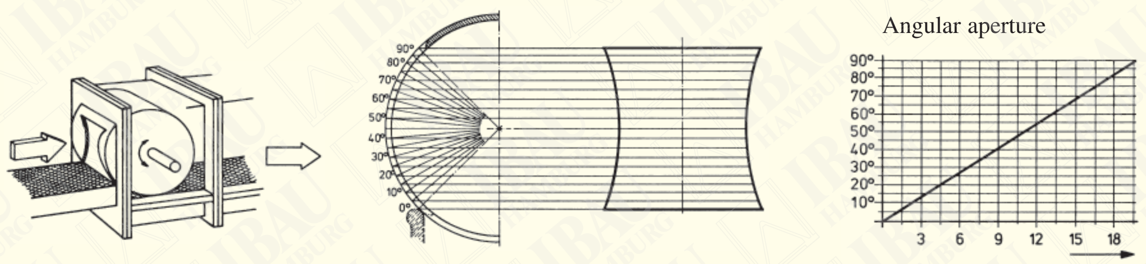
Flow metering equipment

The IBAU Flow control gate with pneumatically controlled drive

The pneumatic actuator is designed for the linear control of the material throughput quantity.

A further important feature is the emergency shutdown, i. e. the flow control gate is closed pneumatically in case of a power failure. The set-point as well as a position feedback are carried out by means of a 4-20 mA signal.

The combination of any desired type of roller with a pneumatic actuator, connected to an electro pneumatic control device, is eminently suitable for bulk handling, e. g. on the discharge spouts of silos or bins where a linearly controlled discharge is required and where, for safety reasons, the discharge process must be stopped in case of a power failure.



Material flow direction | Angular aperture | Adjustable cross-section | Cross-section projection

Flow control gate with adjustable cross-section

IBAU Screw pump for material transport to the preheater

The IBAU Screw pump

Screw pumps have been in use for more than fifty years for the pneumatic transport of cement, raw meal, all types of lime, pulverized coal, fly ash, alumina and many other pulverized materials.

It is a conveying unit which is able to feed large quantities of such materials into a pneumatic conveying line practically without any blowback of air.

A further advantage of screw pumps is their compactness and especially their low overall height. These low space requirements make them suitable for confined locations. Screw pumps can operate against conveying line back pressures of up to 2.5 bar.

They are available in various sizes with capacities ranging from about 5 to 500 m³/h.

IBAU Airlift system for the material transport

The IBAU Airlift

An alternative for the preheater feeding is the IBAU Airlift, which facilitates a dust-free vertical transport. The airlift does not require much maintenance as there are no mechanical parts in the conveying line which have to be maintained. A rotary piston blower supplying the conveying air does not require much maintenance either. (Air intake filter and changing of gear oil). Parts of an airlift system are: The cylindrical airlift body with aerated bottom, the vertical nozzle and conveying pipe, a separator (when not feeding directly a preheater or a small silo). As with all other types of pneumatic transport a dedusting at the end of the conveying line is necessary.

A rotary piston blower or a group of blowers supply the necessary oil- free conveying air.

A head of conveying material forms the air lock against atmospheric pressure; in other words the higher to convey the higher the airlift body.

The original IBAU HAMBURG Central cone blending silo

The IBAU Blending silo operation

The silo feeding has to be carried out continuously so that horizontal layers with equal grading are built.

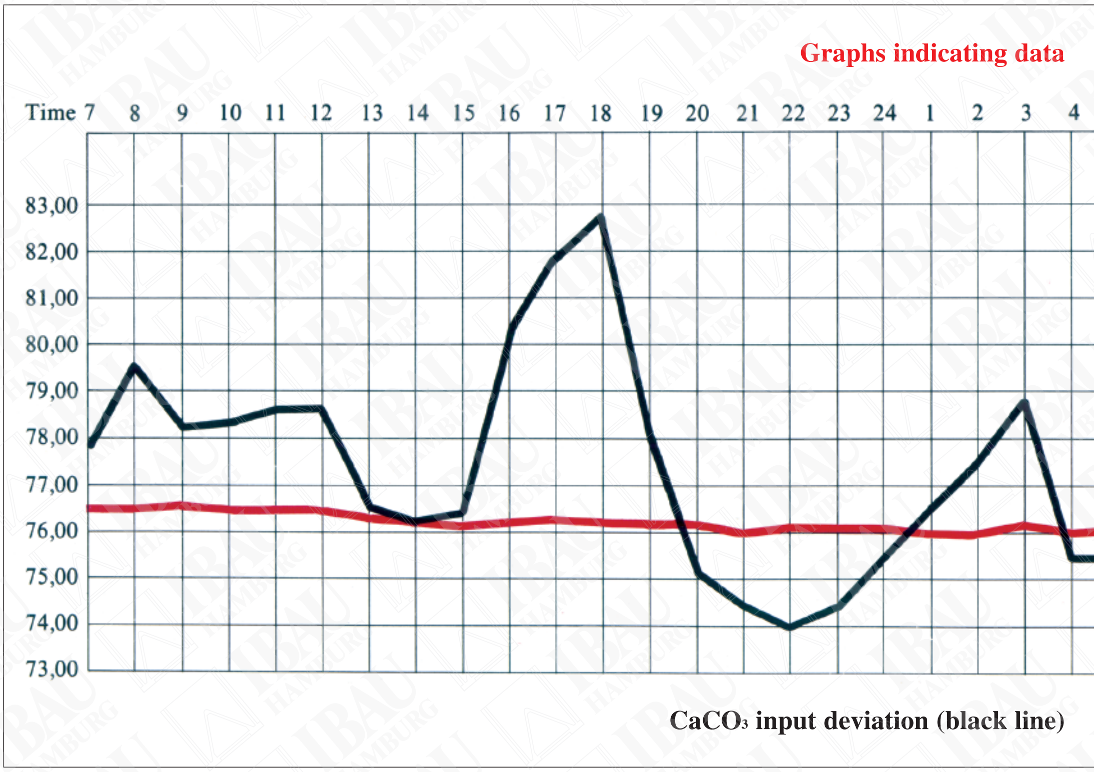
The layers must have different chemical and physical compositions, thus being statistically independent from each other. The thinner the layers with different characteristic concentrations are, the more easily they blend with each other.

Therefore, it is essential for the achievement of a high blending effect that not only correspondingly high deviations are present in the layers but that they alternate within the silo inlet as often as possible. Thus, there must be a certain periodicity. All of the known throughput blending silos produce more or less gravity flow profiles, which are also called blending funnels.

In order to achieve an optimal blending effect a high ratio of material exchange and a minium silo level of 70% are required.

Evaluation of blending quality

Blending and homogenizing can be understood as uniforming of chemical and physical variations in solid mixtures such as cement raw meal. Concentration values within the mineralogical mixtures are used for the evaluation, e. g. the $CaCO_3$ content in weight-% for cement raw meal.



For a quality assuring mixture control it is necessary to have a representative measurement for sampling and analysis. The evaluation of the blending effect is made according to the regulations for the mathematic statistic by using the standard deviation.

Individual samples are taken in front of the silo inlet and after the silo outlet every 0,5 to 1 hour and then are analysed accordingly. Representative test series are generally made over a period of 24 hours.

Measuring faults in the analysis process

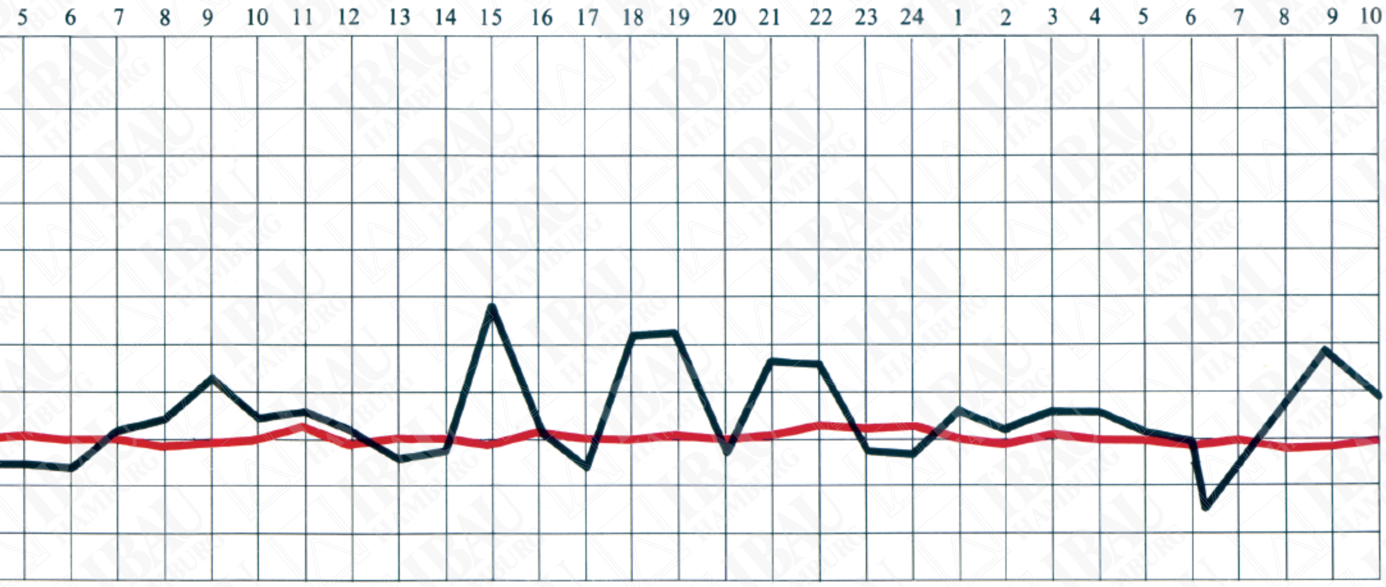
The aforementioned values of analysis are afflicted with faults as the devices for the sampling and analysis only measure samples instead of the effective values of an entity.

Therefore, the fault for the sampling and analysis process with the fault standard deviation, indicated with „S_{P+An}“, has to be deducted for the calculation of the actual standard deviations. The measuring fault can be experimentally identified on site.

Within several seconds, several individual samples are taken and divided for example into 10 test portions. Then each single test portion is analysed and the standard deviation is identified from the results which then can be used as S_{P+An}.

For the homogeneity assessment, generally the concentration degree of the biggest mass fraction being present in cement raw meal is taken, such as calcium carbonate content, $CaCO_3$, with a weight proportion of approximately 70 - 80%.

taken during test period



$CaCO_3$ output deviation (red line)

Blending effect

The blending effect is defined by the following relation:

$$M_S = \frac{S_E}{S_A} = \frac{\sqrt{S_{EF}^2 - S_{P+An}^2}}{\sqrt{S_{AF}^2 - S_{P+An}^2}}$$

S_{EF} = Standard deviation with measuring fault silo inlet

S_{AF} = Standard deviation with measuring fault silo outlet

S_{P+An} = Standard deviation of the sampling and analysing process (measuring fault)

S_E = Standard deviation without measuring fault silo inlet

S_A = Standard deviation without measuring fault silo outlet

A statement, which is actually more important for the material quality, can be made by the outlet variation rectified with the measuring fault:

$$S_A = \sqrt{S_{AF}^2 - S_{P+An}^2}$$

Example blending effect

The following values have been determined and are applied now:
S_{EF} = +/-2,1 % $CaCO_3$
S_{AF} = +/-0,3 % $CaCO_3$
And S_{P+An} is about +/-0,2 %.

The blending effect will be:

$$M_S = \frac{S_E}{S_A} = \frac{\sqrt{S_{EF}^2 - S_{P+An}^2}}{\sqrt{S_{AF}^2 - S_{P+An}^2}} \qquad MS = \frac{S_E}{S_A} = \frac{\sqrt{2,12 - 0,22}}{\sqrt{0,32 - 0,22}}$$

$$M_S = \frac{S_E}{S_A} = \frac{\sqrt{4,41 - 0,04}}{\sqrt{0,09 - 0,04}} = \frac{\sqrt{4,37}}{\sqrt{0,05}} = \frac{2,09}{0,223} = 9,37$$

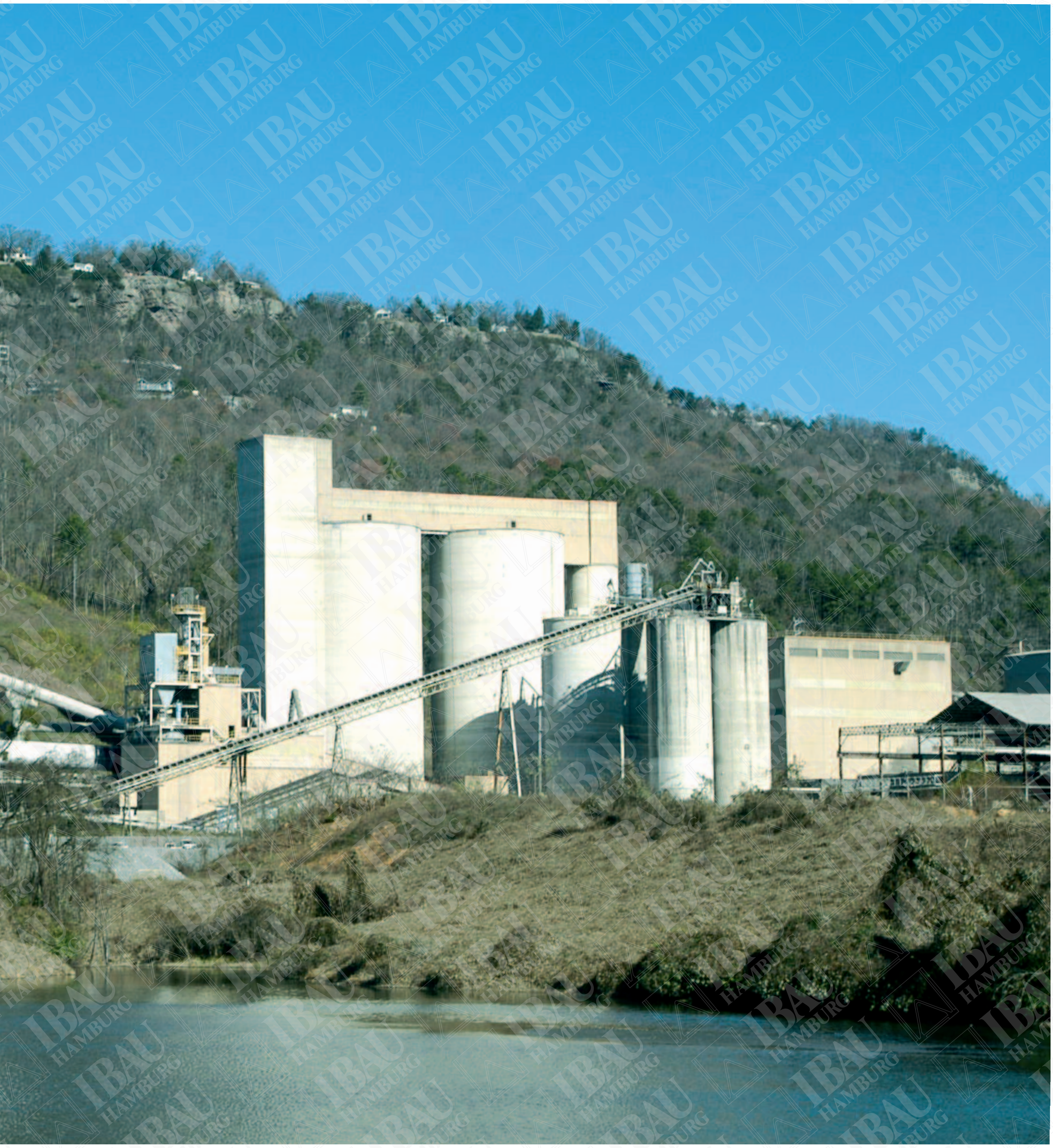
MS = 9,4
The outlet variation is about:
S_A = +/-0,223 % $CaCO_3$

For the assessment of the silo plant it generally makes sense to analyse the process factors, which are also being used for the raw grinding plant and for the mixed bed composition. This is either the limestone factor, the tricalcium silicate (C_3S) or the tricalcium aluminate (C_3A).

The calculation of these process values is done by means of the main oxides CaO, SiO_2; Al_2O_3, Fe_2O_3.

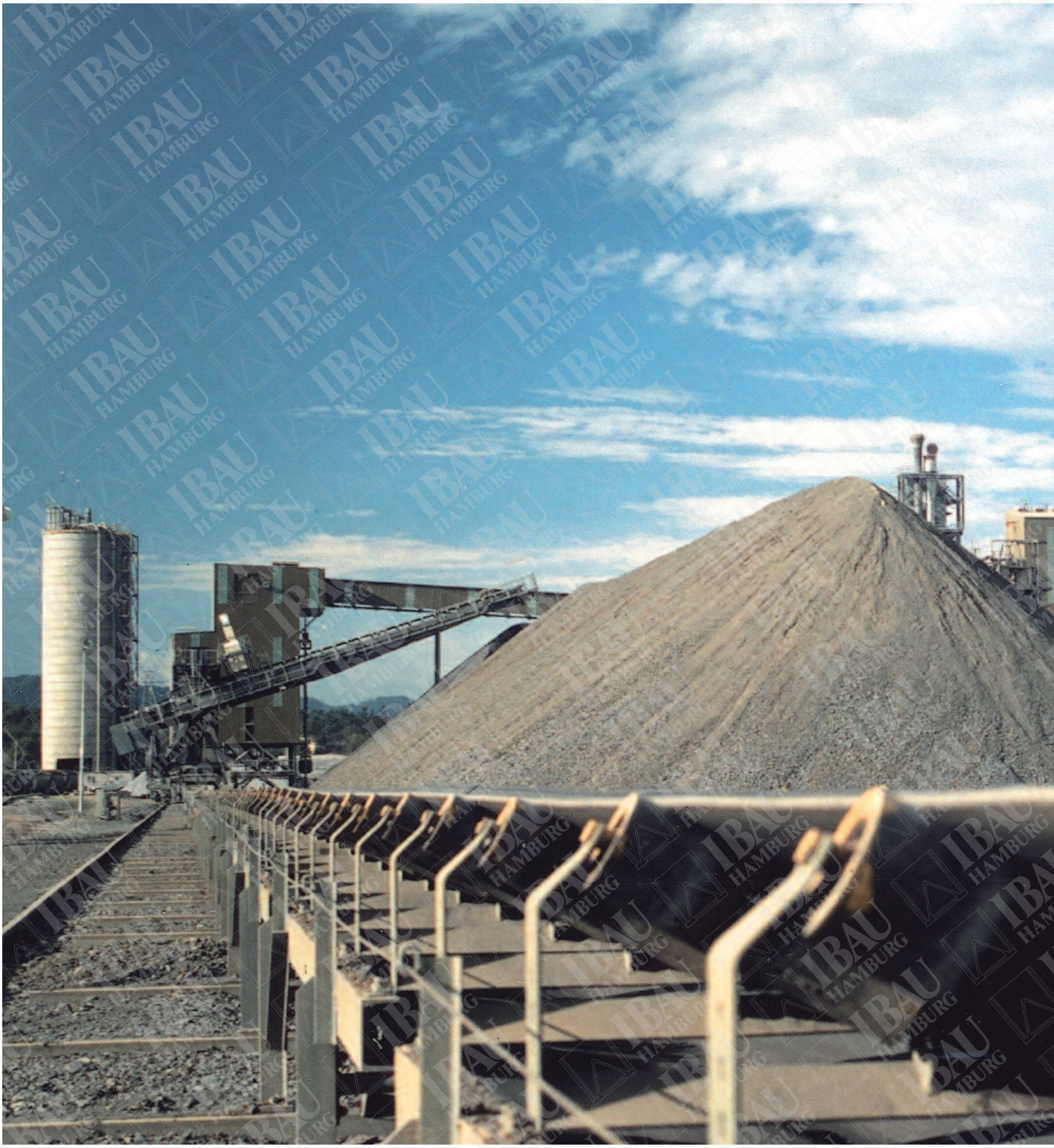
The original IBAU HAMBURG Central cone blending silo

Plant view of Signal Mountain Cement

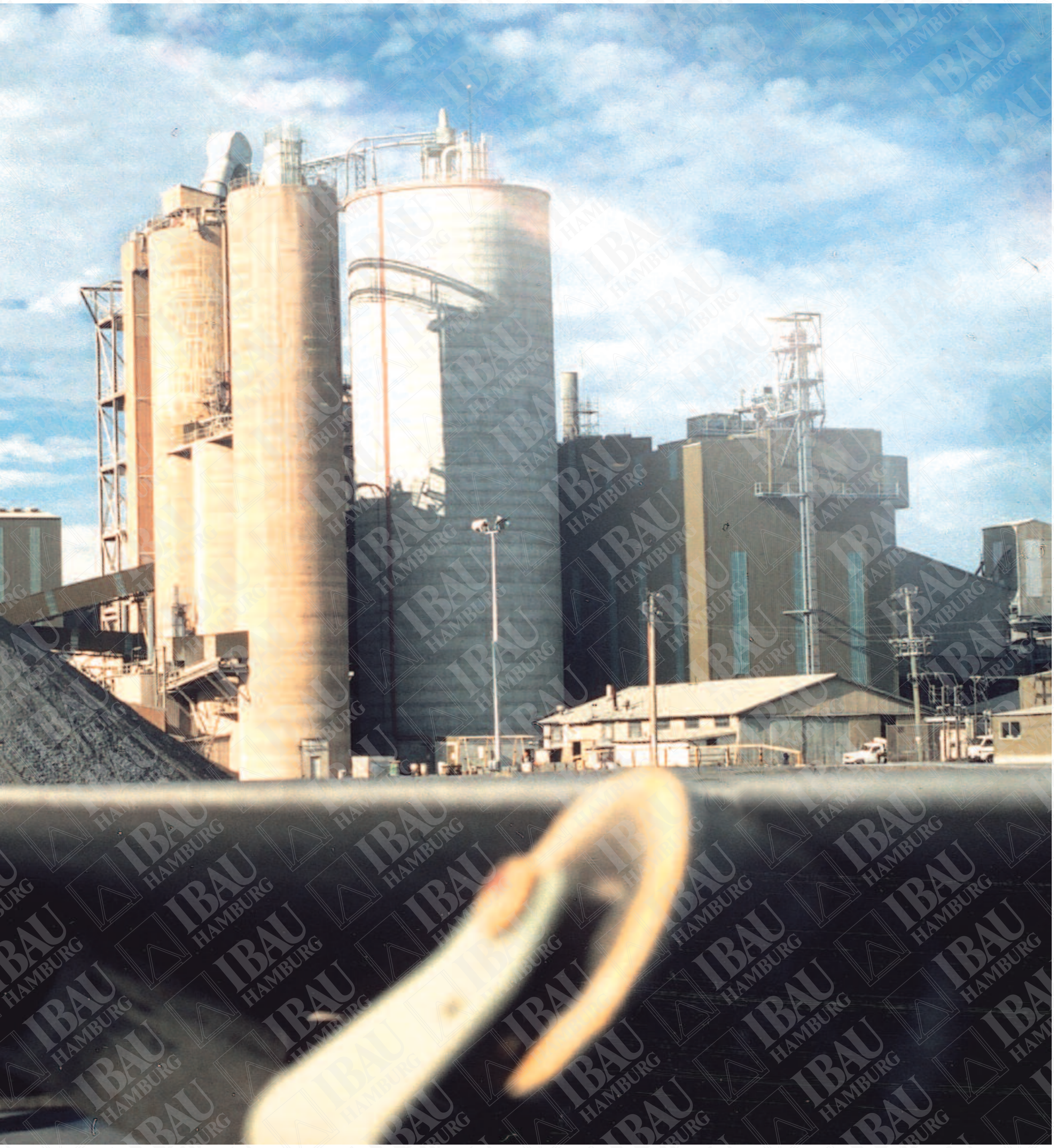


Company, Chattanooga, Tennessee, USA

The original IBAU HAMBURG Central cone blending silo



Cement Australia Railton,



Tasmania, Australia

The original IBAU HAMBURG Central cone blending silo

Advantages of the IBAU Central cone blending silos:

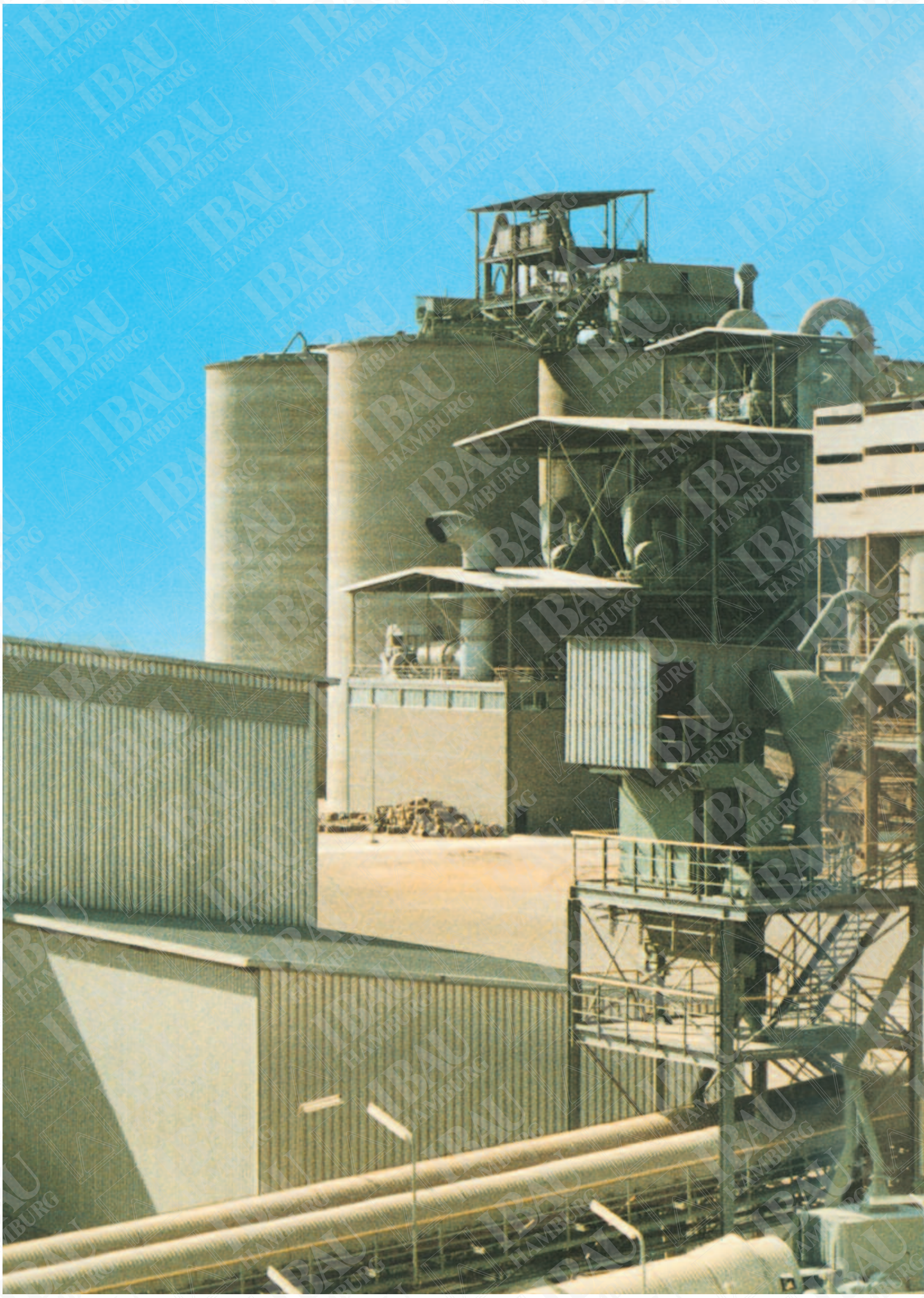
1. Very uncomplicated civil engineering concept due to a favourable load distribution via the central cone into the silo wall
2. Optimized material aeration and discharge technology
3. High operating reliability thanks to direct process parameter control
4. Easy access for inspection and maintenance
5. High blending effect at a low power consumption due to realisation of the mass flow principle

The raw meal silo fulfils two purposes:

It is used for raw meal storage, in order to feed the kiln with raw meal even during the downtimes of the raw meal grinding plant.

Furthermore, it homogenises the raw meal produced by the raw meal grinding plant, so that a constant clinker quality can be generated in the kiln.

Whereas it is important to either maintain the homogeneity which was generated in the previous process steps or, if the required level of homogeneity was not reached, to generate it accordingly.



Arabian Cement Company Ltd.,

Rabigh plant, line 1-4, Saudi-Arabia

IBAU HAMBURG – THE STATE OF THE ART

We have designed and built worldwide about 7.000 large capacity silos, 250 multi-compartment silo plants, 2.000 pumps for bulk material transport, 250 power plant equipment, 60 terminals for bulk material mixing, 100 marine terminals for cement, 30 shipunloaders for cement, and 20 self-unloading cement carriers

Cement silo installation with bulk loading in Samalayuca / Mexico

Raw meal blending silo, Dyckerhoff Zement / Germany

High capacity mixing plant HOLCIM, Antwerp / Belgium

Coal-fired power plant Mehrum / Germany

Shipunloader on rubber tyres for Continental Florida Materials, Port Canaveral / USA

Cement carrier M.V. GLEN VINE

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