I BAU HAMBURG

Your efficient partner for modern and effective bulk material handling

PLANT DESIGN - ENGINEERING - EPC-CONTRACTING







IBAU HAMBURG Alumina Handling Systems

na Handling Systems



Bulk material handling at aluminium smelter plants

Modern aluminium smelter plants are designed for production capacities of approx. 600,000 tonnes/year.

There has been a marked rise in the demands made on the bulk material handling of such plants in recent years.

Besides reliability and minimum environmental impact, importance is increasingly attached to improved technology and high process stability.

In this sector IBAU HAMBURG has proved itself to be a competent partner who offers the relevant technological expertise, advanced international experience and cutting-edge technology for such plants.

Since the company was founded in 1975, it has planned and built well over 5000 large-capacity silos alone for the storage of a wide range of bulk materials.

As the base materials for molten-salt electrolysis fresh alumina (Al2O3) is required as well as aluminium fluoride (AlF6) and cryolite (Na3AlF6) as the fluxing agent. Approx. 1.9 kg of alumina is necessary for 1 kg of primary aluminium. Accordingly, a 0.6 Mta plant uses approx. 1.15 Mta (million tonnes/ annum) Al2O3 and



Material distribution system at a large-capacity silo containing alumina

Alumina silo with airlift feeding, distribution and a discharge system with homogenisation effect.

 approx. 0.01 Mta of the additive AIF6. AI2O3 is delivered by rail or ship. Transport by sea is generally via Handymax and Panamax ships with a capacity of up to 80,000 t. The most important steps for bulk material handling include: unloading of ships or railway wagons mechanical or pneumatic material transport silo storage and loading equipment. the silo storage equipment equipment. the silo storage equipment equipment equipment. the silo storage equipment equipme	bulk ngmechanical or pneumatic vertical mechanical trans- port system also designed for 600 - 800 t/h. One alternative is to deliver the material via railway wagons or trucks, which provide for direct trans- port to the alumina silos of the smelting plant.elter tire with unloading the wagons. 00 t However, pneumatic collectors for the alumina leliv- atic ms g0 00 t/h.There are generally no special conditions for unloading the wagons. However, pneumatic collectors for the alumina have proved to be eco- nomical when installed at the emptying system. They consist of an in- clined bottom with fluidslides and a dosing device with flow rates of 600 t/h, which conveys	 the material to the storage silos via a further mechanical or pneumatic transport system. Either bucket elevators or so-called airlifts are used here. An airlift system takes up little space and does not involve mechanical devices. A nozzle is used to pass the material from an aerated vessel directly to a vertical conveying pipe. This system provides for very high conveying capacities and high vertical distances. Alumina takes the form of a fine white powder with a relatively small grain size distribution between 1 - 200 μm. A problem is 	caused by the fine materi- al, normally accounting for $5 - 10\%$, with particle sizes $< 45 \mu$ m. Segrega- tion phenomena occur- ring in certain zones of the storage silo may cause enrichment of the fine material. After discharge in the downstream process chain this will impair the efficiency of the elec- trolytic cells and increase HF emissions, thus hav- ing an adverse effect on the smelting process. This is why alumina stor- age silos are generally equipped with a so-called anti-segregation system. IBAU HAMBURG has revolutionised this sys-	tem, thus offering opera- tors of aluminium smelter plants improved process stability. Its patented system firstly prevents segregation occurring due to dead areas of flow in the silo by ensuring even silo filling via a distribution system with fluidslides. Systematic venting of the displaced air firstly pro- duces air flows in the silo that prevent dead areas of flow and segregation. Secondly, the silo dis- charge system is designed to ensure homogenisation of possible segregations. The silo operates accord- ing to the "first-in/first- out" principle. Material
System for emptying railway wagons				Silos with truck-loadir

discharge is carried out via sectional aeration of the silo bottom. For homogenisation blending of the material is performed from individual aeration sections of the silo bottom. The material is discharged from the alumina silo at rates of 300 - 500 t/h. Storage silos with a centre outlet have proved to be practical here. The material is discharged downwards from the centre outlet via a fluidslide.

Silo discharge is carried out using an IBAU flow control gate, which provides for the controlled discharge of material. Actuation of the individual aeration sections of the silo bottom with blower air is ensured by annular butterfly valves and components, used as a standard in the tried and tested central cone silos of IBAU HAMBURG.

IBAU silos with aerated bottom discharge are used to store additives.

Such silos have a diameter ranging between 3.0 and 5.0 m and a height of 12 - 15 m offering a storage volume of approx. 150 m³. A silo battery with 2 - 3 silos provides for the storage of approx. 300 - 450 m³ of additives, which are delivered either in containers or Big-Bags. After emptying the additives



ling equipment for additives

are conveyed to the storage silos pneumatically. At many aluminium smelter plants the distances between storage silos and the daily silos for molten-salt electrolysis are very large so that pneumatic or mechanical conveying is not suitable here.

The storage silos for the additives are therefore equipped with loading equipment for trucks, which transport the material from the port silos to the daily silos.

Standard loading capacities for the trucks are between 300 - 400 t/h.

IBAU silo discharge

With the large silo diameters of alumina silos featuring a central discharge it is normally extremely difficult to ensure an even discharge from a radial bottom segment.

IBAU HAMBURG has solved this problem. For example, a cone measuring 7 m in diameter is installed in a silo with a diameter of 44 m on the inclined bottom of the silo to provide a storage capacity of 65,000 t.

The bottom under the cone is completely cov-

ered with individual fluidslides, like the annular area outside the cone. The material in the annular area is conveyed into the cone using a fluidslide discharge tunnel.

Controlled inlet of the aerated material into this tunnel from the side is possible. The centre cone and the radial covers of the fluidslide discharge tunnels are made of concrete or steel.

The diameter of the centre cone and the number of fluidslide discharge tunnels depend on the diameter of the silo and the maximum size of the individual aeration sections. For example, 12 sections are provided for a 44 m silo. The silo bottom does not only slope towards the centre outlet point but also towards the fluidslide discharge tunnel of each section.

Alternating actuation is used for the individual aeration sections so that the entire material in the silo is put into motion during a complete cycle. This avoids all problems regarding dead zones. The system provides for full silo emptying up to 99% of the nominal storage capacity.



Discharge area under the central cone



Central steel cone with segmental design









Pneumatically operated IBAU flow control gate

In practical terms the fluidslides used in alumina silos do not differ from those installed by IBAU HAMBURG in other silos. The fluidslides consist of lower boxes provided with aeration fabric. The air for aeration is introduced underneath the fabric and fluidises the material above the fabric. For alumina and additives as required in aluminium smelter plants, this fabric provides for a service life exceeding 10 years or several track times of the electrolytic cells. Intermediate cleaning of the fabric is not necessary.

IBAU modular system

The conveying elements for alumina and additives used in aluminium smelter plants are based on the tried and tested modular system from IBAU HAMBURG.

IBAU flow control gates are used for the volumetric flow control of mass flows from a silo. An adjustable roller is used for this purpose.

It offers different roller apertures depending on the application and thus provides for the throughput of different volume flows. There are a range of drive concepts here. Pneumatic drives are mainly used in aluminium smelter plants.

IBAU flow control gates are available in many different sizes. Sizes 300 - 500 are used for material discharge from alumina silos and provide for controlled discharge of up to 500 t/h.

As alumina is a relatively free-flowing material, no special measures or precautions are necessary for the silo discharge. All other machines and components from IBAU HAMBURG used in the aluminium industry such as airlifts, mobile loaders and fluidslides are also available in the required sizes for alumina and additive handling.

The proper functioning of a plant not only depends on tried and tested cutting-edge technology but also the correct dimensioning and design of plant and components.

Here IBAU HAMBURG can offer international experience with such plants that stands comparison in all cases.



Silo discharge with IBAU flow control gate and downstream closed fluidslide





IBAU flow control gate for bulk material handling





Information

IBAU railway wagon unloading