

# Bulk materials handling meets Industry 4.0

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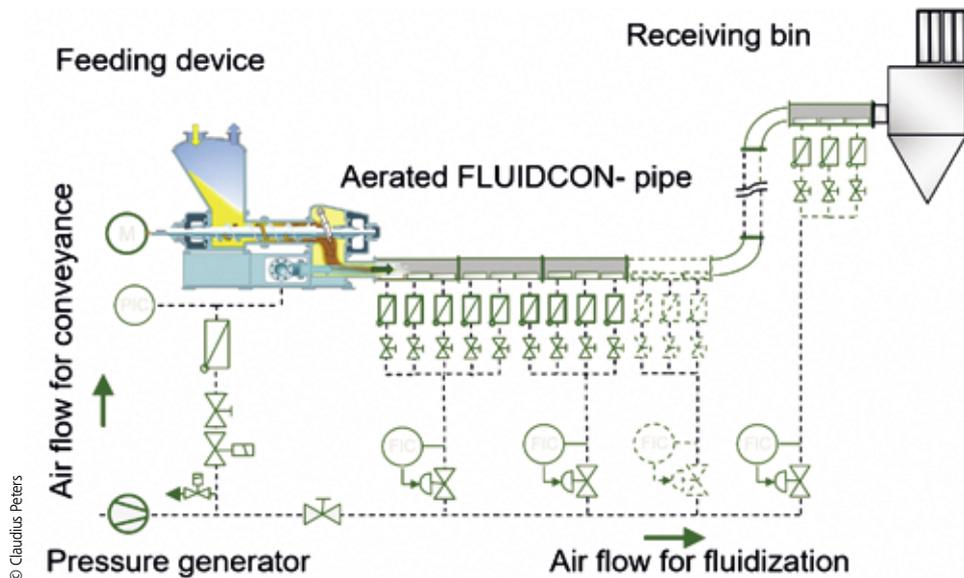


Fig. 1: Principle of Fluidcon pipe and typical layout of conveying plant

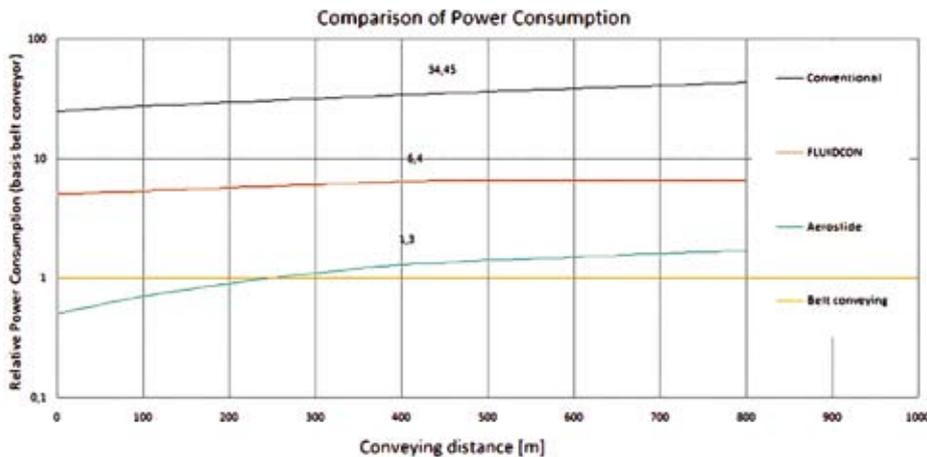


Fig. 2: Energy demand for different conveying systems

The employees of Claudius Peters are experts in materials handling and processing systems in the cement, coal, alumina, gypsum and other bulk handling industries. Claudius Peters designs and manufactures equipment for these industries. Our equipment is solid and robust. Our latest goal was to turn solid machines into intelligent machines and to enable our machines to improve the operation and maintenance processes.

Alumina is a very susceptible material. Cautious handling of this pulverized material is very important for its role in subsequent processing, because attrition or segregation of the powder during handling and storage can cause problems.

Claudius Peters Projects is renowned in the

fields of materials handling and special grinding processes. Especially for application in the alumina refinery or in the aluminium smelter the company offers optimized solutions for the industry:

- The **Fluidcon** conveying system combines low energy consumption and low conveying velocities.
- The **Anti-Segregation System** is a filling system especially for large silos, especially for application in the alumina industry.
- The **Aerated Distribution System – ADS** is distributing secondary alumina to the electrolysis

cells. It is probably the most energy-efficient and material-friendly distribution system in the market.

- The **Claudius Peters EM-Mill** is a vertical grinding unit, a perfect equipment unit for anode coke grinding.

- Our **Technikum** carries out tests on equipment on a semi-industrial scale. Before we deliver a new product, we test the process in our Technical Centre, the **Technikum**. It is open to our customers, to test new ideas before they are installed in the field.

- We developed the modular set of **smart solutions** to collect data, and to visualize information where you need it, and to enable the optimization of existing process plants.

In the following the advantages of these specialized systems for the aluminium industry are described.

## Low speed pneumatic conveying with Fluidcon

Cautious handling of alumina powder plays a very important role in its subsequent processing. Destruction of particles or attrition influences the further processing and has to be avoided, and segregation of the powder during storage has to be minimized. Loss of product at take-over-points or deaeration systems is a direct loss of value.

When designing new projects or planning modifications to existing systems, the design of the transport and storage systems plays a decisive role in the overall success of the installation. Claudius Peters has therefore developed the Fluidcon conveying system, a unique fusion of aeroslide and dense phase conveying, which combines low energy de-

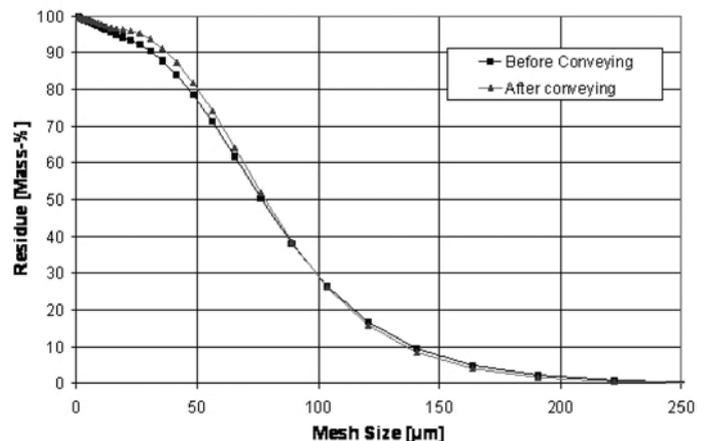


Fig. 3: Particle size distribution before and after conveying

Type of Conveyance	Power Consumption	Reliability			Maintenance Cost	Flexibility	Environmental Behaviour	Capital expenditure
		General	Clogging Risk	Power Failure				
IBC and Aeroslide	Green	Green	Green	Green	Green	Red	Green	Red
Pressure vessel without bypass	Blue	Red	Blue	Blue	Blue	Green	Blue	Blue
Pressure vessel with bypass	Blue	Blue	Blue	Blue	Red	Green	Blue	Red
IBC conveyor	Green	Green	Green	Green	Red	Green	Blue	Red
Pipe conveyor	Green	Blue	Blue	Blue	Red	Red	Blue	Red
FLUIDCON	Blue	Green	Green	Green	Blue	Green	Blue	Blue

Table 1: Comparison of different conveying systems (green: positive; blue: neutral; red: negative)

mand and low conveying velocities. In the Fluidcon system the total conveying gas is split into fluidising gas and axial driving gas. The fluidising gas is used to aerate the material along the conveying distance, and to keep the material in a fluid-like state. Then the axial driving gas moves the material in the conveying direction. This reduces the friction of the material, and so consumes less energy compared to standard pipe conveying.

Several Fluidcon systems are in operation worldwide with different products. Conveying distances in the plants installed range from 20 to 600 metres, with capacities from 10 t/h to 220 t/h.

Due to the low conveying velocity and the low friction, the energy demand is significantly lower than for conventional pipe conveying. This is schematically shown in Fig. 2.

The low conveying velocities of the Fluidcon system offer a further advantage, especially for the alumina handling: The rate of particle fracture with this conveying system is very low. Fig. 3 shows an example. Convey-



Fig. 4: Filling of a silo with Anti-Segregation System

ing distance in this case was 400 metres with a vertical height of 35 metres. With this conveying there is only a slight increase in the range of particles smaller 45µm.

It is important to compare and weigh the different options for every conveying task.

When modifying existing plants there are space restrictions that have to be taken into consideration. Table 1 shows an example of a qualitative comparison for different types of conveying options.

#### Anti-Segregation System – the best mix

Claudius Peters delivers storage solutions of different sizes for various industries. The size range starts with small pre-hoppers and ends with high-capacity silos. The main focus in the alumina industry is on the cautious handling of the precious material, and especially on minimizing its segregation. The segregation can be counteracted in two ways, avoiding it during filling of silos, or homogenizing the material at the discharge. Whatever you need: yes, we can.

With the Anti-Segregation System the material is handled by patented filling tubes at several positions at the perimeter of the silo. These filling tubes transport the material downward and they prevent turbulences in the material stream. The material leaves the filling tube nearly dust-free. The segregation of fine particles during filling of a silo is minimized. New installation or modification, the AS System works for you.

#### Aerated Distribution System – let the material work for you

The Aerated Distribution System (ADS) is the ideal solution for the distribution of the secondary alumina to the different electrolysis cells. It distributes the alumina from the secondary alumina silo at the fume treatment plant to the different cells in the potrooms. The ADS consists of inclined aeroslides. The layout of the system is shown in Fig. 5.

The ADS is operated by controlling the flow of the aeration air to the different parts of the system. When the aeration air is switched off, the material flow stops immediately. The system is deaerated via the pot superstructure to the gas collecting ducts. The inclined aeroslide results in a very reliable operation.

More than 1,000 cells worldwide are already fed using the ADS. The wear rate is very low, and the systems need only very little attention. There have been some reviews of the systems in operation, and they have shown very positive results. For example analysis of the particle size distribution at different positions of a system revealed that there is an even grain size distribution, which is an excellent precondition for smooth operation.

With a horizontal aeroslide, the coarse material fractions will be found more likely in the first part of the system, but the inclined aeroslide has a more even material distribution over the entire conveying length. By comparison, a pipe conveying system has high velocities and higher pressure drops over the conveying distance, which results in scaling or in material attrition. The ADS, by contrast, uses an inclined aeroslide system, and so avoids the aforementioned difficulties.

Because of its simple modular design, the ADS fits easily into existing plants, and it is also an ideal solution for new installations. The aeration air supply can be realized with plant air, or via central supply or using diversified air supply systems.

#### EM Mill – continuous operation and excellent results

The Claudius Peters EM Mill is the premium grinding technology to make fine pet coke for anode production. The introduction of the vertical spindle EM Mill into existing production lines for anodes has improved the consistency and quality of the anodes remarkably. The properties of the fines, characterized by their grain size distribution or Blaine number, can be maintained with less fluctuations compared to conventional grinding mills.

The capacity of the EM Mill can be adjusted between 100 and 25%. This allows actual capacity to be matched to the production requirements, so avoiding frequent stopping of the mill, i.e. producing less grinding losses.

Maintenance requirements are minimized due to the long service life of the grinding elements. During the service life it is not necessary to replace or install grinding balls. The low specific drive capacity of the total plant and the low maintenance requirements make this process much more efficient. →

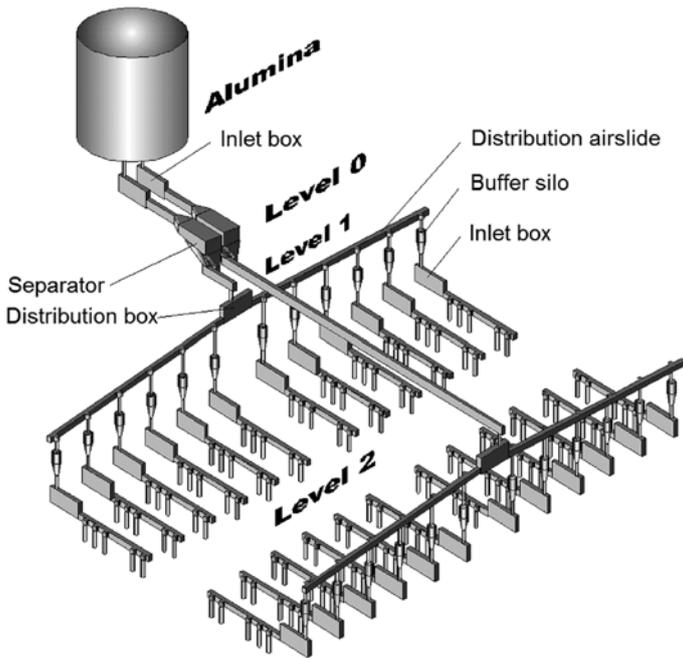


Fig. 5: Layout of Aerated Distribution System

**Technikum – try it out**

Our Technikum offers clients the opportunity to test any bulk solid conveying solution, grinding operation, or calcining test, or to perform laboratory testing of powders (Fig. 9). Extensive testing, backed by years of experience, enables Claudius Peters to design and produce conveying and handling systems that combine high reliability with minimum power consumption.

Incorporating conveying lines up to 5,000 metres in length and an extensive range of diameters, the Technikum provides opportunities to design and supply systems with for optimized process parameters. Each material is measured for its mechanical behaviour, so as to ensure that each customer gets the best solution for his needs.

The Technikum is open to clients to check special operating parameters or to analyse the effect of special material behaviour.

**Smart solutions**

To survive and prosper in the age of Industry 4.0, companies must become agile organizations. New capabilities, new ways of thinking, new structures and new methods of communication are essential to this process of conversion. To equip themselves for the challenges ahead, companies must become experts in networked thinking, open communication and across-the-board collaboration.

*CP Portal / Customer Portal:* Imagine a scenario where you are at the centre of intelligent data, with continuous access to import-

ant information and documents, anywhere and on every device; where you could receive data via a QR code while in the plant, for components which had already been installed. This is CP Portal.

Continuously adapted to customers' changing requirements, CP Portal has been designed to bring considerable enhancements to overall plant efficiency. A simple, intuitive user interface enables the interlinking of data from many sources, using retrospective QR coding.

The user receives important and compre-

hensive information during all project phases, with all QR codes and orders since 1994 made available upon request. Further services are currently under development and so as to retrieve even more data via the CP Portal. The CP Portal module can also be scaled for extended requirements, allowing the customer to determine, step-by-step, which plants and machines he wants to integrate into his portal. CP Smart Engineering enables him to do this quickly and efficiently.

Documents and data from the customer's system can then be simply interlinked at the customer's choice.

*CP Smart Engineering:* Imagine having a digital twin of your plant made available in just minutes. What if you could allocate documents and data by means of your TAG numbers? What if you could access a platform which incorporates your own plant structure? All this is possible with Aucotec's Engineering Base platform. Its multi-layer server architecture, along with its Process Configuration Management (PCM) tools developed by Claudius Peters, enables the fast creation of a central interdisciplinary data source to create a complete digital twin of a plant.

The PCM enables configuration of a customer's plant in just a few minutes. Developed process modules and intelligently linked functions allow the creation of data models. These models can incorporate process flow diagrams, piping and instrumentation diagrams, as well as functions, devices and installation sites. With this data, customers can digitalize their documentation and then link it to other data, defining their own standard symbols and plant structure functions.

*CP Plant View:* What if you could virtually walk through your existing plant with a 360° view? Or if you could find your documentation via 360° digital images? What if you were able to share and discuss issues online with any partner anywhere? Since 2014 Claudius Peters has been developing and enhancing CP Plant View, which enables 360° plant views and tours. With a similar functionality to Google's Street View, this facility is integrated into plant documentation, following erection and commissioning.

CP Plant View can also be integrated with

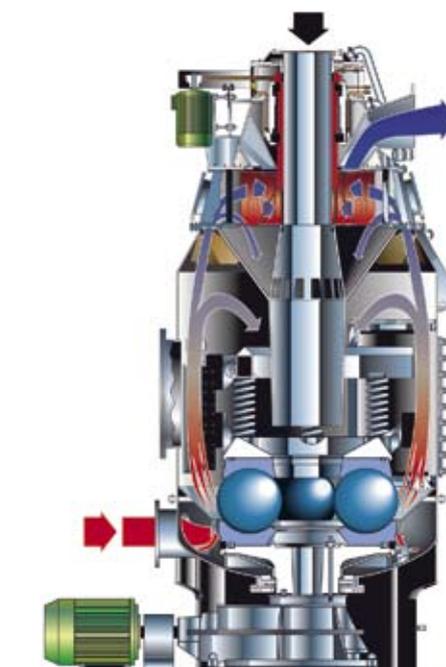


Fig. 6: Claudius Peters EM Mill



Fig. 7: Installation of EM Mill

CP Portal, allowing you to ‘walk’ through your plant, then enter the CP Portal for the documentation and extended information. This module can also be developed for existing plants and installations. CP Plant View can be shown virtually on a smartphone. According to one customer: “This type of plant tour is perfect for our maintenance personnel. Our colleagues can orientate themselves via images and can easily find the required information on the CP Portal.”

*CP Smart Design:* What if you could follow a 3D plant design live and online? What if all revisions of the 2D/3D design could be viewed and compared with each other online? And what if all of this functionality was available without CAD software and was viewable on any device?

Building Information Modelling (BIM) is a much talked-about technology. Claudius Peters has been offering this service to its customers and suppliers for some time now. For current and new projects, partners can access planning and the documentation in several

approved areas, can download and upload information, and can enter their comments, questions and modification requests online. They then have the option of contacting the appropriate staff member to handle their request.

As a way to faster and more efficient project processing, CP Smart Design is proving popular with customers. “At first we were a bit sceptical. However, the experience of cooperation between ourselves and Claudius Peters has been very impressive. We can now even take pictures of the site with the tablet and/or the smartphone and integrate these in the BIM platform. From now on the BIM platform will be prescribed for our future projects,” said a customer.

*CP Smart Device:* Interlinking data with machines is normally only possible with modern equipment. However, Claudius Peters has developed a retrofit concept which can interlink existing technology with older machines and plants, so collecting data and making it available outside the plant. The CP

Smart Device can easily be configured for a range of applications locally or remotely. Additional and affordable measuring devices can be retrofitted as required. CP Smart Device gives the customer constant access to all collected operating data, and complete control over how data is shared with others.

The data, which is not stored on the cloud, is written into a database

in a standard format, and then visualized. Rules can be defined as to how and when CP Smart Device contacts personnel, via email or SMS. Monitoring systems can also make use of the device for predictive maintenance purposes.

Because CP Smart Device makes PLC data available outside the plant, so machine and plant conditions can be checked from outside. Customers can view trends over hours, days, weeks or months without interfering with the control of their plant. The device can be installed at the plant, at the switchboard, or can be made available as a mobile unit.

*Data Security:* All these services are adapted to the needs of the customer. The customer decides to what extent a data exchange takes place, and which services are useful for him.

## Conclusion

Fluidcon conveying system, which combines low energy consumption and low conveying velocities. The Anti-Segregation System is designed especially for use in the alumina industry. The Aerated Distribution System ADS is probably the most energy efficient and material friendly material distribution system on the market. The Claudius Peters EM Mill: the finest solution, delivering consistently high quality. Our Technikum allows for material tests on a semi-industrial scale.

Claudius Peters Smart Devices are our idea of Industry 4.0. It is a continuous process for us, and this process has enabled Claudius Peters to develop new technologies, concepts and ideas for improved cooperation between customers and suppliers. According to one customer: “I thought that Industry 4.0 only means collecting data without real usefulness for me, but I was wrong. I find it unbelievable that you could assist me in my aim of reducing costs through intelligent interlinking of my experts with my suppliers.”

Through the cross-linking of data and machines, through cross-platform collaboration and taking a holistic outlook, Claudius Peters is able to immediately understand and to quickly provide solutions to the challenges facing its customers.

## Authors

For more than 20 years Dipl.-Ing. Arne Hilck has been with Claudius Peters Projects, where he now works as product line manager for Silo and Alumina. In addition, he also took over as group manager for the Claudius Peters Technical Centre. Dipl.-Ing. Jan Paepcke has been with Claudius Peters for more than 25 years. Today, he is Territory Sales manager at Claudius Peters, responsible for all sales.

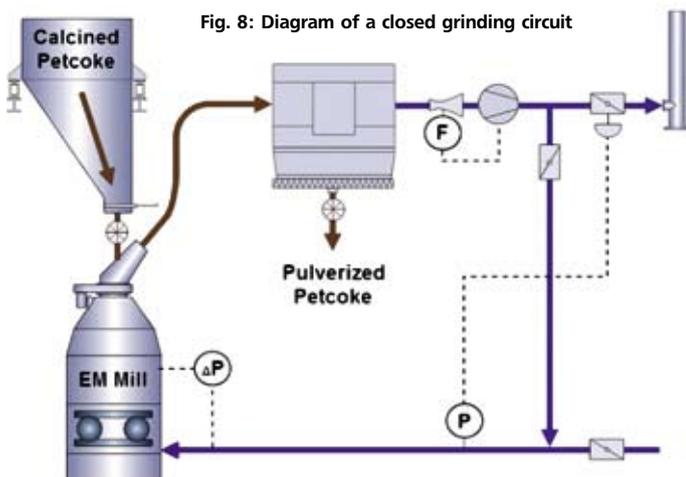


Fig. 9: Inside view of the Technikum

