# THE MOELLER DIRECT POT FEEDING SYSTEM FOR A SMOOTH AND CONSTANT PNEUMATIC TRANSPORT OF SECONDARY ALUMINA TO THE ELECTROLYTE CELLS

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## Abstract

The MOELLER Direct Pot Feeding is a high efficient and full automatically facility for a smooth and wear-resistant constant pneumatic transport of secondary alumina to the electrolyte cells.

This pneumatic transport system is a combination of a dense phase feeding from a storage silo to intermediate bins at the electrolyte cells and a SFS (Super feeding system) air slide system directly to each of the electrolyte cells.

The TURBUFLOW® dense phase feeding as well as the SFS (Super feeding system) air slide system are approved systems which preserves the particle size distribution and the flow ability of the alumina.

The main conveying air volume is separated in the intermediate bin and do not influences the situation of feeding secondary alumina from intermediate bin via point feeders into the electrolytic cell.

The mass flow of secondary alumina is blocked automatically when the bunker of an electrolytic cell is full and the bulk material cone level has reached the fill spout discharge opening. The fluidising of the bulk material inside the SFS air slide system still works and ensures no remarkable variations of the bulk density. When secondary alumina is removed from the bunker of the electrolytic cell, the pneumatic transport starts again automatically and a constant and reliable mass federate to the pots is ensured.

This most competitive system for the pneumatic feeding of secondary alumina to electrolytic cells is one of the components to ensure the quality of the aluminium production on the highest possible level.

## 1. Introduction

Based on more than 60 years experience in design, planning and supply of all kind of pneumatic transport systems (TURBUFLOW®-, Airlift- and Air slide Systems) in the field of the electrolysis and the fume treatment process and large capacity storage facilities, MOELLER MATERIALS HANDLING has developed a pneumatic transport system for feeding the electrolyte cells directly.

This pneumatic transport system is a combination of a dense phase feeding from a storage silo to intermediate bins at the electrolyte cells and a SFS (Super feeding system) air slide system directly to each of the electrolyte cells.

The special features of this pneumatic transport system are first of all to ensure a smooth, constant and reliable flow of secondary alumina to each of the electrolyte cells and a minimum of fines generation, dusting and segregation.

## 2. The Direct Pot Feeding System

The new MOELLER Direct Pot Feeding is schematically shown in Figure 1.

This pneumatic conveying and transport system is a combination of a dense phase feeding via pressure vessel (2) and TURBUFLOW® conveying pipe (3) of secondary alumina from a storage silo via a vibration screen (1) to intermediate bins (5) near by the electrolyte cells and a SFS (Super feeding system) air slide system (6) to each of the electrolyte cells (7).

The pressure vessel (2) is equipped with a MOELLER filling valve, a MOELLER conveying pipe shut-off valve and the necessary pneumatic valves, ball valves and non return valves for the optimal air distribution for fluidising and conveying of the bulk material.

The intermediate bin (5) is equipped with a MOELLER filling valve, air slides at the outlet and a level indicator (max.). The filling of the intermediate bins (5) will be initialised by another level indicator (min.) or after a well defined period of time.

For the conveying air consumption a separate compressor (8) or the plant net for compressed air (8) can be used. For the fluidising air of the SFS air slide systems either the plant net for compressed air (8) or a separate blower is used.

The (single-) pressure vessel system is a non- continuously working pneumatic conveying system for feeding secondary alumina to e.g. one section of electrolyte cells.

The SFS air slide system is a continuously working transport system. When the bunker of an electrolytic cell is full and the bulk material cone level has reached the fill spout discharge opening, the mass flow of secondary alumina is blocked automatically. The fluidising of the bulk material inside the SFS air slide system still works and ensures no remarkable variations of the bulk density. When secondary alumina is removed from the bunker of the electrolytic cell, the pneumatic transport starts again automatically and a constant and reliable mass feedrate to the pots is ensured.

For safety reasons, the SFS air slide system of each electrolyte cell is equipped with two electrical insulators. This equipment does not influence the conveying process, but is a key component for the whole Direct Pot Feeding system.

**KEY WORDS: Direct Pot Feeding, TURBUFLOW® dense phase feeding, SFS (Super feeding system) air slide system**

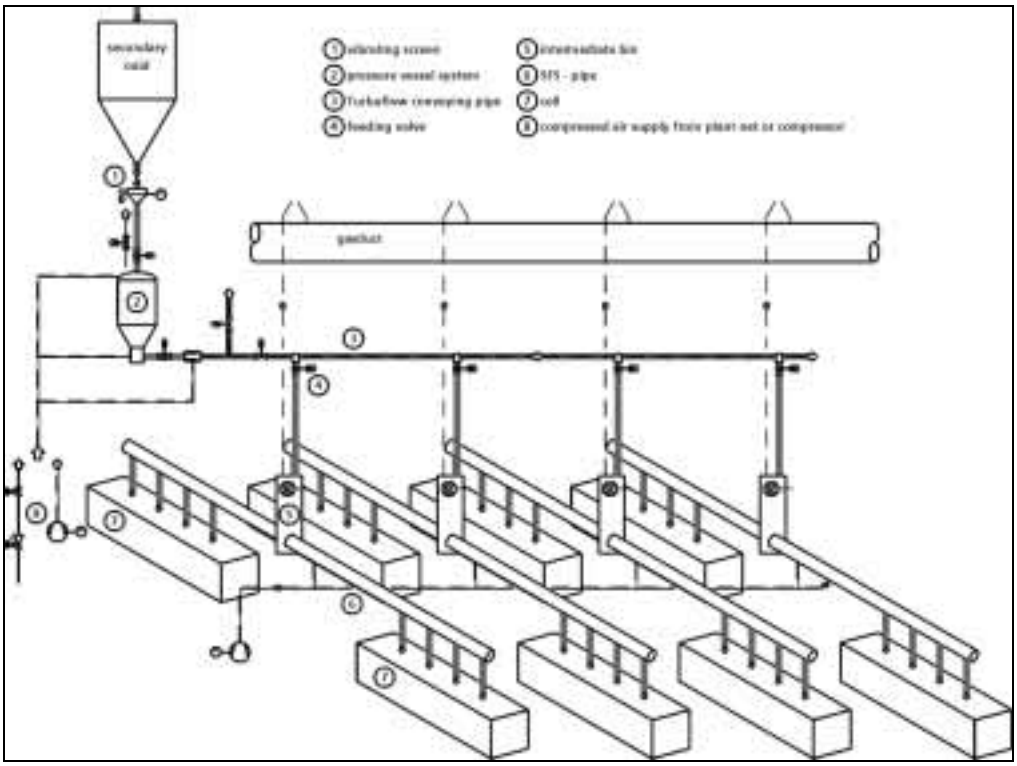

Figure 1 — Direct Pot Feeding — Side by Side (Mostar, Bosnia-Hercegovina)

### **2.1** *The TURBUFLOW® dense phase feeding*

The TURBUFLOW® dense phase feeding is a slow and therefore a smooth and wear-resistant pneumatic transport of secondary alumina and if necessary over a long conveying distance to the intermediate bins near by the electrolyte cells (pots).

Because of the low conveying velocities at the beginning (approx. 6–8 m/s) and at the end (approx. 14–16 m/s) of the conveying pipe, the generation of fine particles (< 45 microns) is minimised. The segregation effect is minimised because of the high material/air rate and the low conveying velocities. These are big advantages in comparison to dilute phase feeding systems, which have to operate with higher conveying velocities and lower material/air rates.

In Figure 2 a comparison of different pneumatic transport systems regarding the conveying velocities is shown.

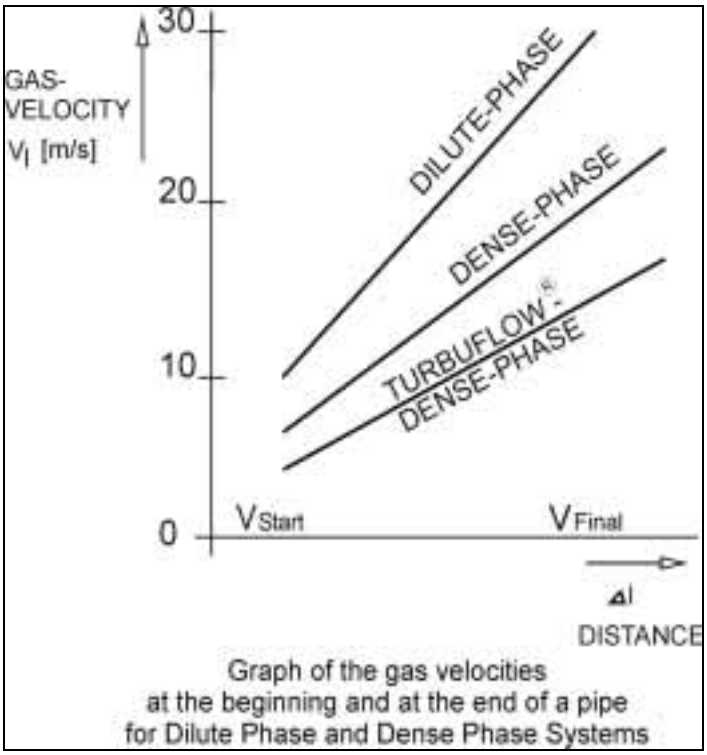


Figure 2 — Conveying velocities of different pneumatic transport systems

There is no doubt, that a dense phase feeding of secondary alumina over a longer conveying distance is the most efficient pneumatic transport system which preserves the particle size distribution and the flow ability as much as possible.

Table 1 shows the changes of particle size distribution after approx. 150 m TURBUFLOW® dense phase feeding and approx. 10 m SPS air slide feeding at the reference plant in Mostar, Bosnia- Hercegovina. There are no remarkable changes of particle size distribution.

Dust samples has been taken from the silo and from the bunker of the electrolytic cells.

Comparable test with secondary alumina has been done at the MOELLER test plant too. The result was the same. The TURBUFLOW® dense phase feeding preserves the particle size distribution and the flow ability of the alumina.

Table 1 — Particle size distribution before and after pneumatic transport

| Particle size | Storage silo | Bunker of electrolyte cell |
|---|---|---|
| 250 microns < x < 400 microns | 0 % | 0 % |
| 200 microns < x < 250 microns | 0 % | 0 % |
| 125 microns < x < 200 microns | 11,7 % | 11,7 % |
| 80 microns < x < 125 microns | 48,3 % | 48,1 % |
| 56 microns < x < 80 microns | 24,2 % | 23,9 % |
| 45 microns < x < 56 microns | 6,8 % | 7,1 % |
| < 45 microns | 9,0 % | 9,2 % |
| Σ: | 100 % | 100 % |

No blockage of bulk material in the conveying pipe during operation and the possibility of re-start with a full conveying pipe because of a secondary inner bypass tube with inlet and outlet openings and an integrated disk are worldwide known advantages of this TURBUFLOW® dense phase feeding system.

Figure 3 shows this patented TURBUFLOW® dense phase feeding system (type I and II) and a standard pipe. The main difference is the inner bypass pipe with the orifice and the inlet and outlet openings.

If a lump forms somewhere in the TURBUFLOW® pipe, the airflow through the inner bypass pipe is increasing. At one of the next openings, the lump or material clot is fluidised by the turbulences.

Because of local initialised turbulences, a continuous and blockage free transport of bulk material is ensured.

TURBUFLOW® pipe type II will normally used only for the pneumatic conveying of alumina, because of the lower gas retention of this bulk material (Group B, acc. to Geldart diagram). TURBUFLOW® pipe type I will be used for the pneumatic conveying of e.g. fly ash, cement, gypsum etc.(Group A/B, acc. to Geldart diagram).

High efficiency because of a high material/air rate and the resulting reduced conveying air and de-dusting requirements, high reliability and low maintenance are further benefits of this 100 % self-regulating TURBUFLOW® dense phase feeding system. No additional booster valves and outside bypass pipes along the conveying pipe are necessary. Low investments are therefore a further advantage of the MOELLER System.

A comparison of material/air rates as function of the conveying length for different pneumatic conveying systems is shown in Figure 4.

Last but not least, the main conveying air volume is separated in the intermediate bin and does not influence the situation of feeding secondary alumina from hopper via point feeders into the electrolytic cell.

### **2.2** *SPS- Super feeding system pipe (type: conduit-air slide)*

The SPS- Super feeding system pipe (type: conduit-air slide) is an ultra slow conveying of secondary alumina from the intermediate bin to each of the electrolyte cells. Because of the very low conveying velocities (< 1 m/s), the generation of fine particles (< 45 microns) as shown in table 1 as well as the segregation and scaling effects are minimised and not possible to measure.

No pressure tight sealings of the electrolyte cells are necessary, because of this low (over) pressure conduit- air slide conveying.

The self-regulating and continuous refilling of the electrolyte cell during operation of the smelting plant is another important benefit of this system.

## 3. Reference plants

After approx. 5 years experiences in the operation of the MOELLER Pilot plant at HAMBURGER ALUMINIUM WERKE (HAW) in Hamburg and the latest modifications in January 2000, the handing over of the first reference plant (ALUMINIJ Mostar/VAW Aluminium

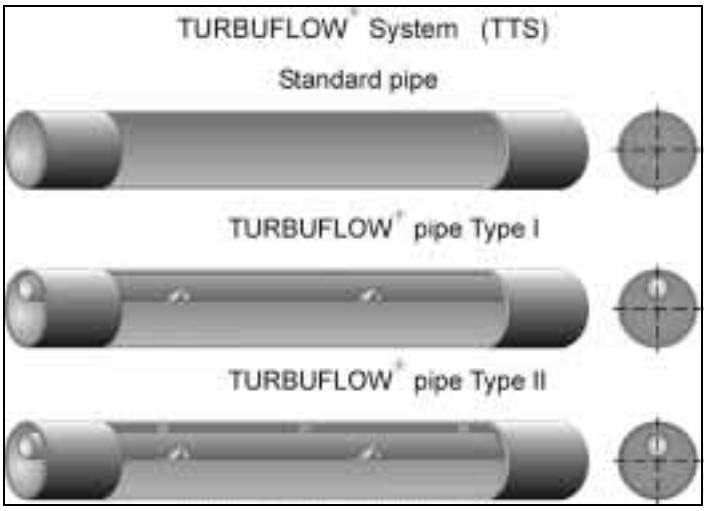


Figure 3 — The TURBUFLOW® Dense Phase feeding system

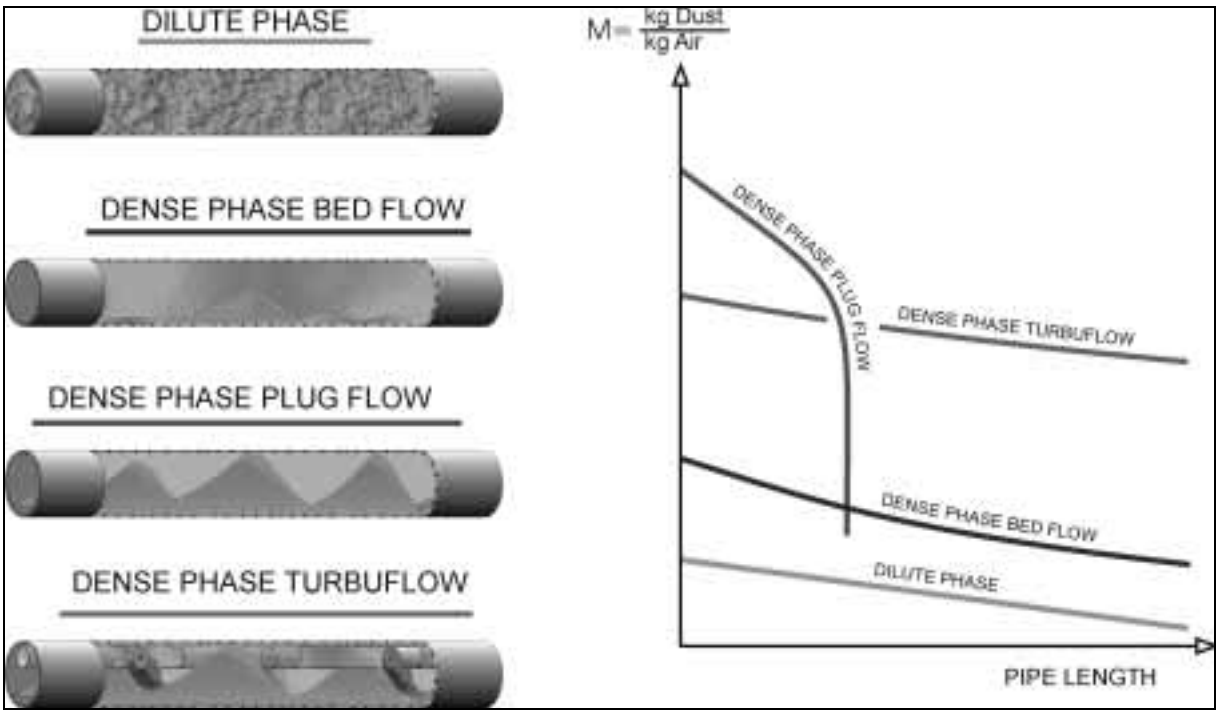


Figure 4 — Material/air rates for different pneumatic conveying systems

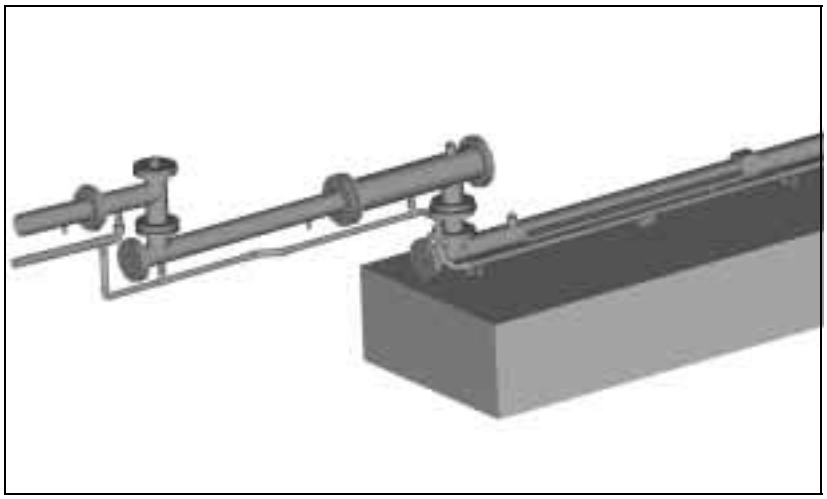

Figure 5 — SPS- Super feeding system pipe

Technology GmbH) with 256 aluminium smelting pots (4 different sections with 64 pots each) will take place end of June 2002. Two sections (2 × 64 electrolytic pots) are already in successful operation since September 2001. The third section with another 64 electrolytic pots is in successful operation since February 2002.

The TURBUFLOW® dense phase feeding system is designed for a conveying capacity of nom. 9 t/h and max. 15 t/h for each of the 4 sections. One of those feeding systems consists of three pressure vessel systems, one for stand-by.

The SPS- Super feeding system pipe (type: conduit-air slide) for each electrolyte cell is designed for nom. 110 kg/h and max. 130 kg/h conveying capacity.

The test runs for the first two sections took place in April 2002 very successfully. The guaranteed conveying capacities and compressed air consumptions are 100 % fulfilled. The MOELLER Direct Pot Feeding System works properly and without any problems since the first start of the system in September 2001.

## 4. Conclusion

It is the combination of both — the TURBUFLOW® Dense Phase feeding and the Super Feeding System Pipe (type: conduit- air slide), that makes this innovative Direct Pot Feeding working so smooth, effectively and efficiently in aluminium smelting plants.

The MOELLER Direct Pot Feeding is designed to ensure constant and reliable mass flow to the electrolytic cells and to preserve the particle size distribution and the flow ability of the secondary alumina.

The main conveying air volume is separated in the intermediate bin and does not influence the situation of feeding secondary alumina from intermediate bin via point feeders into the electrolytic cell.

Figure 6 — SPS- Super feeding system pipe at ALUMINIJ Mostar, Bosnia-Hercegovina

Self-evident the conveying plants need low maintenance and low investment costs.

This most competitive system for the pneumatic feeding of secondary alumina to electrolytic cells is one of the components to ensure the quality of the aluminium production on the highest possible level.

## Reference

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