Pneumatic conveying of alumina - comparison of technologies

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Abstract

During pneumatic conveying and storage of alumina, the material should be treated very cautiously. Degradation of the material must be avoided. Conveying with high air pressure may result in some cases in scaling in the pipelines. In this paper the general mechanisms of attrition during conveying are highlighted. The technical background of attrition and pneumatic conveying is described. Some general conveying options are compared. Key point is always a thorough analysis of the material to be transported. If the conveying plant is optimized to its specific task, savings in energy and investment can be made.

Keywords: Pneumatic conveying; attrition of alumina; alumina storage; alumina conveying.

1. Introduction

The requirements on a system for the handling and transport of alumina are:

- No grain abrasion and no grain fracture; the particle size portion of < 45 µm, critical for the further processing procedure, must not be increased,
- No segregation according to grain size, meaning the critical portion < 45 µm must not accumulate during transport or storage, etc., neither spatially nor over time,
- Systems must be designed wear-resistant and must have low wear during operation.

The two points stated first essentially influence the quality of the product “sandy alumina” and therefore also the operation of the subsequent aluminium electrolysis cells. The third point influences the economic efficiency of the complete production line. For alumina storage silos and feeding systems for the electrolysis cells highly efficient and proven solutions already exist with Anti Segregation System (AS-System) and Aerated Distribution System (ADS) [1].

The transport of alumina between different plant areas can be realized with either mechanical or pneumatic conveying systems. The simple plant design and the closed, i.e., environmentally-sensitive, conveying line are advantages of a pneumatic conveying system. Disadvantages compared to the mechanical conveying are the system-inherent higher power consumption and increased wear sensitivity. In Figure 1, a schematic of the general dependencies of pneumatic conveying is given. With low conveying velocities the risk for a plug of the conveying is given and the pressures are high. With high velocities the pressure difference per distance is lower, but the overall energy consumption is high. The general tendencies are shown in Figure 2.

In FLUIDCON conveying system, presented in this paper, the conveying velocities can be further substantially reduced.

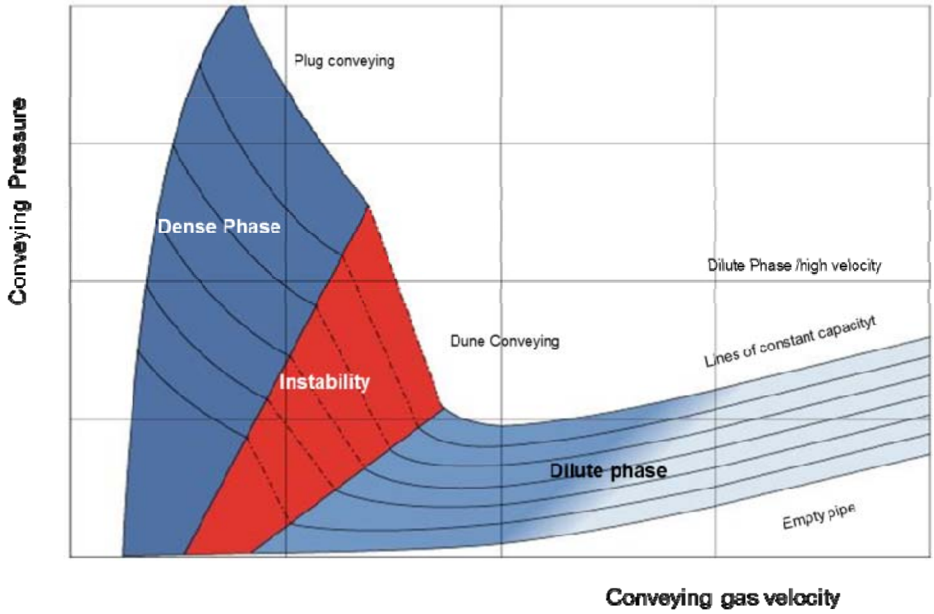

Figure 1. Schematic pneumatic conveying diagram.

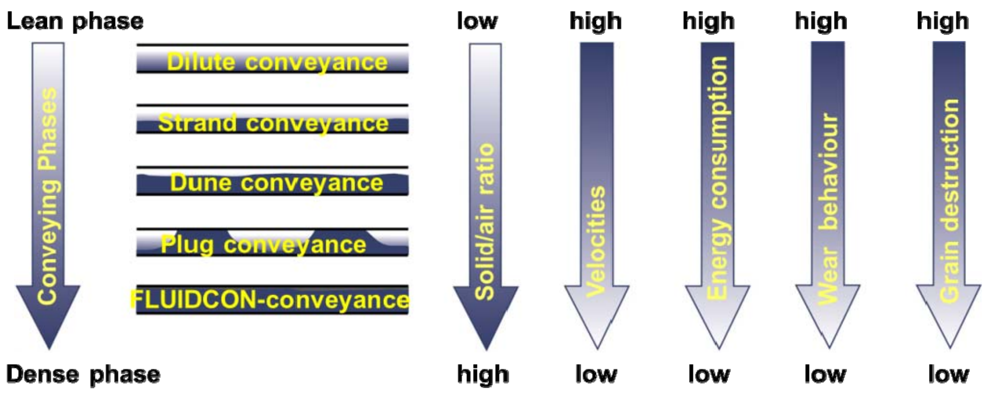

Figure 2: General relation of pneumatic conveying systems

2. Conveying principle and application of FLUIDCON

FLUIDCON can be described as a combination of aeroslide conveying and pneumatic pipe conveying. It consistently uses the advantages of both processes and eliminates essential disadvantages by combining them. Aeroslide conveying is characterized by extremely low energy consumption but needs an inclination of the aeroslide in flow direction. It therefore has a limited flexibility in the pipe routing, i.e., no vertical conveying is possible. The advantage of the pneumatic pipe conveying is the almost unlimited flexibility in the pipe routing; its disadvantage is the much higher power consumption.

Figure 3 shows the structure of a FLUIDCON conveying plant. The total gas flow supplied by a pressure generator is divided into a fluidizing gas flow and a driving gas flow. The fluidizing gas flow quantity is adjusted by a controller and is fed to the conveying pipe, distributed along the transport route, for fluidization of the bulk material. The driving gas flow is fed at the beginning of the conveying pipe and triggers the axial solids transport. Here the pressure drop of the driving gas flow replaces the inclination of the aeroslide. Due to the fluidization the bulk solid is transferred into a fluid-like state with nearly no internal friction and is lifted off the pipe

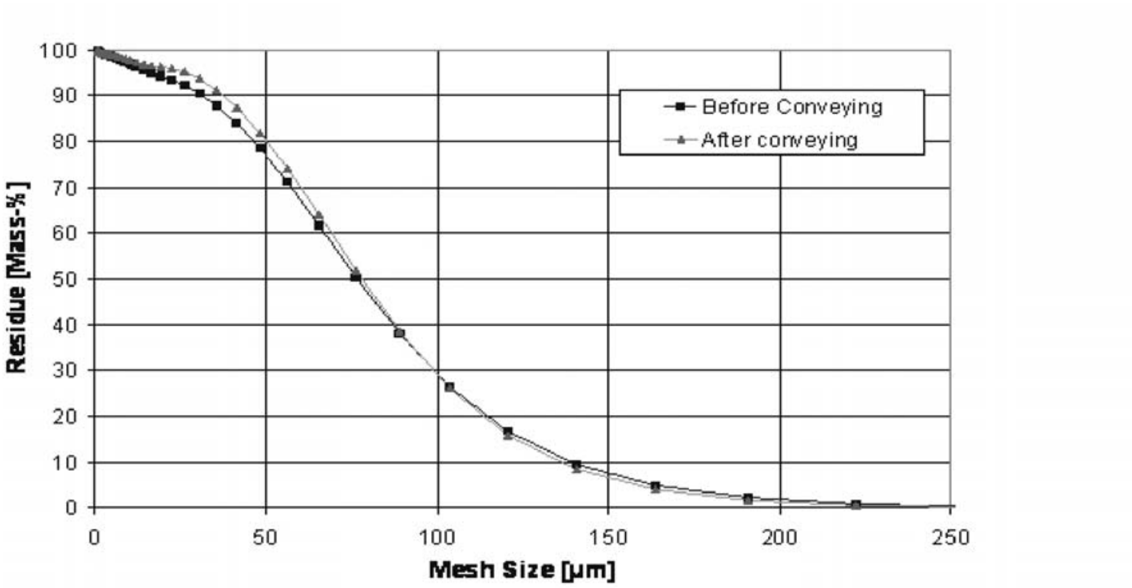

Figure 6. Evaluation of particle attrition, taken from [7].

4. Conclusion

A description is given of a simple dense phase conveying system that combines the advantages of aeroslide conveying and pneumatic pipe transport. The characteristics of the FLUIDCON conveying system are an extremely low transport velocity and a low power requirement. The design of the conveying pipe, the layout of the system as well as the requirements to the bulk materials which are conveyable with FLUIDCON are discussed. The operating behaviour of FLUIDCON in the case of the transport of "sandy alumina" is represented with the aid of the results of extensive systematic measurements carried out in a test plant in the Claudius Peters Technologies research centre and is applied to a real plant implementation.

4. References

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