Concepts for Alumina Handling in Smelters - Efficiency from Port to Pot

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Abstract

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The aluminium production depends on a stable and constant flow of alumina. Variations in particle size of the material effect the smelter operation. Investment cost for transport and storage need to be as low as possible. The handling system should only need low maintenance and the system should be as energy efficient as possible. In this paper different concepts of storage, handling and conveying of alumina are described. Based on laboratory tests with different materials and field experience the methods of conveying are compared. With modifications to existing plants there are different requirements compared to new installations, which would allow for completely new concepts for the layout of the system. There is no One-size-fits-all-solution.

Keywords: Alumina conveying, alumina attrition, efficiency of conveying, storage.

1. General Criteria for Decisions

The criteria of a transport system are mainly easy to describe, low cost, no disturbance.
In detail the question is more complex. With Greenfield Installation the decisive factor is only the cost, Capex-cost. Technical requirements, like conveying capacity, or storage capacity are defined in advance and suppliers respond to these requirements. In most cases the cheapest system is chosen, technical advantages that come up during the negotiation process are in most cases not considered, as this would start a new cycle of negotiations.

The same applies for technical advantages that a system from one supplier might have towards other systems, for example: maintenance cost or other life cycle aspects, as these are often not considered. With changing general preconditions for the installation other aspects like environmental aspects or aspects for a fair trade could come into focus (see Figure 1).

Therefore, it is crucial to define the right parameters in advance under the given preconditions. In this paper is defined a set of general parameters for conveying and storage solutions in smelters and compares different options for these tasks.

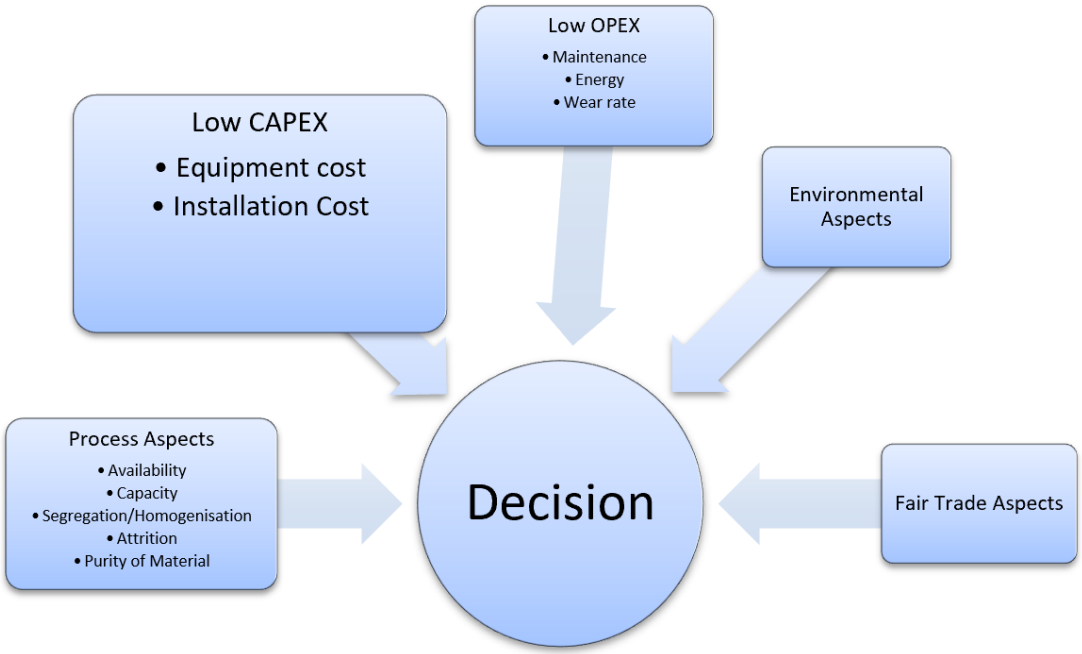

Figure 23. Factors influencing the decision to upgrade conveying systems.

In the following section we will focus on the parameters of the process and the general requirements on the different tasks that arise from these parameters.

2. Requirements from the Smelter

At the bottom line, the pot needs a stable supply of material that holds homogenous properties within a certain window of operation. The main requirements have already been comprehensively discussed in many other papers [1 - 6].

The smelter grade alumina (SGA) arriving at the pot must have very stable properties. Attrition of the material particles during the process steps upfront must be minimized. Wear on the system itself may lead to impurities in the material.

Besides these details there are some general requirements that have to be fulfilled by the transport line from port to pot. All foreign particles need to be screened from the material at the best possible position, whereby these foreign particles are likely to be parts from rail or ship transport, or from loading and unloading operations. Agglomerations could grow during road or rail transport and need to be deagglomerated or screened from the system. If the root cause of agglomerations is clear, e.g. take up of humidity in a transport step, they should be avoided as much as possible, as the effects like blockages are massive and the moisture content reduces the performance considerably.

In Table 1, the general requirements are summarized:

all connected pots. For this task often a horizontal aeroslide system is used. The problem is, however, that as conveying distances increase the retention time in the aeroslide increases as well and in that case two problems can occur. First is the segregation of coarse particles at the bottom part of aeroslides and they will be extracted primarily at the beginning of the line. If there is no screening of the coarser particles, then these may lead to blockages. The second point are the fine particles that need to be closely looked at in large installations and investigate if they can be taken out, otherwise an even particle size distribution is not possible.

As new pot lines get bigger this is becoming more and more a challenge [3, 13, 14]. In the table below different options for a material distribution are compared.

a) Pipe conveying with valves to all receiving points;
b) Horizontal aeroslides; and
c) Inclined aeroslides.

While with a horizontal aeroslide the coarse material fractions will be found more likely in the first part of the system the inclined aeroslide will have a more even particle size distribution over the entire conveying length. The overall air consumption is less, as the inclined system runs intermittently to refill pre-bins when needed.
Compared to this a pipe conveying will have high velocities and higher pressure drops in conveying distance, resulting in scaling or material attrition. If there is no inclination in the system, the coarse particles might need to be drained out at the front end of a distribution system, as the accumulation of coarse particles in the front end might affect the overall transport capacity.

Table 5. Different Options for Material Distribution [13]

		Version A	Version B	Version C
Description		Pipe conveying with separate valves	Horizontal aeroslide	Inclined aeroslide
Installation Cost				
	Supporting Structure	Only piping small size	Horizontal easy to install, but high demand deaeration	Inclined aeroslide not easy to install
	Mechanical Equipment	Minor but a lot of valves	Same as inclined	
	Installation	Very easy	Easy	Easy
	Electrical Equipment	Lot of valves	Fewer to no valves	Few valves
Operational Cost				
	Air Consumption	High	High	Low
	Air Pressure	High	Low	Low
	Wear Parts	Very high demand	Low demand	Low demand
Operational aspects				
	Scaling	Very high	Possible	Very Low
	Segregation	Low	Possible	Low
	Attrition	High	Low	Low
	Control of operation	Reasonable	Low	Very good
	Monitoring of operation	Reasonable	Low	Good

7. Conclusions

The requirements and decision parameter for different conveying equipment is highlighted. Different storage and handling procedures are compared. There is no solution that fits every requirement, but for every requirement there is a solution that fits best.

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