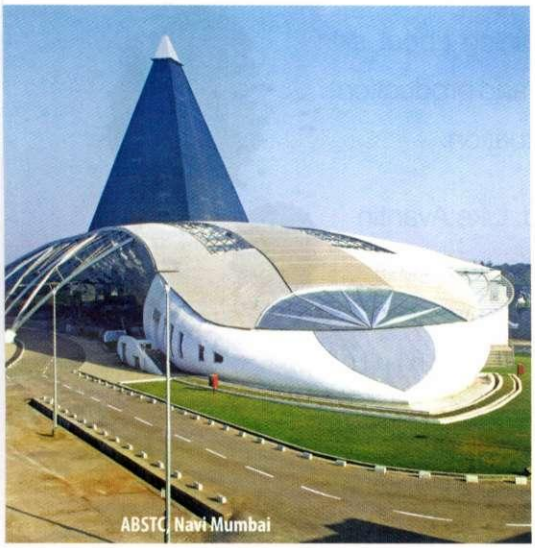


Science and Technology for a Sustainable Future

The Aditya Birla Group's technology team from the Aditya Birla Science and Technology Company Limited (ABSTC), along with the Hindalco Muri Refinery and Hindalco Innovation Center, is building a strong scientific platform backed by science and technology to excel with safe and efficient manufacturing practices at its commercial production sites.

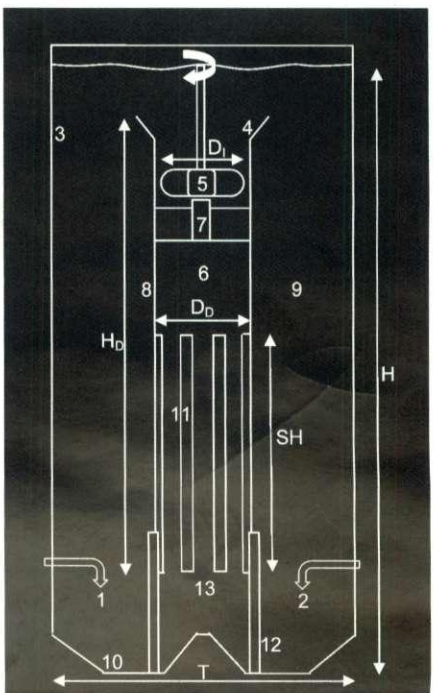
Implementing the best operating practice for efficient energy management in an alumina refinery

Air sparging is widely used in the process industries, in production of chemicals, pharmaceutical applications as well as in food, pulp, paper, minerals and hydrometallurgical industries. Typical mineral processing industries use as much as 30% of their total electricity requirements to make compressed air. The two most cost effective ways include reducing air leaks and/or optimizing the utilization of compressed air for the best performance of a unit process. In the Bayer alumina process, especially in the white side, precipitation process is the rate determining step in the production of aluminium hydrate crystal particles.

A successful commercial scale production especially depends on the smooth and continuous operation of the agglomeration and precipitation growth processes. Industry scale draft tube precipitator design in the Bayer alumina process has the task to uniformly suspend alumina hydrate particles with minimum power consumption. It is important to note that the overflow particle concentration from one stage to the other will be uniform if particles are uniformly suspended in the entire precipitator volume; else gradients in particle concentration will prevail in alumina precipitators. In operational practice, it is generally believed that the compressed air sparging assists and enhances the solid suspension in draft tube

"Managing a complex chemistry of precipitation circuit of Bayer's Alumina process through a precise control of air and pregnant liquor flow and controlled agitation to produce desired Granulometry is an engineering marvel. It makes it extremely critical when 10 giant tanks of 36 m height each having 4,500 m^3 volume are live in the circuit. Technical & Operations team of Hindalco Muri Refinery supported by engineering prowess of ABSTC made us proud by delivering world class results in precipitation productivity."

Sudip Bhattacharyya, Unit head - Hindalco Muri works



Draft tube precipitator (Details of H, H_D, SH, D_I, D_D and T are given in the below Table). (1&2) Air injection location (3) Precipitator wall (4) Draft tube bell-mouth suction (5) Hydrofoil impeller (6) Draft tube region (7) Flow straightening vanes (8) Draft tube wall (9) Annular region (10) Profiled precipitator bottom (11) Draft tube slots (12) Draft tube support (13) Draft tube outlet.

Design	Notation
Tank diameter	T
Draft tube diameter	D_D
Impeller diameter	D_I
Operating fluid height	H
Draft tube height	H_D
Total slot height	SH

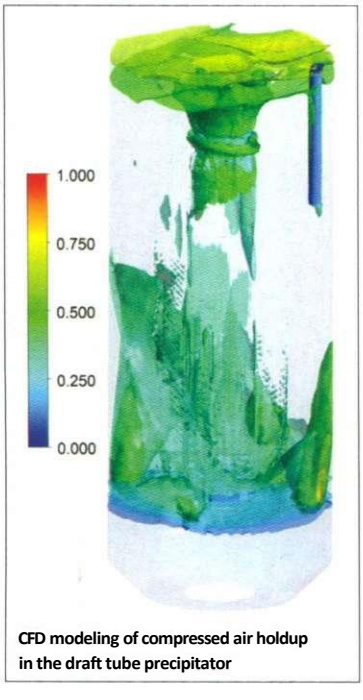
precipitators. A fundamental investigation has been made to characterize the flow and hydrate suspension phenomena in the draft tube precipitator design using computational fluid dynamics (CFD) modeling.

Objective: To reduce downtime in the white side of alumina refinery by improving hydrate suspension in the draft tube precipitators.

Challenges: Attempted several process and design modifications to improve hydrate suspension. None of them sustained with improved suspension. Finally excessive compressed air agitation prolonged the hydrate suspension, however, not sustained.

In-house R&D investigations: Initiated in-house R&D to critically figure out the root cause of the problem. The fundamental and scientific based critical investigation helped the entire team to understand the actual root cause problem in-depth.

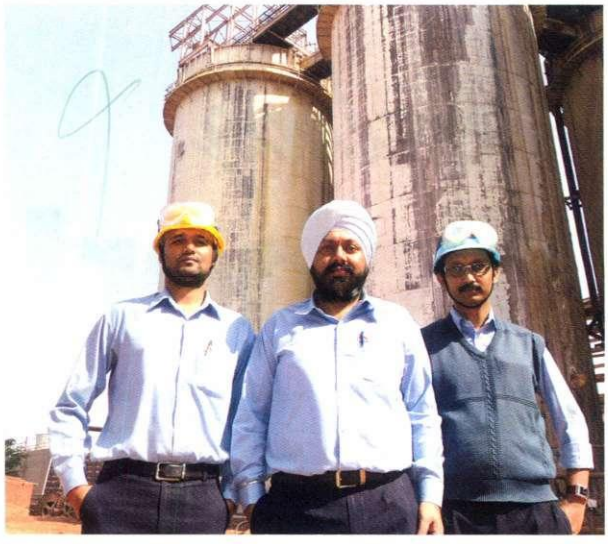
The principal objective of the draft tube design along with an axial down pumping agitator is to pump the mass from the top portion (4) of the precipitator towards the tank bottom (13).



CFD modeling of compressed air holdup in the draft tube precipitator

The impeller rotation creates a tangential swirl and it results in the formation of low pressure region inside the draft tube. Depending upon the local pressure distribution, slots will have both inflow and outflow through draft tube wall section (11). In industrial processes, the process variability can disturb the smooth and consistent operation, which could be triggered by upstream and/or downstream operations. The disturbances in the process variables initiate the hydrate settling. In order to overcome the settling problem without affecting the productivity, the operational practice is to inject air from the bottom of the annular region of the tank (1 & 2).

In-depth CFD modeling investigations clearly showed the impeller region inside the draft tube is completely flooded by the air holdup. The moment air occupies the impeller region, the pumping capability of the impeller drastically reduces and initiates the solid settling in the precipitator.


Hindalco Muri engineering team at the shop floor continuously working to improve the productivity without compromising on the product quality

Parameter	UOM	Before	After
Precipitation Productivity	gpl	-	6 gpl improvement
+ 150 µm	%	> 20	10-12
Residence Time	hrs	23.5	27.1
Suspension	-	Non-uniform	Uniform
Air Flow/tank	Nm^3/hr	300	150


The Scientist Team from ABSTC continuously supports the alumina business to strengthen its long-term competencies and to develop proprietary technologies and intellectual property

Implementations and Benefits

Detailed investigation helped the team to understand the characteristic dynamic behavior of the draft tube precipitators. Hence instead of suspending the hydrate particles with excess air, the team focused on reducing the standard deviation in the process variability by excellent seed management and reducing the compressed air consumption of white side of the refinery by 50%. This practice resulted in improved solid suspension and equipment uptime.

Investigations are in progress to further reduce the level of compressed air agitation to excel the performance of alumina productivity efficiently and cost effectively.