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Outotec
More out of ore

Optimising large flotation cell hydrodynamics using CFD

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Output

Over the past 15 years there has been a quantum leap in the size of flotation cells. This change has largely been driven by the need to treat lower and lower grade ore bodies economically and the only way to achieve this aim was to use larger and larger sized equipment. This change in economics generated an exponential need for larger flotation cells. Since 1991 the flotation cell size has steadily increased from $38m^3$ to over $300m^3$ in 2007. - refer Figure 1 below.

The biggest challenge has been to maintain the flotation cell efficiency as these cell sizes have increased. Substantial development in froth crowding and launder designs have been incorporated into the large cells to improve froth handling. The benefits of these developments have been easily observed through better concentrate grades and visually more stable froth.

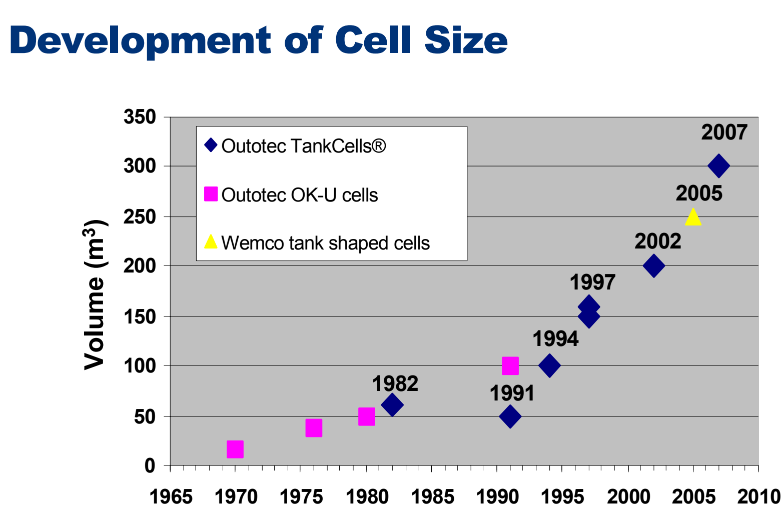

Figure 1

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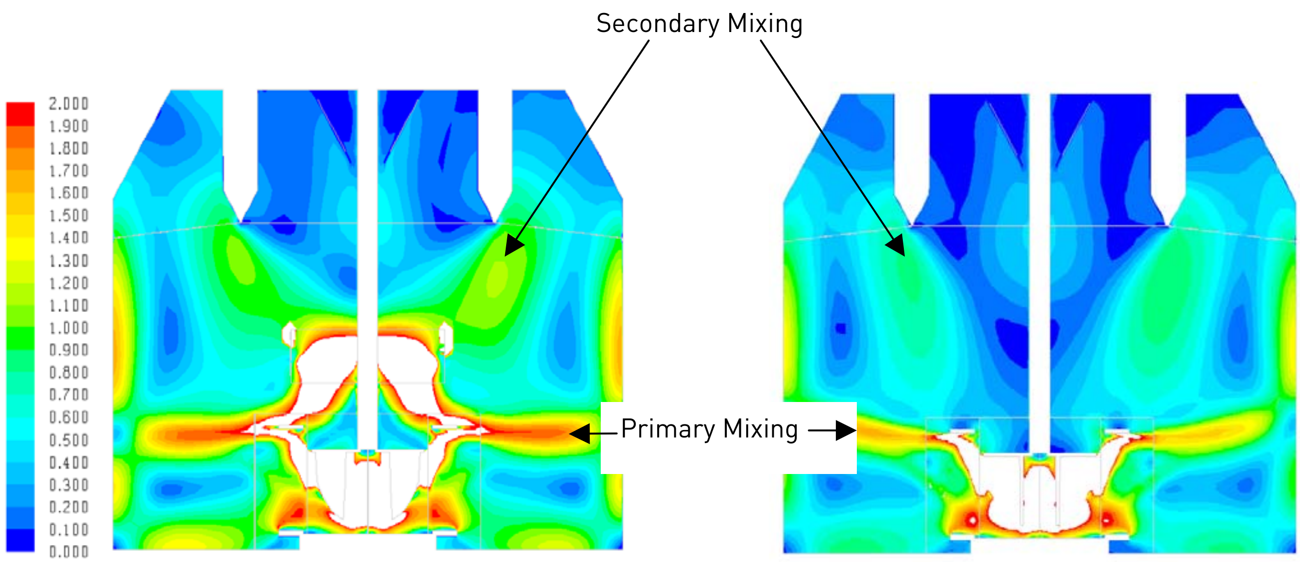
The other area of concern to the flotation industry has been the efficiency of mixing in these very large cells. The key questions being:

1. Do the large cells have sufficient mixing in both the bottom of the cell and the upper area of pulp below the froth?
2. How can we optimize this mixing profile in the cells?

To investigate these questions a CFD model has been developed and built for the Outotec cells. This Model has been used to test new ideas to improve the mixing inside large flotation cells particularly in the top regions of the cell.

One of the innovations to come from CFD Modeling is the patented FlowBooster™. The FlowBooster™ is a pitch blade turbine that is attached to the lower shaft above the normal flotation mechanism located at the bottom of the cell. The results of the CFD Modeling are presented below in Table 2. The results were analyzed by plotting the vector fields, velocity contours and turbulent kinetic energy. In addition, the characteristic volumetric flow rates in the main circulation loops in the tank were analyzed from the results and compared. The reference cell in Table 2 is the cell on the right hand side without the FlowBooster™ whilst the cell on the left hand side has the FlowBooster™.



TankCell® with FlowBooster™ TankCell® without FlowBooster™

The results from the CFD Modeling show clearly that the FlowBooster™ increases the primary and secondary mixing flow. The power draw during the simulation increased by approximately 10%. However, in practice, the actual power draw increase for a FlowBooster™ installed in a TC150 ($150m^3$) was found to be approximately 7% on average.

The results of the CFD Modeling have led to several plant trials over the past 4 years to validate the FlowBooster™ results. The Depth Profiles illustrated in Table 3 were taken in August, 2003. The presence of significantly more +100um particles in the 0.5m and 1.0m depth samples for the cell with the FlowBooster™ illustrates the increased mixing provided by the FlowBooster™ in a $150m^3$ cell.

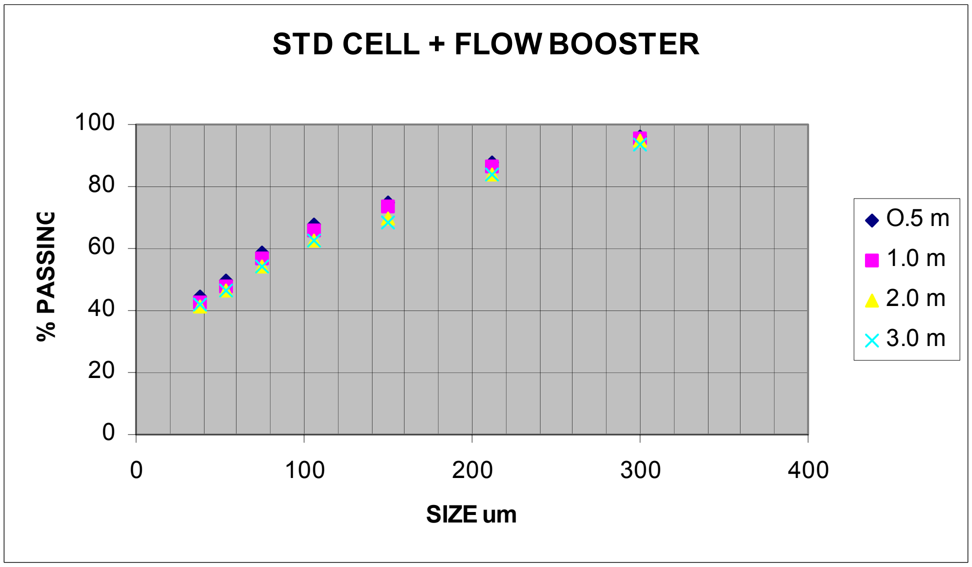


Table 2 - CFD Modeling results, LHS with FlowBooster™, RHS STD Cell (Reference Case).

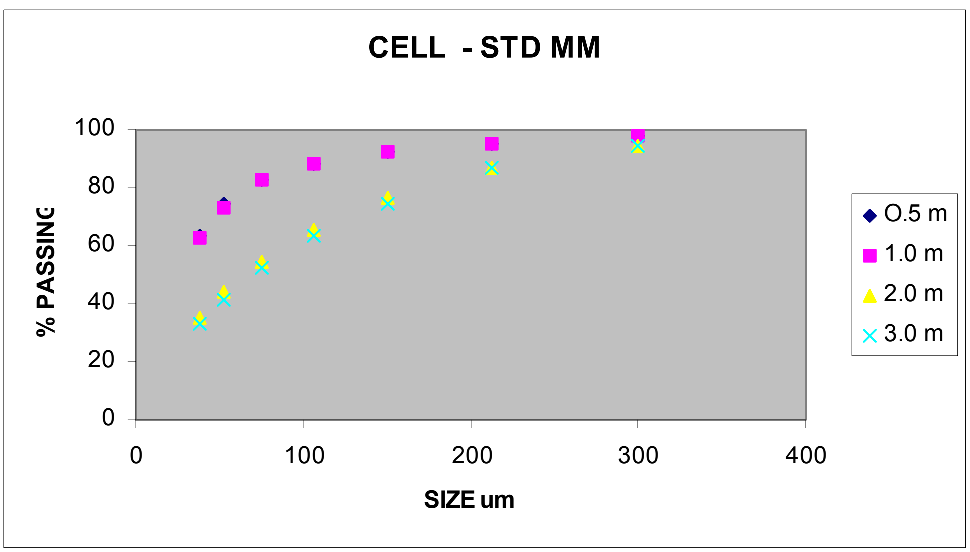
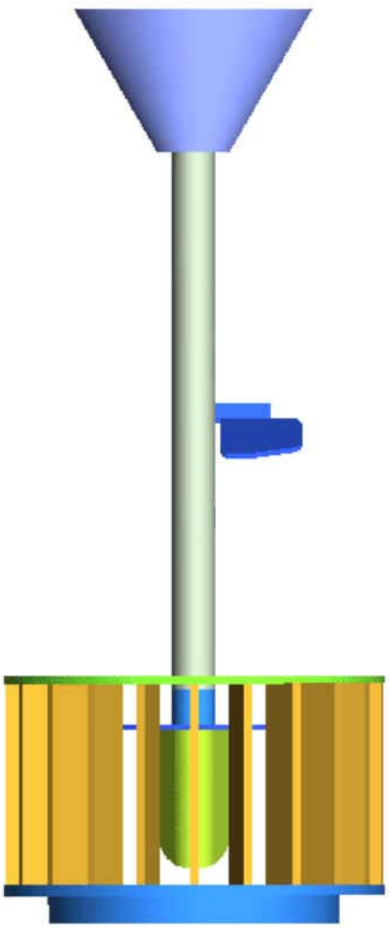


Table 3 – Depth Profiles TC 150 Outotec Flotation Cell – with & without FlowBooster™.

During the trials it became evident that a mono directional FlowBooster™ would not be acceptable to the Industry since to maximize the life of the Rotor & Stator the mechanism must be reversed atleast 3 to 4 times per year. Hence, in order for the FlowBooster™ to be acceptable in practice it must be designed to be reversible. This means that no matter what direction the Rotor is turning the FlowBooster™ must always pump axially downwards. This requirement sounds simple enough but in practice this has proved very difficult to achieve.

After several weeks of brainstorming this problem was finally solved and the first reversible FlowBooster^{TM} was installed for testing.

The testing of the Reversible FlowBooster^{TM} in several plants plus the ongoing CFD Modeling has highlighted a range of benefits for large flotation cells. Some of these benefits include the following:



Flotation mechanism with FlowBooster^{TM} attached

- 10% improvement in the Primary mixing flow
- 7% improvement in the Secondary mixing flow
- low maintenance product that bolts to the Lower Shaft for easy fit up
- potential to further optimize reagent additions to large flotation cells
- potential to reduce the overall power consumption in large flotation cells
- improves the flotation efficiency in large flotation cells above 150 m^3

Last month 3 x TC300 Outotec TankCells were commissioned and all three cells were fitted with reversible FlowBoosters^{TM}. These cells have a net volume of over 300m^3 and are now the largest flotation cells operating in the World.

Peter Bourke is currently Outotec's Global Technology Manager - Flotation Process. He has over 16 years experience in the design and selection of minerals processing technology having worked on projects such as Leinster, Mt Keith, Kambalda, Century Zinc, Escondida, Chuquicamata, Cadia/Ridgeway, Telfer, Boddington, Mt Isa and Macraes TC300s. Peter has over 16 years production experience in the minerals processing industry before joining the company in 1991.

If you would like more information, click here to contact

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