

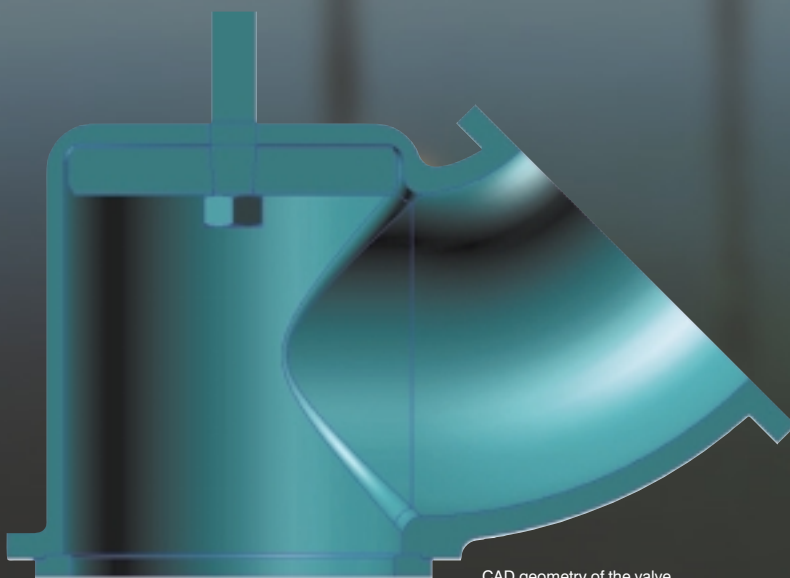
Optimisation of alumina refinery isolation valves

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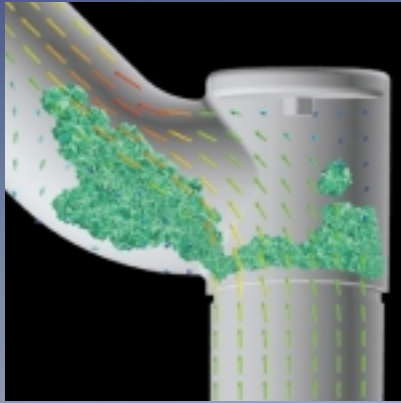


A typical piping system on the plant.

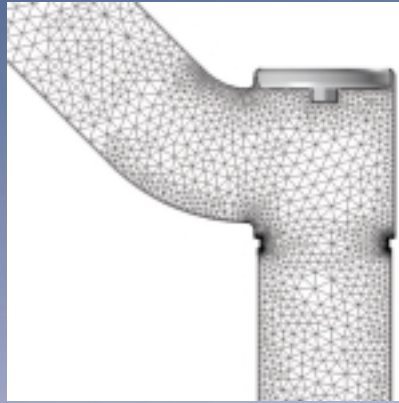


CAD geometry of the valve.

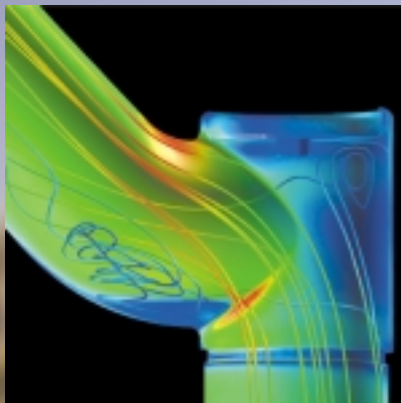
‘Alcoa is now using CFX-5 to develop completely new valve designs’



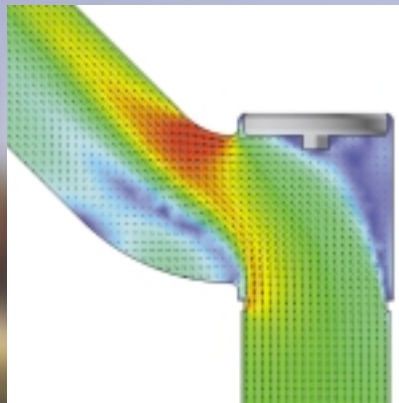
CFX-5 adaption step. New elements have been created to refine the mesh in the regions of strong flow gradients.



The original CFX-5 mesh (left) and after adaption based on flow gradients (right).



Streamlines showing the flow recirculation in the valve.



Velocity vectors and contours of speed before (left) and after adaption (right).

At Alcoa World Alumina Australia, we routinely use CFX-4 and CFX-5 for the design of process equipment used in our three alumina refineries. Components that have received particular attention are the isolation valves which are used to turn on and off the flow in pipelines and into and out of process vessels. There are typically in the vicinity of 10,000 such valves in an alumina refinery, ranging from very small (50 mm diameter) to very large (600 mm diameter), and they are operated in a variety of difficult process conditions. Those operated in slurry duties suffer significant wear problems due to the high silica content in the slurry, while in liquor duties, a hard scale will form on any valve surfaces where the flow is allowed to stagnate or cool. This scale can build up to

the point where it prevents opening or closure of the valve. The large diameter valves in particular are also required to open and close against very high pumping pressures and can suffer significant vibration problems.

Since 1997, Alcoa has been using CFX-5 to modify the design of isolation valves to minimise these problems and also to reduce the head loss through the valves when they are fully open. For a typical valve analysis, the geometry is brought into CFX-5 as a 3-D solid model from CAD using the Parasolids import feature in CFX-Build. A range of models are then run with the valve in the fully-open position and in several semi-open/closed positions to assess the head loss and the wear, scale and vibration

potential. A range of mesh controls and inflation are used to ensure adequate grid resolution in regions of interest. CFX-5's mesh adaption has also been used successfully in several simulations to capture regions of separated flow within a valve with minimal initial mesh control specification.

Alcoa is now using CFX-5 to develop completely new valve designs. The first of these is scheduled for full-scale physical testing this year, and we expect that it will have a significantly lower head loss than current types. Vibration during opening and closure should also be significantly reduced, as should scale growth and the hindering effects of any scale which does form.