AA09 - Improved Flow for Y-Flume Launders on Alumina Precipitation Tanks

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Abstract

Queensland Alumina Limited (QAL) uses several Y-shaped launders (Y-flumes) at the discharge of the last precipitation tanks to direct flow into classifiers. Scale builds up in these launders causing flow restrictions and difficulty in opening the valves at the discharge end of the Y-flume. A laboratory experimental study was undertaken using a purpose made model Y-flume at CSIRO. It was found that stagnant flow zones developed at the launder inlet section, corresponding to where scale/sedimentation are found at full-scale at QAL. A baffle installed in the inlet area of the Y-Flume was conceived and tested. The stagnant zones were found to be eliminated by this design modification in the tests. This was found to result an improved flow and suspension of the solids. A full-scale trial with the proposed modification installed at QAL, demonstrated significant reduction in scale growth.

Keywords: Scale, sedimentation, launder, alumina precipitation, laboratory flow modelling.

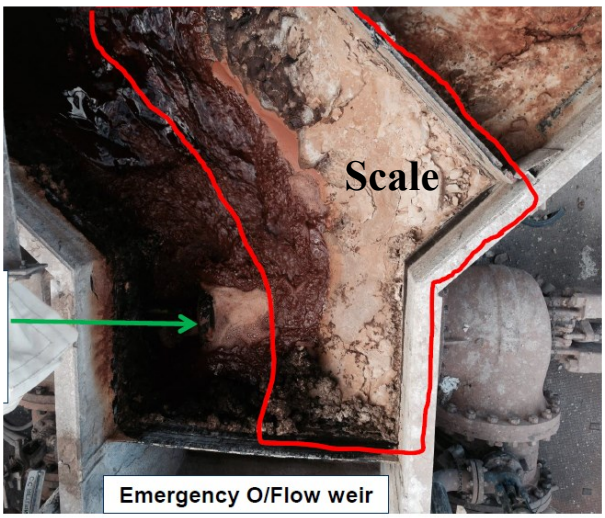
1. Introduction

Queensland Alumina (QAL) uses several Y-shaped launders (Y-flumes) to direct flow from the outlet of two precipitation tanks into a classifier. An example of a Y-flume is shown in Figure 1 (a) and (b). Flow is only down one side of the Y-flume, depending on which tank is the last online tank in the row. Flow out of the bottom of the "Y" is via two outlet pipes equipped with bayonet valves, located on opposite sides of the launder. Of these, one pipe is in operation and the other standby. The slurry then flows by gravity to the downstream classifier units.

With the flow path aligned in one direction for prolonged periods (approximately 90 days), it becomes difficult to swap flow directions, as the alternate flow path is heavily scaled and difficult to use as seen in Figure 1(c). Although some sections of the flume can be chemically cleaned with a caustic solution, this approach is ineffective on hard scale which can only be removed by mechanical methods (jack-hammering and/or hydro-blasting) which are time consuming and expensive with additional safety hazards.

Slurry flow through open channels, with constant cross section is well understood in the literature [1]. However, the flow in an apparently simple Y-Flume geometry as used at QAL can be complex, having poor flow distribution with stagnant zones that may lead to sedimentation and scale formation.

(a) (b)



(c)

Figure 1. Y-flume launder used at QAL. (a) CAD drawing, (b) during operation, (c) extent of scale prior to de-scaling.

CSIRO Fluids engineering laboratory is specialized in flow modelling and fluid dynamics research. After discussion between CSIRO and QAL, it was decided to conduct a laboratory flow study using a geometrically scaled-down, purpose-built model Y-Flume. This paper presents the model study results, the development of a new design and its installation and operational experience at QAL.

2. Experimental Facility

An experimental Y-Flume flow model rig was set up at CSIRO in Melbourne, Australia. The test rig consisted of an approximately1/5 geometrically scaled model of QAL's Y-Flume. The Y-end outlet was connected by the pipe and looped back to the feed chamber via a pump with its motor controlled by a Danfoss variable frequency drive (VFD). A Rosemount electromagnetic flowmeter was installed to monitor flow rate. A photograph of the rig, a schematic and a close up of the scaled down version of Y-Flume at CSIRO's laboratory in Melbourne is shown in Figure 2 (a), (b) and (c).

5. Conclusions

A purpose-built scale model laboratory water flow test rig was built at CSIRO to study the problem of scale/sedimentation in the Y-Flume launder at the last precipitation tanks at Queensland Alumina Gladstone (QAL) Refinery in Australia.

It was found that stagnant flow zones develop behind the weir at the launder inlet section which correspond with observed scale/sedimentation in the Y-Flume at QAL.

Modifying the design by way of an installed baffle weir, the investigation found that the flow could be redirected to increase the velocity/energy over the floor of the flume, promoting minimal sedimentation and improved transport of slurry.

QAL implemented the design modification and after 12 months of operation, QAL concluded that the modified design achieved a substantial reduction in scale formation, and downtime required for descaling.

6. Acknowledgements

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7. References

1. Kenneth C. Wilson, Flume design for homogenous slurry flow, *Particulate Science and Technology*, Vol. 9 (1991), 149-159.