

Open vs Closed Thickener Feedwells - still a debating point?

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The increasing quest for better recoveries, higher performance and greater reliability continues in the (still) booming commodities market. With this in mind, one would think that only the latest, top-of-the-range, next-generation-technology is what the marketplace demands to optimise processing of its orebodies. Not necessarily!

In thickening, for example, open versus closed feedwells is still a debating point – despite the fact that closed feedwells have been adopted on a wide range of mineral processing duties and have proven effective in giving better performance and lower reagent costs.

1. Design

Looking at the basics, what is the structural difference between open and closed feedwells?

When the world's first SUPAFLO® high rate thickener was built in 1986, the closed bottom feedwell design quickly redefined thickening and clarifying methods around the world. The feedwell design in high rate thickeners (see **Fig 1**) forms a distinctly separate chamber from the surrounding thickener volume, and the material within the feedwell does not have a direct exit path, but must pass out via the annular gap defined by the feedwell outlet flange and the deflector plate.



Figure 1 A feedwell in a high rate thickener

By contrast, **Fig. 2** shows a traditional “open” feedwell which is simply a cylindrical well, with the bottom outlet to the thickener volume being of the same diameter as the rest of the feedwell

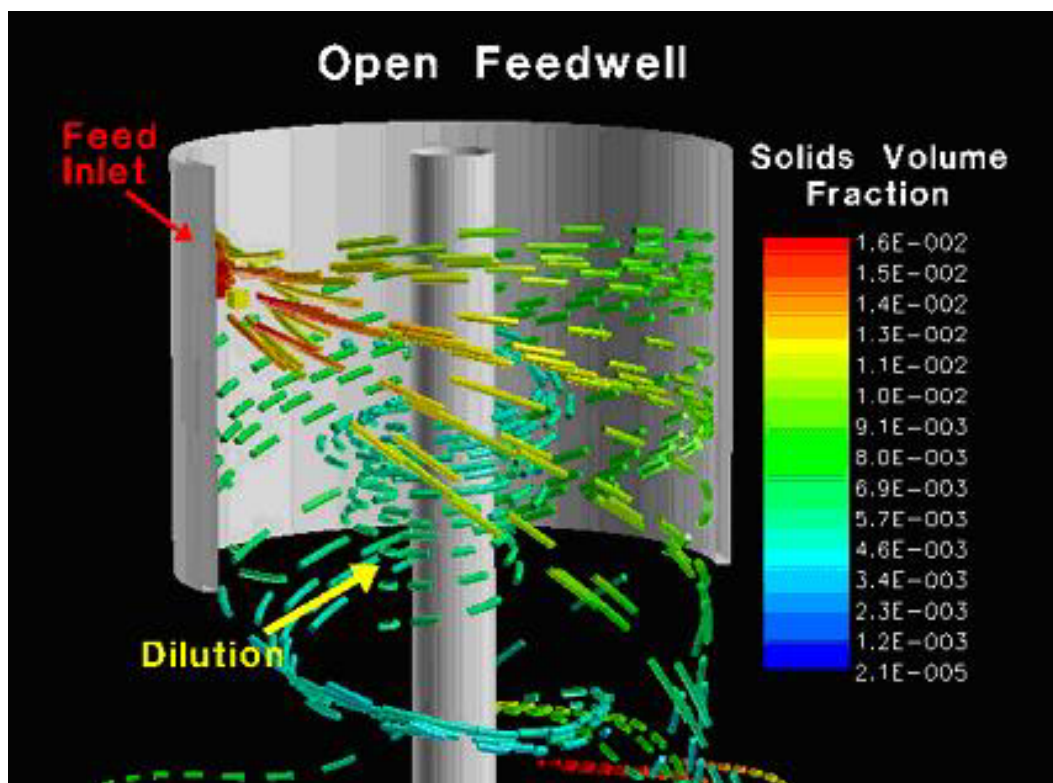


Figure 2 An open feedwell

2. Performance

There is a significant difference between the performance of the two feedwell types. Whereas the open type of feedwell was suitable for conventional thickeners, generally without the use of flocculants, the advent of High Rate and other forms of high performance thickeners meant that a more sophisticated feedwell design was required.

A thickener feedwell has six basic functions to fulfil - dissipate the energy of the incoming feed, introduce dilution water to achieve the optimal density in the feedwell for flocculation of the solids, deaerate the incoming feed, mix the flocculant into the incoming feed, retain feed in the feedwell whilst dilution and flocculation occur, and distribute the flocculated material evenly over the thickener diameter. Optimising these tasks in a single chamber is at times difficult. Energy dissipation creates high shear zones in the feedwell, which can result in aggregate breakage. However, energy dissipation within the feedwell also provides the driving force required to provide sufficient mixing of the feed and dilution water streams and to prevent feed short-circuiting. Optimising these factors is critical to feedwell performance.

What, if any, of these functions, does an open feedwell perform? Energy dissipation is minimal. Dilution occurs, but is largely an uncontrolled upflow of dilution liquid through the bottom of the feedwell, which results in accelerated bypassing of the higher density feed. Deaeration is minimal. The most serious drawbacks of the open configuration, however, are the lack of mixing and inability to retain solids for the important dilution and flocculation steps.

It is generally understood that 30-45 seconds is the optimum time for dilution, mixing and flocculation of thickener feed. The closed feedwell provides the necessary volume for this to occur, as opposed

to dropping the feed straight through, as in the open feedwell. Efficient mixing allows smaller and larger particles to agglomerate, preventing short circuiting and ensuring less fines are left unflocculated. It also ensures lower operational costs, as less reagent is required when the feed is properly mixed.

3. When it's useful to be 'open'...

As explained above, demand for closed feedwells has been driven by the desire for higher performance and the need to exploit larger, difficult-to-process orebodies. However, conventional or open feedwells do still have some, albeit limited, use in the industry. Conventional thickeners are useful where no or low reagent is required. With a fast-settling, uncomplicated orebody, such as some iron ores for example, the heavier particles can pass straight through the open feedwell and settle at the bottom of the thickener with relatively less mixing and reagent required.

4. Taking 'closed' to the next level

It is true that, as the feedwell gets bigger for larger tonnage applications, both types of feedwell need to increase in diameter, with less increase in depth. This creates a "flat" aspect ratio for large feedwells, which inherently creates difficulties in the distribution and mixing of feed with dilution liquor and flocculant. The introduction of annular shelves and other types of baffle have been used to improve distribution in large feedwells.

Outotec has carried out extensive CFD studies on large feedwells, mostly in collaboration with CSIRO, utilising their knowledge gained from the AMIRA P266 "Improving Thickener Technology" programme. The resulting designs retain Outotec's basic "closed" SUPAFLO® configuration, enhanced by the addition of a suitably designed shelf, a set of angled vanes, and tangential addition of the dilution flow. **Fig 3** shows a view of the "new generation" SUPAFLO® feedwell

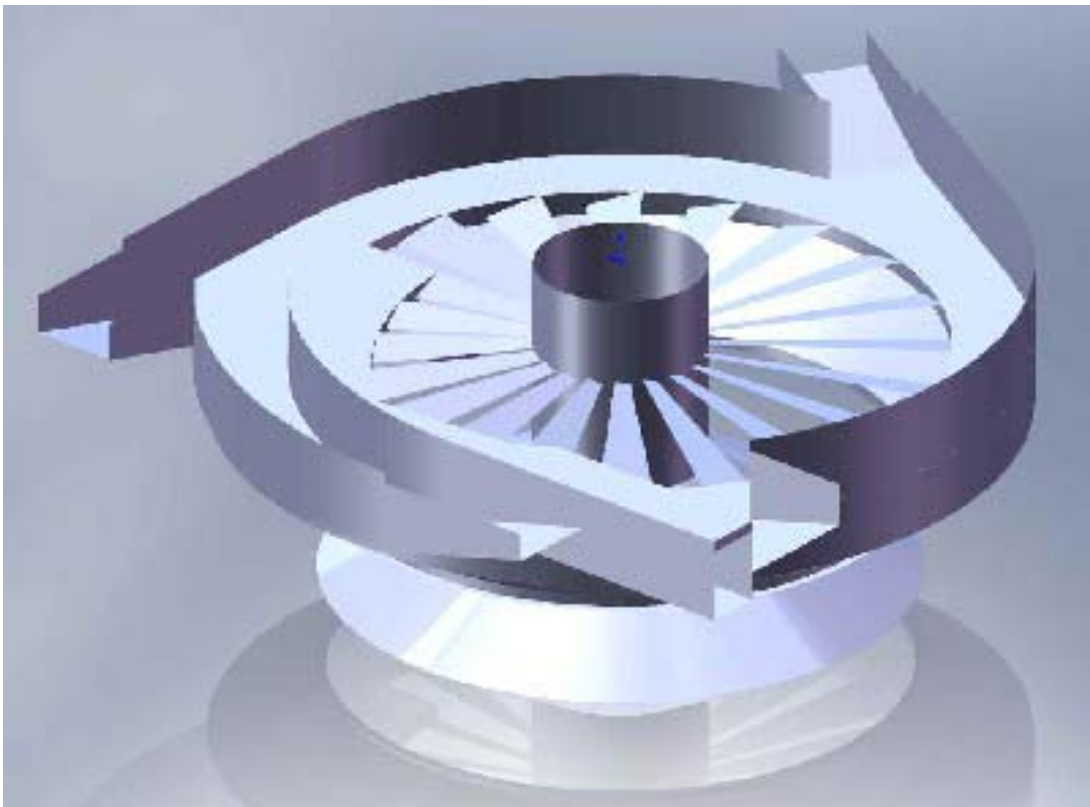


Figure 3 SUPAFLO® feedwell – industry's first new feedwell innovation in over 15 years

This arrangement has been installed and tested in two operating thickeners, and found to be a significant improvement on the original feedwells. Essentially, the additional shelf and vanes are used to allow the feedwell to be divided into two compartments, the upper section being for mixing and dilution, and the lower section for energy dissipation, prior to the flocculated material being distributed evenly into the thickeners via the annular deflector cone gap.

The myth of aggregate breakage on exit from a closed bottom feedwell has also been dismissed by the CSIRO studies.

It should be understood that the open feedwell arrangement does not readily lend itself to such design innovations. So, although open feedwells do have their uses in limited applications, in the context of today's requirement for high performance in minerals processing, open cylindrical feedwells are fundamentally outdated, a "dinosaur" of a previous age, much like the slow death of VHS since the advent of DVD.

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Previous roles have included general management, sales and marketing, project management and process engineering design. Ian has specialised experience in solid/liquid separation including filtration and thickening and has been responsible for a number of design patents in this area. Ian has been involved in industries including mining and minerals processing, water and wastewater treatment and chemical/industrial.

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