

Thickener tank design options

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When the GFC hit in early 2009, the mining industry was dealt some tough challenges, with everyone forced to tighten their belts and cut costs wherever possible. There were many projects which were permanently shelved or put on hold for better days, with a few managing to get the green light.

Since then, those that do proceed nowadays need to ensure, more than ever, that the most efficient, cost effective solution has been chosen. In such challenging times, reviewing and questioning the way we 'normally' do things can result in simple, clever and more cost-effective options. Really looking at the various options in thickener tank design, for example, can bring substantial rewards....

Thickener design and construction – What are your options?

1. **Piece small fabrication** – comprising many small individual pieces. This option is cheap to fabricate, easy to transport but expensive to construct due to increased handling, fitting and welding at site. Steel tanks are commonly delivered in small pre-cut sections. Section sizes are often determined by standard plate dimensions and practical workshop fabrication methods. Transport limitations can also determine plate dimensions for delivery and site erection.

For piece-small delivery of tanks as described above, the ex works price is low. Site fabrication and surface treatment however, involve a significant investment of time, resources and, consequently, cost. Plates must be welded and usually site surface treatment will involve blasting and either painting or rubber lining.

2. **Piece large fabrication** – comprising large sections, major items pre-assembled. Here the risk of misalignment of mating parts is reduced, and there is reduced installation time. This option, however, is difficult (but not impossible!) to transport. For example, a recent Outotec 22m diameter thickener was delivered in two halves to site. Obviously the access route to site had to be very carefully mapped out, ensuring all roads, bridges etc could cope with the diameter of this piece large fabrication. Once the pieces arrived, welding together at site took just 14 days.



Transportation of piece large thickener tank

3. **Fully pre-assembled** – one, fully constructed thickener. Cheap to fabricate and construct (depending on diameter), very difficult to transport. However, generally speaking, workshop fabrication results in a better quality final product.

4. **Bolt together** – large modular pieces, higher capital cost to fabricate due to significant number of bolts and flanges. The higher initial capital costs, however, can translate into substantial overall project savings as hundreds of metres of site-welds and painting are replaced with a simplified fitting and bolting process.

For a typical welded thickener installation time of 12 weeks, it's common for an equivalent bolted design to take 4 to 6 weeks, with less manpower. This option is proving to be especially popular in the mineral sands industry.

A mineral sands concentrator needs to be moved periodically to a new excavation site, so the easier portability of this design is highly useful.

Benefits of the bolt together design include:

- Better value proposition overall as reduced total costs. Ex works cost is higher but as shop fabrication is significantly cheaper than site, with associated time benefits, overall savings can be impressive
- Large reduction in site erection time and manpower. We would expect a 43m thickener to be fully erected within approximately 6-8 weeks
- Shorter delivery time on an installed basis due to reduction in site time
- The majority of the fabrication is performed in the workshop, providing better control of both fabrication and surface treatment quality
- Increased safety by reduction in site installation processes – no welding and no/minimal site surface treatment (blasting, painting, blast containment)
- Low risk install - less time on site, little/no surface treatment, minimized exposure to inclement weather, wind (blast containment) and also minimized exposure to industrial disputes



Transportation of fully preassembled 20m paste thickener



Bolted tank design

Design standards

As there is no specific published methodology for the design of a bolted thickener tank, Outotec has made significant investment conducting research into the behaviour of flanged tank joints. Through extensive testing and analysis, the company has developed specialized methods for the design of bolted tank connections.

Quality and structural integrity is ensured through meeting design requirements of particular codes and standards. Outotec's flanged tanks meet strength requirements of API650 (welded steel tanks) and AS3990 (allowable stress design for steelwork).

Flange joint sealing

Joint sealing is another important consideration in the design of bolted tanks. AS1210 (pressure vessels) is referenced as part of Outotec's design philosophy, ensuring bolted joints are designed for no leakage.

Joint surfaces on the inside of Outotec bolted tanks are usually finished with sealant, selected specifically to meet process and application requirements. To maintain structural integrity, no sealant is applied to mating faces of flanges.

Manufacturing

Obviously, a reputable, experienced manufacturer is vital to ensuring a quality product and is particularly important in the case of bolted tank design. If your thickener supplier has a long, proven track record in bolted tank design, this will help ensure their manufacturer will provide a quality product. Reputable manufacturers will use purpose-built jigs for floor plate assemblies to achieve complete accuracy. They should also insist on including trial assembly of components for dimensional checks and to ensure problem-free assembly on site.

Installation

This step is particularly critical and it is strongly advised that you use either your technology supplier for installation or at least for installation supervision. An installation by an inexperienced workforce will potentially undo all savings from the bolted design option, not to mention OH&S considerations.



Floor gores installation



Tank walls almost completed & joints sealed

Conclusion

Bolted tank construction is an attractive option in many industries. Benefits include faster installation, lower cost and better quality control. Although the ex-works capital cost (fabrication) can be higher, the overall (fabrication & install) value for money can be better with a bolted design. Given that the construct and install phase of a thickener's birth constitutes 75% of the time (and time = money), it makes sense to not just look at a thickener's capital cost, but also take installation time, risk and final quality of workmanship into consideration. In these challenging times, looking at options outside the box can bring real rewards.



Rake mechanism assembled in bottom of tank

Gena Hart is currently the Technology Leader in Thickening for Outotec in Perth, Australia. Gena holds a double degree in Mineral Engineering and Commerce from the WA School of Mines. Nearly 20 years of hands on experience in the "Goldfields" has led to extensive mineral processing knowledge in the Gold and Nickel industry. Previous technical and commercial global roles in water treatment and alumina have ensured Gena has particular specialist knowledge in these industries.

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