How can I support my Flotation Cells?

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The ever increasing size of mineral processing operations has lead to the development of ever larger flotation cells, the largest of which now hold over 300m^3 of slurry. Physically supporting these cells in a minerals processing plant is now a challenge requiring significant engineering design and analysis. Added to the engineering challenge is the economic one. Issues such as the availability of concrete or steel, labour costs and site topography will all have an influence on the cost of supporting the cells. This article will seek to outline the key issues that influence the type of support structure used and provide a guide to the pro's and con's of the two major techniques.

Factors influencing support structure design.

Climatic Conditions.

The two most critical conditions related to the location of the plant are the **prevailing winds** and the **seismic activity**. Many mining regions are in areas of potentially high seismic activity and cyclonic winds which makes the design of support structures more challenging. The key issues when considering seismic loads are the slurry behaviour in the cell and the connection between the cell and the support structure.

Wind loads can also play a significant part with larger flotation cells presenting a substantial sail area with which to catch wind. This can apply a significant side load to the supporting structure. Critically important here is to remember that the cells are not always full of slurry. Careful consideration of the connection between the structure and the cell is required to prevent empty tanks being dislodged during significant wind events.

Site location

The location of a mine can significantly impact the type of support structure used for flotation cells. Three key factors are the **topography of the site**, **accessibility** of the site for major construction equipment and personnel and the **ground conditions** at the site.

Flotation circuits generally have a series of steps between banks of flotation cells. When using very large cells there may be a step between each cell. These steps are necessary to provide the plant operators with the ability to control the flotation process. The flotation tail is generally discharged to a tailings thickener, which is ideally done using a gravity discharge rather than a pump station to reduce the ongoing operating cost (more on this later). Taking these two basic layout needs into consideration it can be seen that a gently sloping site for the construction of the plant is helpful with the flotation circuit inlet at the higher end and the tailings thickener at the lower end. As it is rare to find a suitably sloped site, the creation of suitable topography via earthworks may be an option where the ground conditions allow this.

Ground conditions are also important when considering how to transfer the load of the flotation cells to the earth, which ultimately must support them.

Figure 1 "Mushroom" cell support

If we consider a discrete concrete"mushroom"cell support it is apparent that the load is transferred to the ground in a relatively small footprint. This could be distributed further through a concrete sump floor in some cases. Compare this to a series of say four footings on which a steel structure is constructed. These footings will take a proportion of the full load thus reducing the strength required from the supporting ground.

Finally, the location of the proposed plant site also impacts on the availability of resources. Issues such as how the support structure will actually get to the site be it steel, pre-cast concrete or the raw materials for concrete production at site. Add to this the issue of whether competent people for the construction of the support structure are available in the region the site is located and you can see that there is more to consider than just the engineering design.

Plant Layout

Of great importance when considering the support structure is the fact that it should be designed to support the flotation cells and not the other way around. In an ideal world the flotation cells should be selected and laid out to optimize the operation of the plant. Once the desired layout is established then a suitable support structure is designed. In reality the two processes interact and will generally undergo several iterations. Whilst compromise is necessary during this process it is important that the operation of the flotation cells themselves is not compromised.

Issues such as the height of the final cell discharge, number of steps in the floatation train and suitable access to services surrounding the cells must always be considered. An elegant supporting structure will benefit no-one if there is insufficient head to drive the slurry through he plant.

Design of the Flotation Cells

There are two main types of flotation cell tanks in use today. Those with a **U-shaped bottom** and those which are **flat bottom tanks**, TankCells.

These cells are supported in different ways and whilst it would be unusual to support the U-shaped cells on purely concrete foundations, it could be done. These cells will clearly have different support needs. The U-shaped cells have an inherently self-supporting base whilst the TankCells need support under the base of the cell. It is important to look closely at the loading information provided by the supplier when considering the type of support structure.

Figure 2 U-Shaped Cell

If TankCells are to be supported on steelwork the spacing of the support beams is critical and is clearly impacted by the floor plate thickness of the tank.

Issues such as the location and type of cell dump valve, any access doors into the larger TankCells and the type of slurry discharge valves will all influence the support structure design.

Figure 3 TankCells on the ground

Concrete Vs Steel?

Using Concrete, Pros

- Generally better access under cells where cells are elevated above the plant floor area. Alternatively, for small numbers of cells the concrete bases may be directly on the floor.
- Ability to use pre-cast concrete sections reducing site construction time.
- Generally more economic where concrete batching is readily available.

Using Concrete, Cons

- Difficult to get levels sufficiently accurate (+/-5mm) without using a screed layer.
- Need to accurately cast–in allowances for any discharge valves or cell dump valves that protrude below the tank bottom.
- Generally availability of concrete is poor for remotely located operations.

Using Steel, Pros

- Prefabrication offsite minimises site installation time.
- Easier to adjust site levels during installation.
- Greater flexibility when allowing for ancillary items.

Using Steel, Cons

- Generally more footing in the floor area, which can restrict access.
- Installation of steel structures can be expensive in some locations.

Finally, it is important to consider that a combination of steel and concrete may prove to be the best solution in many cases.

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