Flotation cPlant: an Optimum Modular Approach

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Flotation plant design, construction and start-up can be challenging tasks, because multiple factors and disciplines have to be combined in an efficient manner, in order to execute a project that meets the technical, financial and timeframe expectations. Key considerations that need to be addressed when designing a flotation plant are process requirements, equipment integrability, automation, and up- and downstream processes/designs. Furthermore, several other lifecycle factors need to be considered, such as servicing and maintainability, operational costs, future expansions and decommissioning, among others.

To address these challenges, Outotec has developed a new approach to designing flotation plants that targets eliminating most of the inherent risks that can be found in these types of projects. The new Outotec® plant is a fully modular approach in which the above-mentioned challenges have been taken into consideration in the design phase. As a result, the cPlant concept can give several benefits for new and experienced companies involved in the minerals processing business, such as lower risk investments, fast and cost-efficient flotation plant delivery, faster ramp-up period, easy plant expansions, fully automated processes and operation and maintenance ease.

As well, dismantling and transportation of the cPlant to a new location is easy and fast, hence the new cPlant concept makes possible to exploit small, short-lifespan ore deposits and also retreat old tailings ponds that might contain valuable minerals and where the ore quantities are limited. Furthermore, cPlant is easily implemented for brownfields and temporary expansions during bigger expansions.

INTRODUCTION

During the last decade, several mining and minerals processing projects have overrun their expected capital expenditure due to several challenges encountered during the project execution phase. These challenges can also have an impact over time if the plant design is not flexible enough to overcome possible future changes in the local and global environments. Furthermore, unexpected cost overrun often complicates arranging additional project funding. Delays in obtaining additional funding may result in an inflationary cost environment, long procurement schedules causing significant delays and increase the costs of debt/equity and decrease project returns.

Outotec has been developing a wide range of flotation technologies for decades and is now launching the new cPlant concept. The standardized and modularized Outotec® cPlant provides a novel way to design, manufacture, transport, install, operate and maintain a flotation plant far better than in the past with highly sustainable and safe methods. The Outotec cPlant is designed to handle ore feed rates from 35 t/h up to 250 t/h, can be fully automated, utilizing state-of-the-art on-line analyzers and process control systems, or can be delivered with the basic automation level requirements.

Furthermore, reagent handling modules, conditioning units, pump modules and motor control centre (MCC) modules are included. Outotec is the only technology provider that offers a highly predefined but still tailor-made total delivery package based on customers' needs. Outotec's renowned flotation knowledge is automatically included in predesigned cPlant modules. This innovative, modular product enables fast-track deliveries, predefined costs, state-of-the-art documentation and implementation, efficient logistics, fast installation and has been designed for maintenance ease—all in an environmentally friendly and sustainable way.

MINERAL PROCESSING PROJECT CHALLENGES

Prolonged Projects

Large delays in the delivery of minerals processing projects have become a major concern across the mining industry. Project profitability is jeopardized, making companies face important financial risk if these delays happen during the project execution phase. Figure 1 shows a typical example of a traditional project delivery time frame compared with the new productized modular approach developed by Outotec.

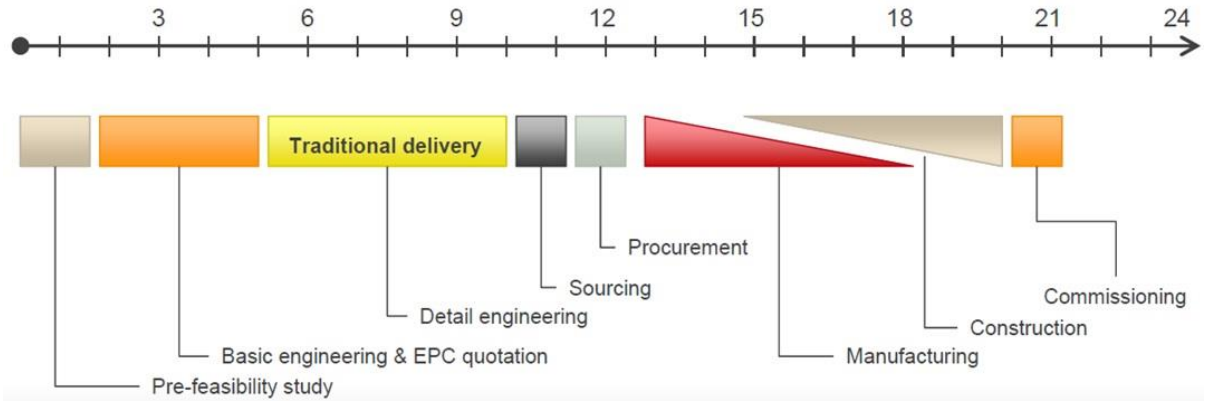

Figure 1. Typical project delivery schedule compared with a productized project delivery approach.

Fit for Purpose

Smaller ore bodies can be discarded, since the planned project execution does not always represent the most feasible answer to make them feasible. This is since, for smaller or larger mineral processing projects, a similar amount of engineering effort and organizational requirements are required: mainly equipment and structure sizes vary.

Local Legislation

Environmental legislations and regulations are becoming tighter, requiring more and better documentation concerning the operational and environmental safety.

Lack of Experience

It has been well recognized by the several mining industry players that there is a lack of experienced people in the engineering industry, in particular. It is also true that engineering–procurement–construction (EPC) companies, themselves, as well as construction companies have recognized the same issue. Mine owners look to the engineering houses for quality design and efficient project leadership, for control over their deliverables, for cost and schedule control and for knowledge that should have been gained during the past projects developed by the large EPC players. It should not be news that this now seems to be essentially missing.

Too Many Suppliers
Dividing a project scope of supply between too many suppliers can lead to increasing risks in terms of project execution lead time and costs overruns. This has been recognized by several companies, because issues with systems compatibilities as well as diluted liabilities are expected to appear if there is not an experienced execution team behind large capital projects.

Ore Quality and Quantity Variations
During the life of a mining operation, ore quality will change when it comes to quality and quantity. Several modernizations, plant optimization campaigns, new plant configurations and expansions will occur in time. Thinking ahead will increase the overall lifecycle profitability of mineral processing operations. An example of a current molybdenum flotation plant can be seen in Figure 2.

Figure 2. Example of current molybdenum flotation plant.

OUTOTEC® cPLANT

Pre-Installed into Standard Container-sized Steel Frames
Outotec's new flotation cPlant has been made into containers or container frames, where the containers are used as support elements. All components are preinstalled at factory. Pipelines are installed into modules, pipes between modules are fitted utilizing fast couplings, and electric cabletrays and cables are mounted at the factory. Blower/compressor module(s), pump sump modules with pumps, conditioner modules (from hHydromet Plant & Equipment Solutions), reagent preparation modules, MCC modules, analyzer modules and control and automation room modules are also delivered in ready-to-install containers. An Outotec cPlant typical arrangement can be observed in Figure 3. This approach results in low investment costs, thanks to pre-fabricated modules that can be easily transported and installed and connected quickly (plug-and-play) to the process.

Outotec cPlant is available for standard feed capacities from ~35 t/h to 250 t/h. It can be installed as a standalone plant or as additional line(s) for existing plants. Gas re-circulating systems for selective molybdenum flotation can be included in the modular delivery.

Small-Capacity Flotation Plant using FloatForce® and Outotec Automation & Analyzer Options
FloatForce® Mixing Mechanism
The heart of the mechanical flotation cell is the rotor-stator mechanism, which mixes the content, disperses air and generates kinetic turbulent energy. This turbulence is needed to accelerate the particles and give sufficient energy to the particle to attach to the bubble. Thanks to advances in hydrodynamic understanding, Outotec has been able to develop the FloatForce® mixing mechanism.

Figure 3. Outotec cPlant typical arrangement.

These mechanisms benefits have been proven in terms of product grade and recovery in several locations worldwide. This mechanism is included in all cPlant deliveries.

Flow dynamics utilizing the FloatForce mechanism in the new cPlant flotation cells have been simulated utilizing computational fluid dynamics (CFD). FloatForce simulations in the new design have revealed optimum mixing conditions for flotation in new cPlant flotation machines. The results of the simulation are shown in Figure 4.

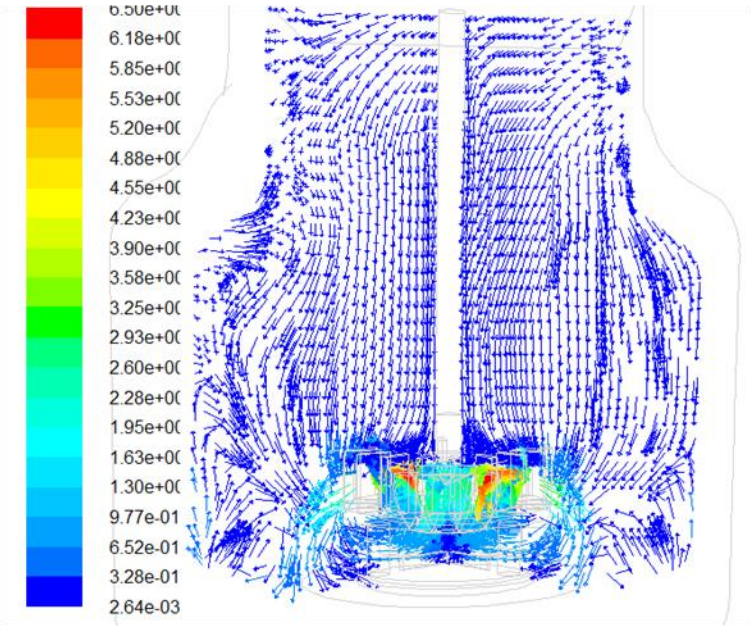

Figure 4. The computational mesh and flow patterns in a cell of the Outotec cPlant.

Automation and Analyzers as Part of C-Plant Deliveries

The new cPlant concept has included Outotec automation solutions as part of the modular approach. The aim of the automation solution is to provide beneficial means for operating the mineral processing plant with minimal operating expenditure and with smooth and quick ramp up. Having a state-of-the-art control solution results in a stable process which is easy to operate and provides a great foundation for cutting-edge optimizing controls.

The modular solution is based on Outotec's long-term experience, references and proven modern technologies, including:

- Needed instrumentation: Instruments have been fitted into the cPlant delivery as part of the modules in order to increase plant control reliability.
- Samplers: Outotec proven sampling technologies have also been fitted into the cPlant concept, so quality samples for either metallurgical balance or process control purposes are collected in an automated and continuous manner.
- Courier on-line analyzer independent modules are part of the cPlant concept. Multiplexer modules and sample return pumps are included in the modular design as seen in Figure 5.
- Containerized Proscon Distributed Control System including Outotec advance control tools and integrity process database and analysis.

Figure 5. Outotec cPlant automation and analyzer modules.

Designed for Maintenance

During the design phase of the Outotec flotation cPlant, the complete life cycle and operability of the plant hav been taken into account. This has resulted in an optimized design when it comes to process performance, because spare parts management, site and equipment maintenance, as well as training needs are integrated into every plant delivery. These dedicated services ensure customers maximum availability and reliability throughout the complete life cycle of their minerals processing technology. Furthermore, future upgrades and expansions have been considered when designing each module, as they can be easily replaced by new modules or added on for increasing plant capacity.

ANSWERS TO CUSTOMER CHALLENGES

Table I shows the features that have been included in the design phase of the new Outotec flotation cPlant to address the customer challenges described in the introduction.

Table I. Answers to customer challenges.

Customer challenge	cPlant features	Benefit
Prolonged projects	Predesigned and standardized plants and modules. Preselected manufacturers, partners and implementation methods.	Shorter project implementation time.
Fit for purpose	Product delivery instead of project delivery.	Lower investment costs in project engineering and execution.
Local legislations	State of the art QA/QC documentation and implementation.	Easy to adapt to local needs.
Lack of experience	Outotec years of flotation experience used for the design of the new modular design, and available for customer during the plant life time.	Sustained plant productivity.
Too many suppliers	Total delivery, total response by Outotec. Tested, standardized products and concepts. All the costs are known.	One-stop-shop concept enables faster project deliveries at lower costs, with minimized project risks for customers.
Ore quality and quantity variations	Standard modules, built for servicing and future upgrades and expansions.	Prolonged plant life cycle and sustained production quality.

CONCLUSION

Short lead time for production and low capital investment, as well as fast-track projects with savings in terms of time, costs, quality and operation can be achieved in minerals processing projects by this new modularized approach. This is thanks to prefabricated modules delivered for quick on-site erection. These modules are easy to transport to site and have fast delivery times (product instead of project). The modules are standardized, hence are easy to replace or upgrade in time, securing a sustainable operation of a minerals processing plant. Furthermore, all metallurgical features from conventional flotation plants can be replicated in this new modular flotation plant design.

ACKNOWLEDGEMENT

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