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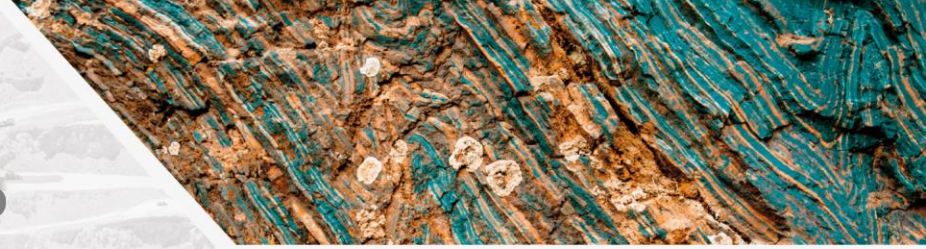
Santiago, Chile
INNOVACIÓN PARA EL DESARROLLO MINERO
INNOVATION FOR MINING DEVELOPMENT



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5° WORKSHOP INTERNACIONAL RESIDUOS MINEROS –RELAVES MIÉRCOLES 25 DE ABRIL 2018

ANALYSIS OF WATER RECOVERY SYSTEMS IN CONVENTIONAL TAILINGS DAMS

Cristian Riquelme A.
Ingeniero de Proyectos
SNC-Lavalin, Chile

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CONTENIDOS / CONTENTS:

1. INTRODUCTION - Water in Mining
2. DEVELOPMENT- Analysis of Water Recovery Systems
3. CONCLUSIONS

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MAJOR CHALLENGES FOR MINING OPERATIONS

Energy Resources

Efficient Water Usage

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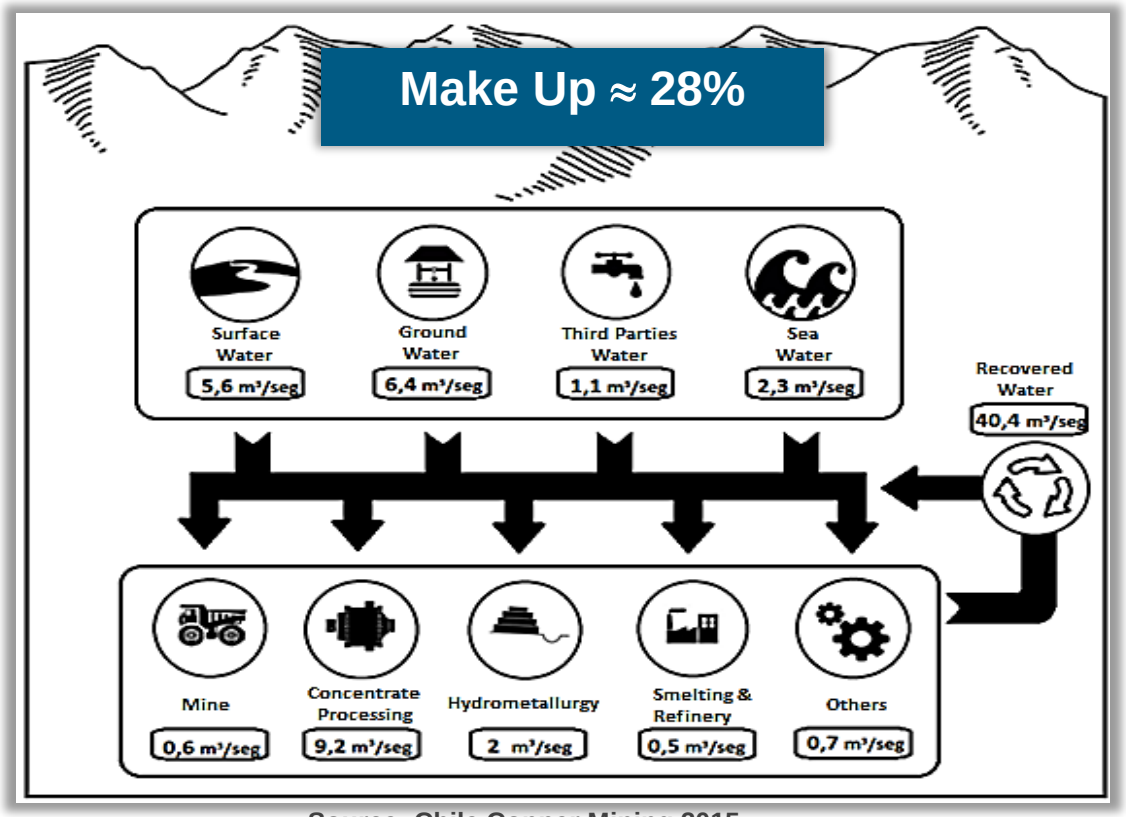
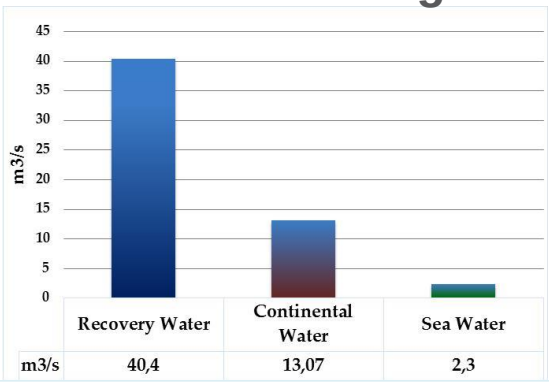
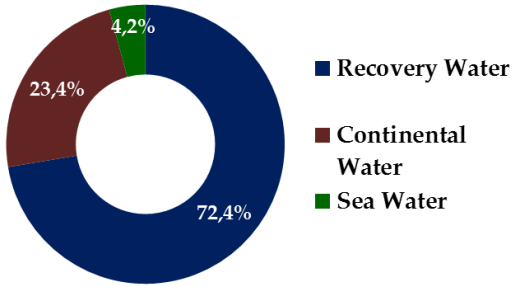
WATER CONSUMPTION IN MINING



Source: Chile Copper Mining 2015

Water Sources in Chilean Mining





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WATER RECOVERY AT THE MINE

Water Recovery at the Concentrator

- Thickeners
- Filters
- Wet processes
- Wash water
- Service water
- Wastewater
- Others

95% of total water losses of the entire mining process are produced at the tailings dam.

Water Recovery in Conventional Tailings Dams

- Drainage systems
- **Water from the tailings pond**

Recovered water from tailings dams fluctuates from 20% to 80% and depends on the solids concentration discharge (65-30%Cw)

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MAIN SYSTEMS USED IN CHILEAN MINING

- Reinforced concrete structure
- System includes vertical pumps (long axis); either cantilever pumps or vertical turbine pumps. The motors are at the surface and the impellers are submerged.
- Water level is controlled by concrete slabs
- Excavation (civil works) is required to access the tower. Civil work is also required to maintain the water depth and cleanliness.
- Tower is accessed via a metal structural bridge
- Intake tower designed with lifting equipment incorporated (sometimes a bridge crane)

INTAKE TOWER

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MAIN SYSTEMS USED IN CHILEAN MINING

FLOATING BARGE PUMP SYSTEM

- HDPE or similar barge structure
- System includes vertical pumps; either cantilever pumps or vertical turbine pumps. The motors are at the surface and the impellers are submerged.
- Water level is controlled by the barge
- Barge is accessed via platforms, hillsides or ponds behind parapets.
- Relocation of the system is according to growth of the water pond.

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COMPARATIVE ANALYSIS

PARAMETER	INTAKE TOWER	FLOATING BARGE PUMP
Energy consumption	Similar for both solutions: same TDH, same efficiency	
Flexibility of the system	Restricted to the total mounted equipment	High, more equipment feasibility
Earthquake design	Structural design is affected	Minimal restrictions
Pump capacity	High TDH	Low TDH (<400 HP)
Quantity of equipment	Lower quantity, greater capacity	Greater quantity, lower capacity
System operation	Superior	More difficult (swell in pond, winds, sensors)
Rainfall areas	More clearances are needed	Self-regulation
Water pond depth	Lower depth. Minimum to ensure impellers are submerged	Greater depth (more area, more evaporation)

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COMPARATIVE ANALYSIS

PARAMETER	INTAKE TOWER	FLOATING BARGE PUMP
Tailings dam growth	Quick growth (> 6 m/year)	Slow growth (2- 6 m/year)
Maintenance	Simple, lower risk	More risk, more frequent
System availability	Higher	Lower than intake tower
CAPEX	Higher	Lower than intake tower
	Total investment cost of intake tower is approximately 2-2.5X greater than floating barge pump systems	
CAPEX + OPEX	Similar for both solutions	
	For barge pump system: the equipment spares, maintenance, civil works, and relocation works are equivalent in cost to the intake tower structure over the life of the system	

CONCLUSIONS

- Water recovery optimization is one of the major challenges facing the mining industry
- Main systems for water recovery from the inside of tailings dams are: **Intake Tower** and **Floating Barge Pump System**
- If the project requires a *Low Capex*, the **Floating Barge Pump System** is the best solution; however if the project emphasizes *High Availability* and *Safe Operation*, **Intake Tower** is more advantageous
- The **selection of system is dependent on several factors**: *geography, water requirements, availability of equipment, maintenance equipment, electrical systems availability, required head, size of water pond and its depth, risk management, operational experience of similar cases and the availability of financial resources (CAPEX)*

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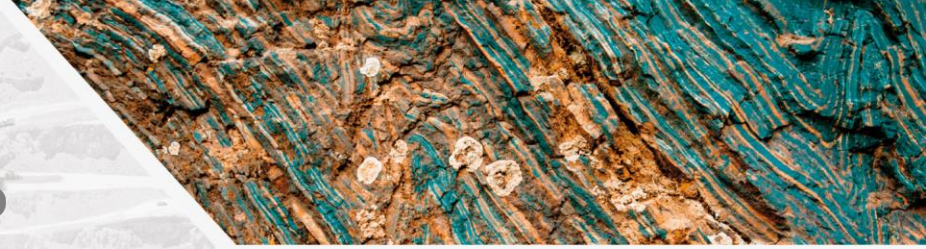

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