UNIVERSIDAD TECNICA FEDERICO SANTA MARIA | DEPARTAMENTO DE INGENIERÍA QUÍMICA Y AMBIENTAL

High water recovery and accelerated evaporation technology to concentrate lithium solutions based on dry bubble injection

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Clean Energy and Sustainability Symposium: Australia-Chile
25 – 26 March 2024 - Santiago

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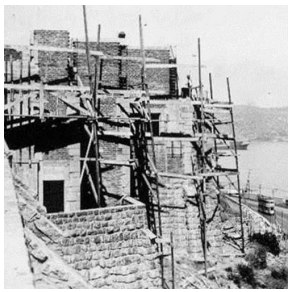
Overview - Universidad Técnica Federico Santa Maria

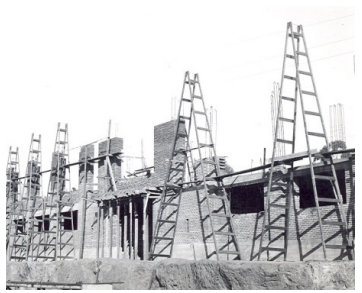
Our Beginnings

• USM: Engineering, Science and Techonology, since 1931.

• Founded in 1931, the USM is recognized as one of Latin America's best universities for its scientific and technological excellence.

• The USM is a Nonprofit Private Foundation, with the character of private university, belonging to the Chilean Universities President Council (CRUCh).

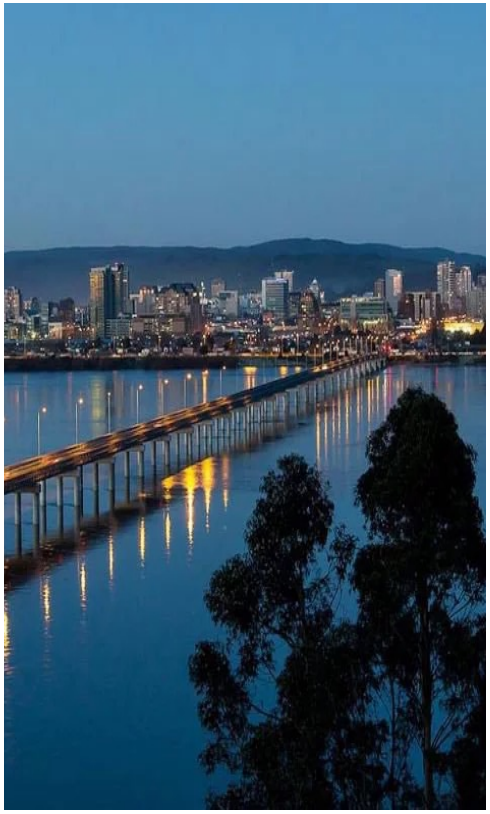


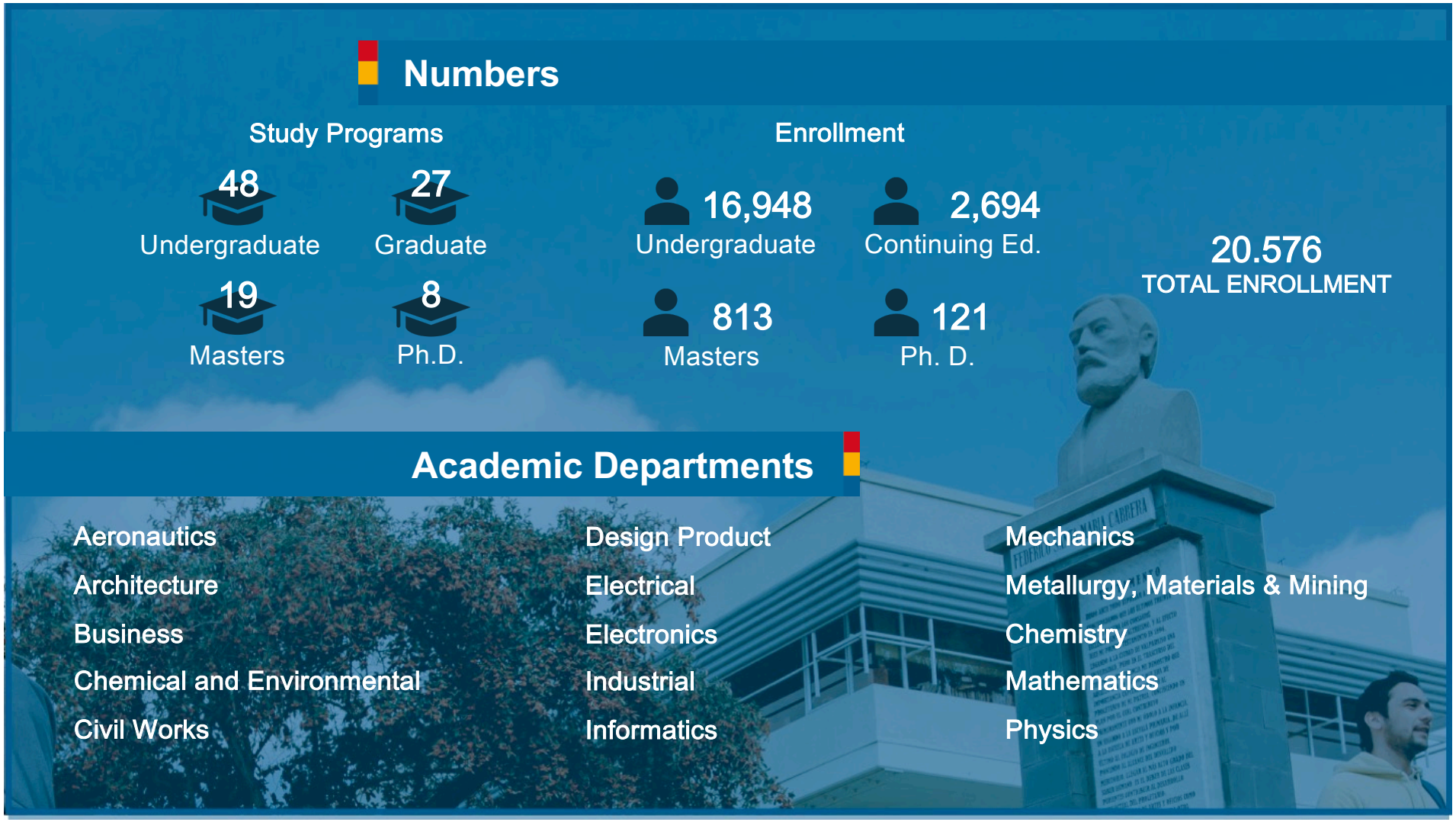


Locations: Valparaíso and Viña del Mar

Locations: San Joaquín y Vitacura, Santiago

Locations: Concepción




Numbers
Study Programs
48
Undergraduate
27
Graduate
19
Masters
8
Ph.D.
Enrollment
16,948
Undergraduate
2,694
Continuing Ed.
813
Masters
121
Ph. D.
20.576
TOTAL ENROLLMENT
Academic Departments
Aeronautics
Architecture
Business
Chemical and Environmental
Civil Works
Design Product
Electrical
Electronics
Industrial
Informatics
Mechanics
Metallurgy, Materials & Mining
Chemistry
Mathematics
Physics

Universidad Técnica Federico Santa María

Chemical and Environmental Engineering Department

Campus Valparaíso and San Joaquín (Santiago)

Academic programs:

Chemical engineering
Environmental engineering
Master in Sciences of chemical engineering
(national and international students)

Professors: **23**

Students: **950**

Associate researchers 8
Technical staff : 12

Mass Transfer Lab

2.2

million L of water are used per ton of Lithium

https://www.euronews.com/green/2022/02/01/south-america-s-lithium-fields-reveal-the-dark-side-of-our-electric-future

Evaporated water in pools

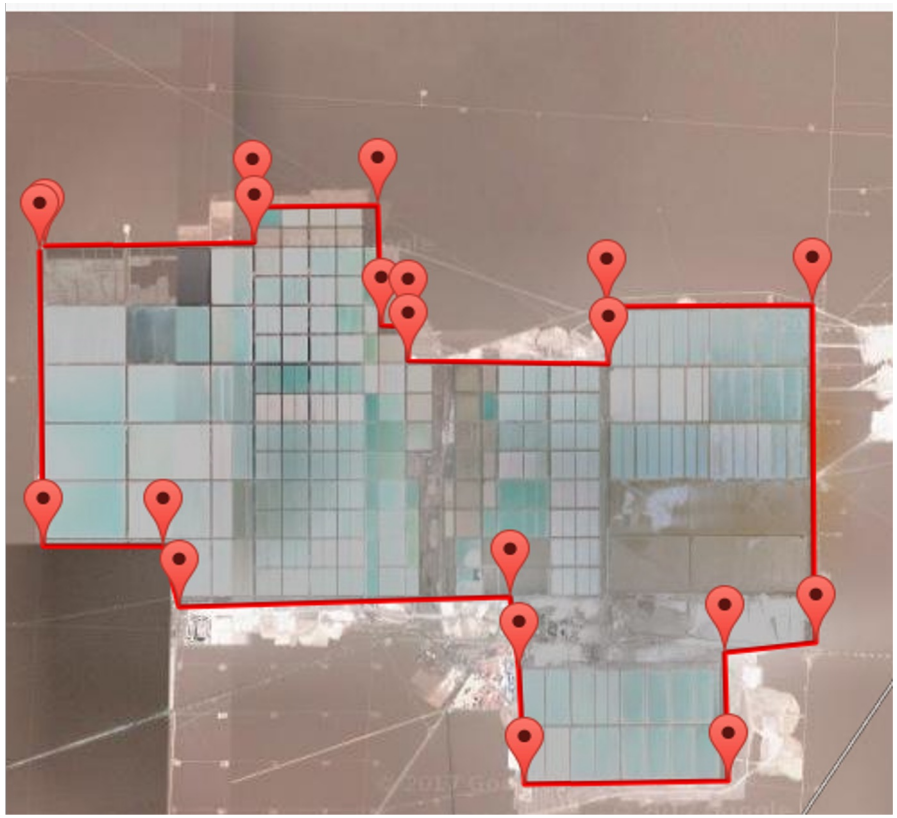
Area: 55.80 km².
Evaporation factor:

6 a 8 [L/m²/day].

Water evaporated:

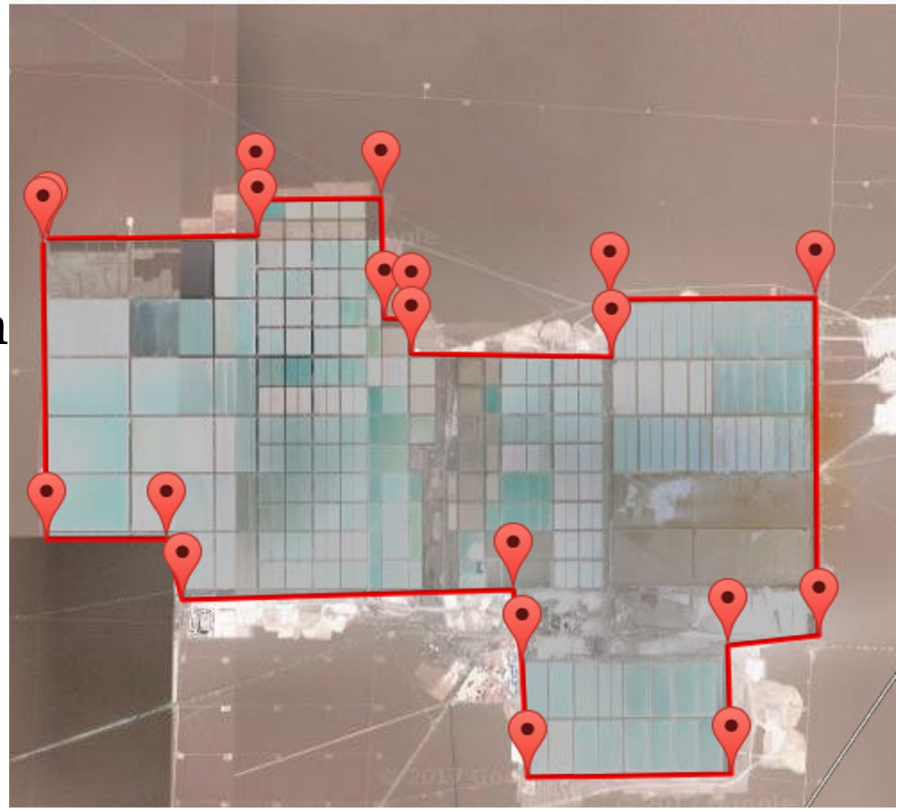
550,000 [m³/day]

6450 [L/s]



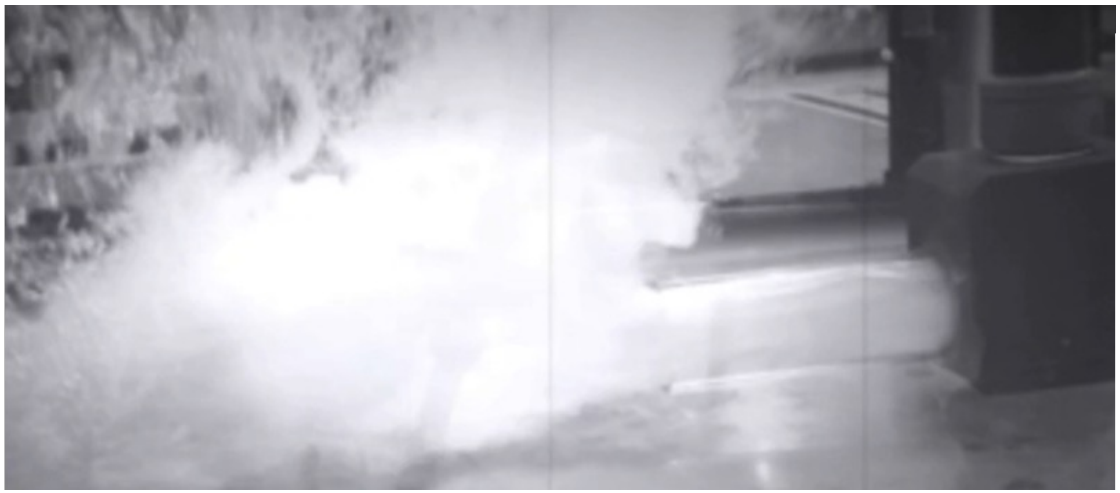
Evaporation depends on air humdity, solar radiation and ions concentration

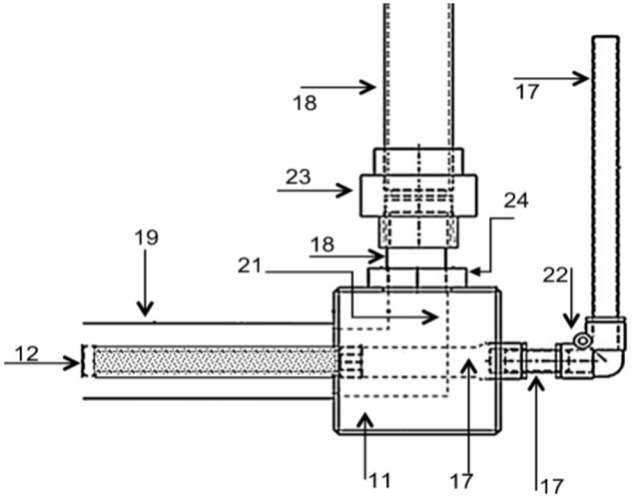
Is it possible to increase evaporation rates and recover evaporated water, accelerating brine production?



Dry bubbles technology

Injection of dry air microbubbles



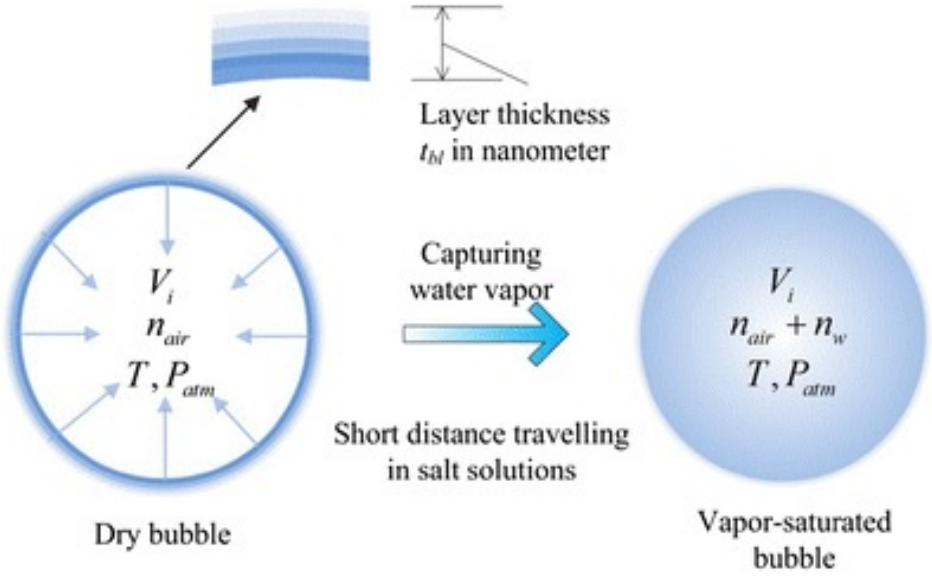


Gas injection system with extended aeration

Patent applied for 2020, Applicant: UTFSM

Dry bubbles technology

Internal evaporation on dry air microbubbles



modeled: Fan, Chao & Shahid, Muhammad & Pashley, Richard. (2018). The energy balance within a bubble column evaporator. Heat and Mass Transfer. 54. 10.1007/s00231-017-2234-x.

OPPORTUNITY DETECTED

Injection of dry air microbubbles

Current condition of pool evaporation

8 L/m²/day irreversible evaporation rate

Dry bubbles technology

80 L/m²/day with full recovery of water

OPPORTUNITY DETECTED

Injection of dry air microbubbles

Dry bubbles technology

8 L/m²/day irreversible evaporation rate

14 Months of operation

30% Capex (2MM US/pool)

50% Recovered lithium

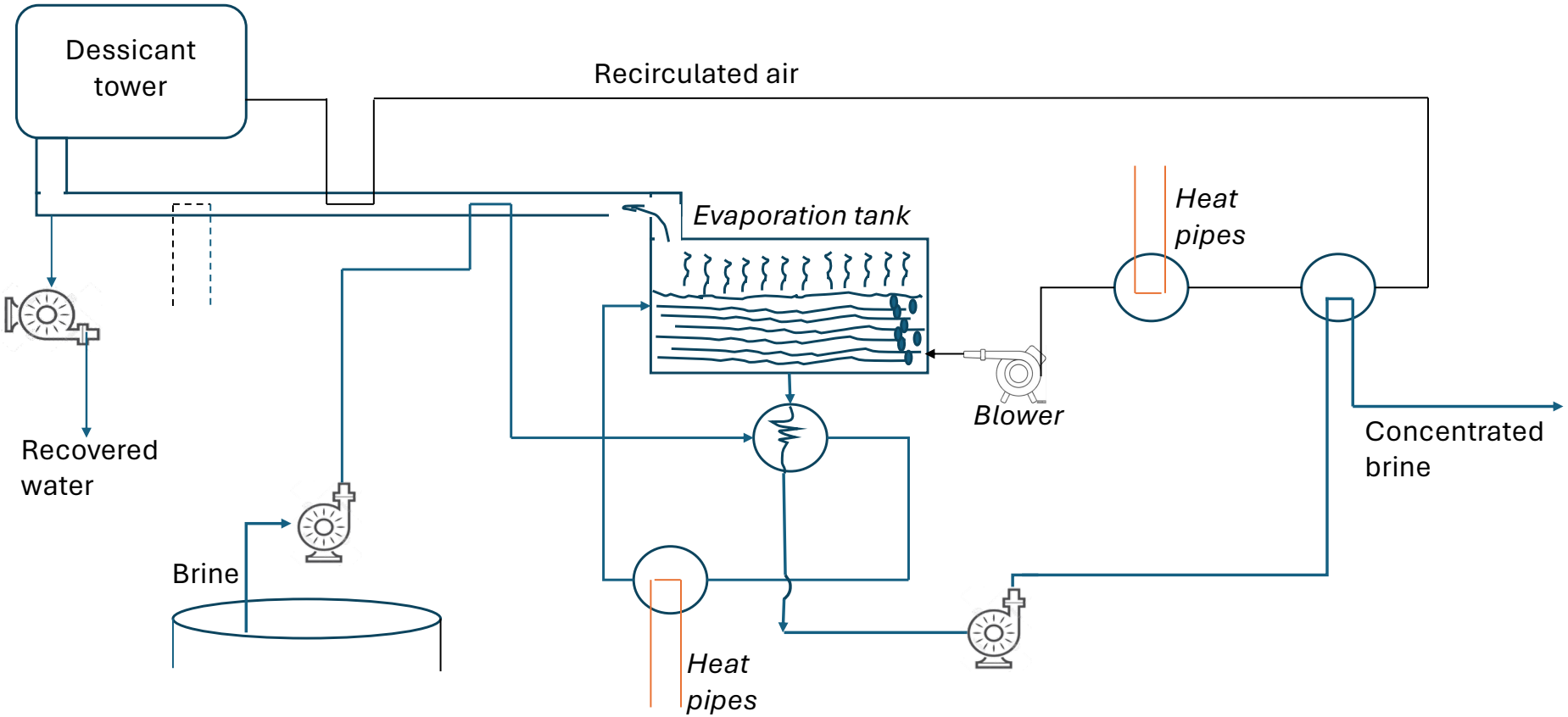
Loss infiltration and impregnation salts

80 L/m2/day with full recovery

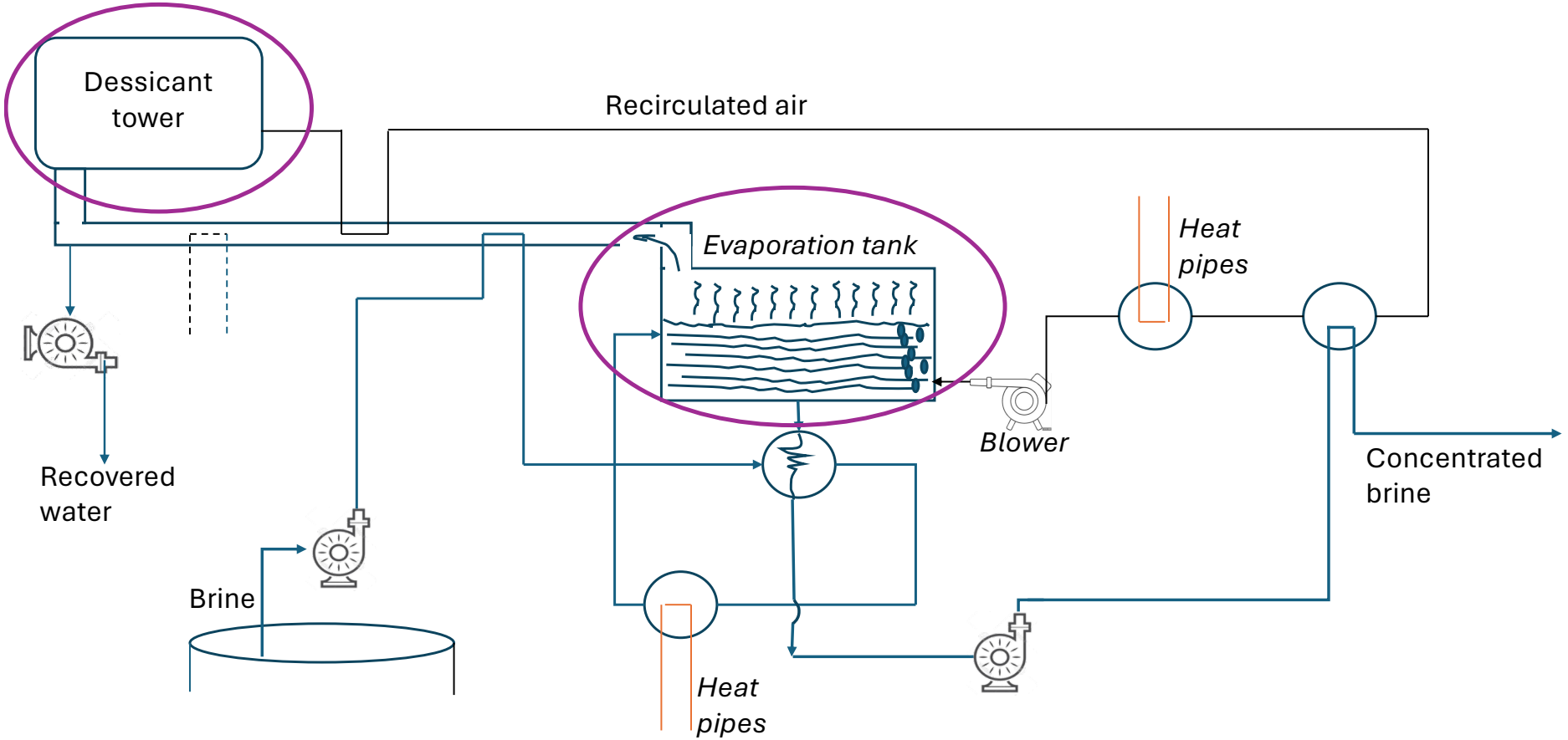
Operation time reduction

Increased efficiency of lithium extraction

Conceptual engineering

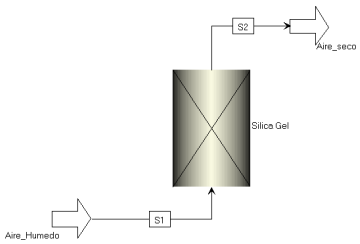


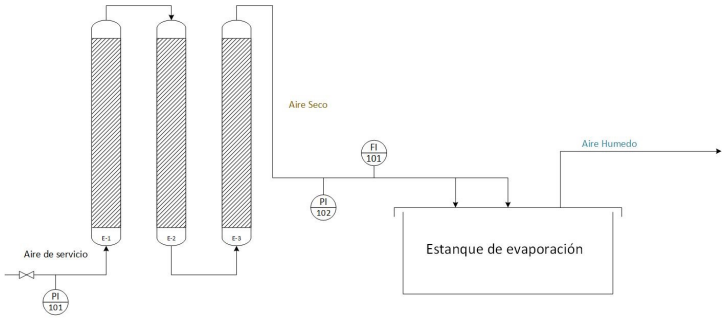
Microbubbles and dry air to increase evaporation rate



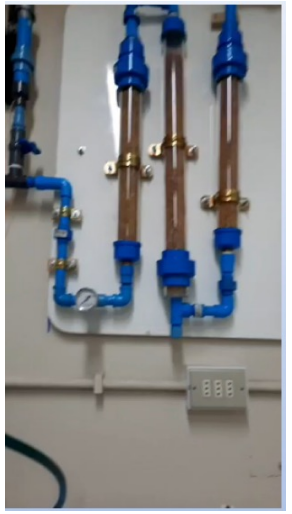
Dessicant tower: TRL-5 Technology Validation

Simulation of the adsorption system → Evaluation of operational variables → Implementation of the adsorption system and evaporation pool → System evaluation versus simulation



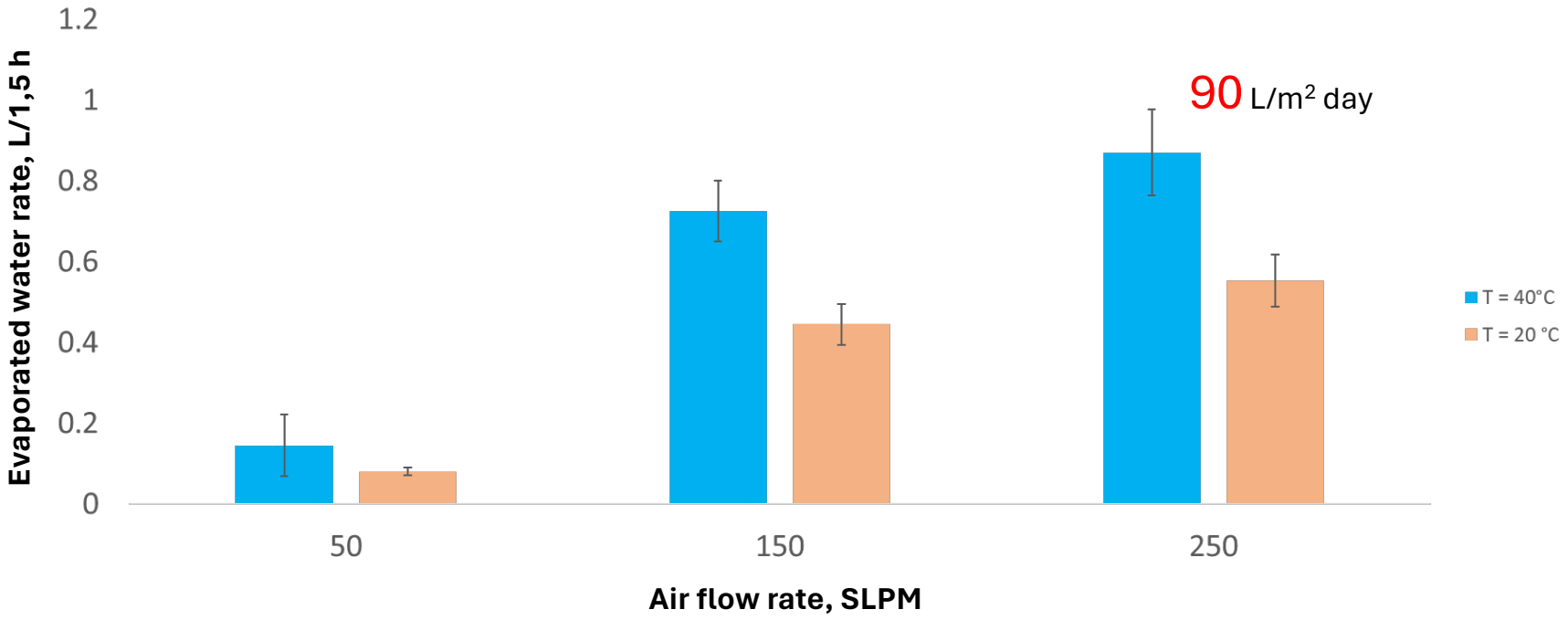


Adsorption System Modeling – Aspen Adsorption



Redesign and assembly of the adsorption equipment

Evaporation tank: TRL-5 Technology Validation



Evaporation tank: TRL-5 Technology Validation

Conclusions

Accelerated evaporation is an alternative to increase brine production while also recovering water as a product.

Control of interface area and residence time allows to optimize equipment, design and to reduce costs of gas injection.

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