CAVALI

CADEIA DE VALOR DO LÍTIO

António Fiúza, Centro de Recursos Naturais e Ambiente

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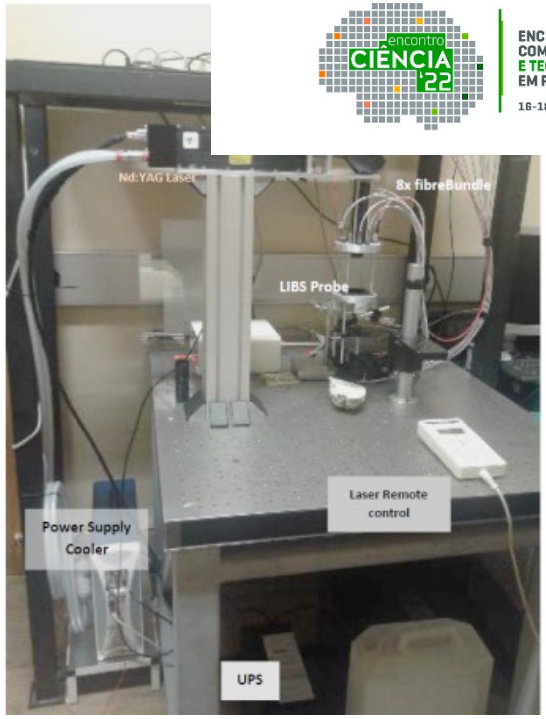
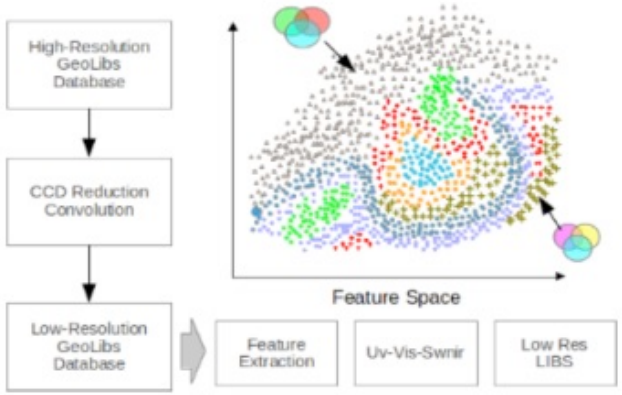
Activity 2 -Ore Characterization by AI-LIBS

Achievements:

- Improvement of the Lithium analyzer by Laser-Induced Breakdown Spectroscopy (LIBS) currently existing on the market, providing a new entirely innovative functionality: **discrimination of the Lithium from spodumene relatively to the one from other minerals using artificial intelligence algorithms**.
- AI-LIBS is a self-learning artificial intelligence system, being the **unique LIBS technology capable of identifying and quantifying all the elements** present in complex samples. Developed by INESTEC (Porto).



LIBS laser system prototype in the Lab



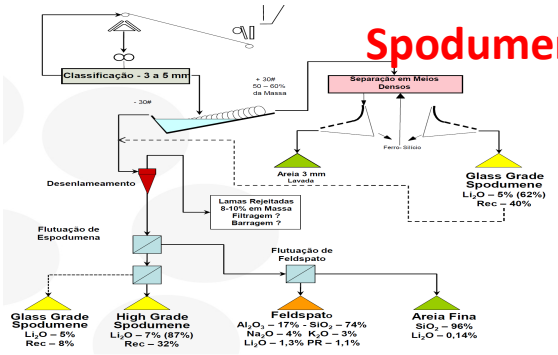
Self-learning artificial intelligence for resolution independent LIBS system

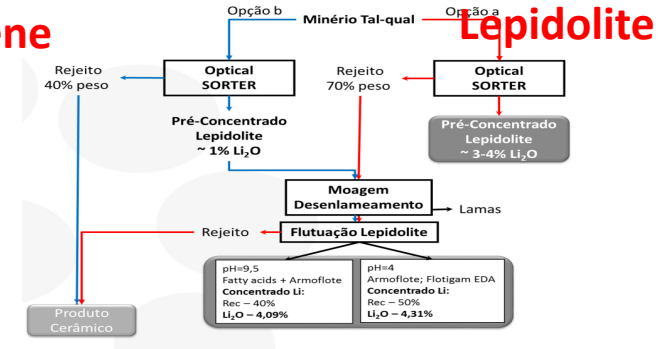
Pitfalls: Commercialization not yet achieved

Activity 3 – Mining & Ore Processing

Achievements

- Development of processing flowsheets at pilot scale allowing for an **integral recovery of all the minerals that exist in the ore** (quartz, feldspar and, eventually, metallic minerals), thus driving to **a process that does not generate solid wastes (tailings)**.
- Utilization of **green reactants** for flotation.
- This way, it becomes possible to attain the two main objectives assigned in the guiding principles of sustainable management of mineral resources: **integral recovery** and **absence of wastes**.





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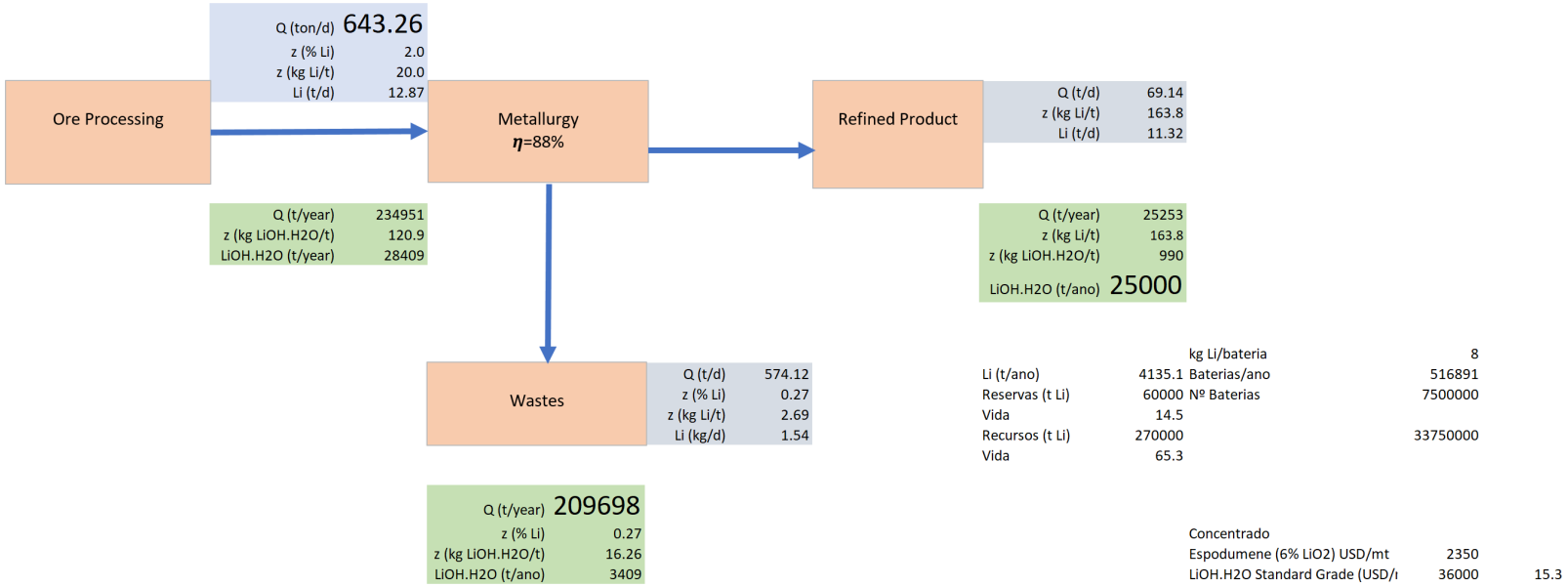
Activity 4 - Hydrometallurgy

Achievements

- UNDER DEVELOPMENT – The project CAVALI aims to obtain a process of production of LiOH, which reconciles one of the processes currently existing for spodumene concentrates with a new process for lepidolite that ***will have in common as many unit operations as possible, allowing the simultaneous treatment of the two concentrates in a single***

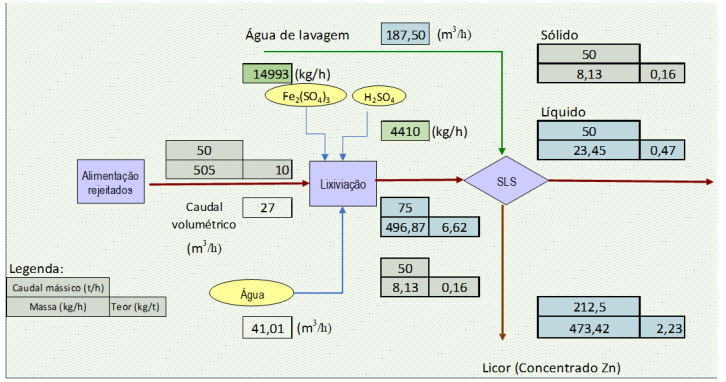


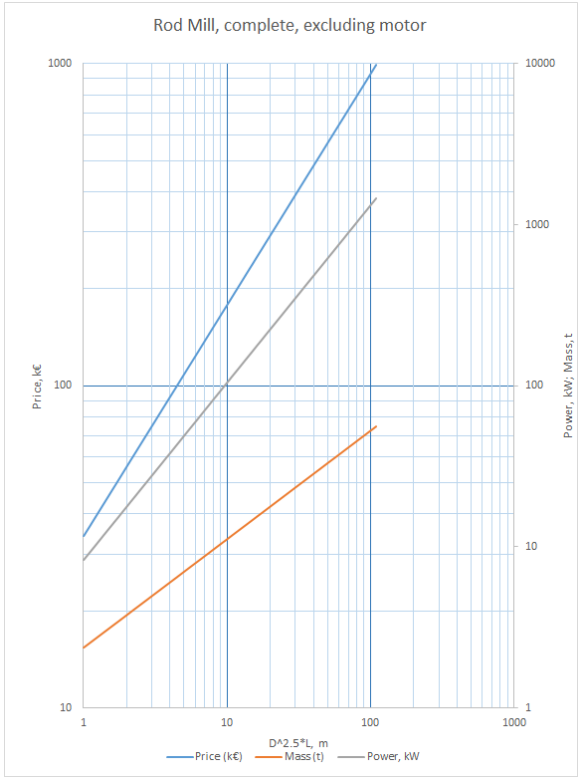
Pitfalls

- Compatibility of different minerals in a single metallurgical unit.
- Find alternatives for the reclamation of the residues from the metallurgical processing.

Activity 5 - Simulation, dimensioning, CapEx and OPex

Item	Designation	Unit Cost	Number Required	Cost
1	Self propelled, crawler mounted drills with percussion hammers		3	
2	Rubber Tired Front End Loader		2	
3	Trucked Front End Loader		1	
4	Front Shovel		1	
5	Haul Truck - 32 tons		4	
6	Dump - 38 t		5	
7	Bulldozer		1	
8	Bucket Loader		1	
9	Irrigation vehicle		1	
10	Exhaustion pumps and pounds		6	
11	Light vehicles		4	
12	Lorry with crane arm		1	
13	Low boy for the transportation of machinery		1	
14	Fuel / Lubrication vehicle		1	
15	Moto Grader		1	
16	ANFO mixing and blast hole loading truck		1	
18	Lighting equipment			
	TOTAL INVESTMENT			0





Operação Unitária	Consumíveis	Energia	Custo variável	Mão-de-obra	Custo total
Perfuração					
Arranque (Tiro)					
Carregamento					
Transporte Minério					
Transporte Escombro					
Diversos					
Encargos Gerais					

Source: A. Fiúza, 2016 and 2021

Activity 6 - Production of Cells for FEB lithium batteries

ACHIEVEMENTS - RESEARCH PARTIALLY DEVELOPED

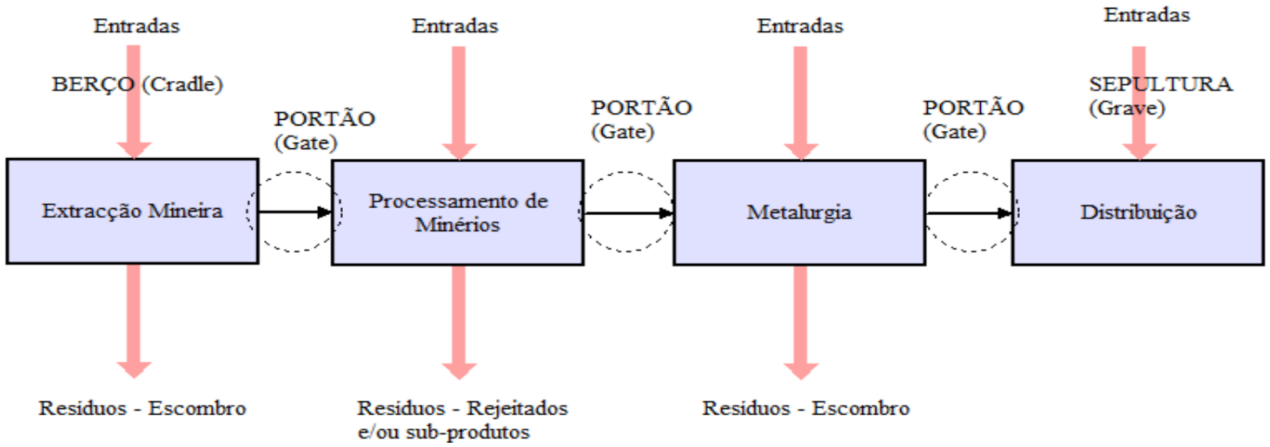
- **Development of a new battery architecture, FEB**: "***ferroelectric-electrolyte batteries***", in which the diffusion of ions is made through chains of dipoles.
- FEB cell prototypes have the following architecture: ***Li/ferroelectric electrolyte/dielectric polymer/cathode.*** The ***electrolyte is patented*** by the University of Porto and LNEG.
- The electrolyte is **a ferroelectric glass with a high dielectric constant** from 10^4 to 10^7, for temperatures between -35 and +25°C.
- The **electrolyte spontaneously polarizes** which causes the **battery capacity** to increase substantially (up to three times more than a traditional battery).
- Batteries with **higher safety** because they contain **non-flammable electrolytes**;
- **Cheaper, compact, and lighter** storing **three times more energy per unit of mass and volume** than LIB batteries;
- More **environmental friendly** batteries: they don't contain electrolytes with **hazardous elements**, they **do not require the use of cobalt electrodes**, and they **do not require stainless steel containers** and other safety systems;

Activity 7 - Control systems for Li FEB batteries

UNDER DEVELOPMENT by the CAVALI Project

- Development of an **electronic management system** responsible for: management of **load/discharge** of cells, **temperature monitoring**, **voltage monitoring**, **optimization of the load** and **longevity of cells**, **thermal management**, performing cell balancing and **implementation of safety and protection circuits** necessary for their use.

Activity 8 - Life Cycle Assessment



Most of the activities described are under development in the project CAVALI (LITHIUM CHAIN VALUE) having the following partners

Financed by