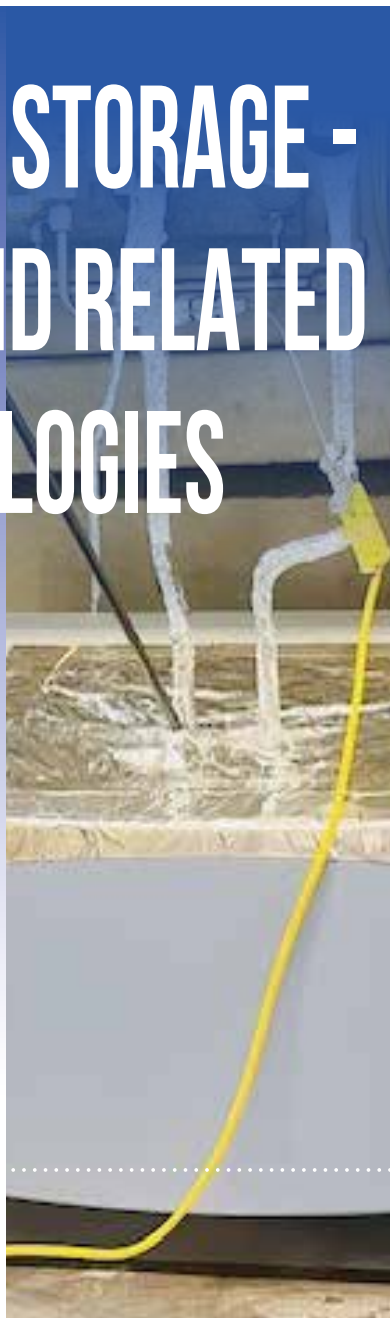
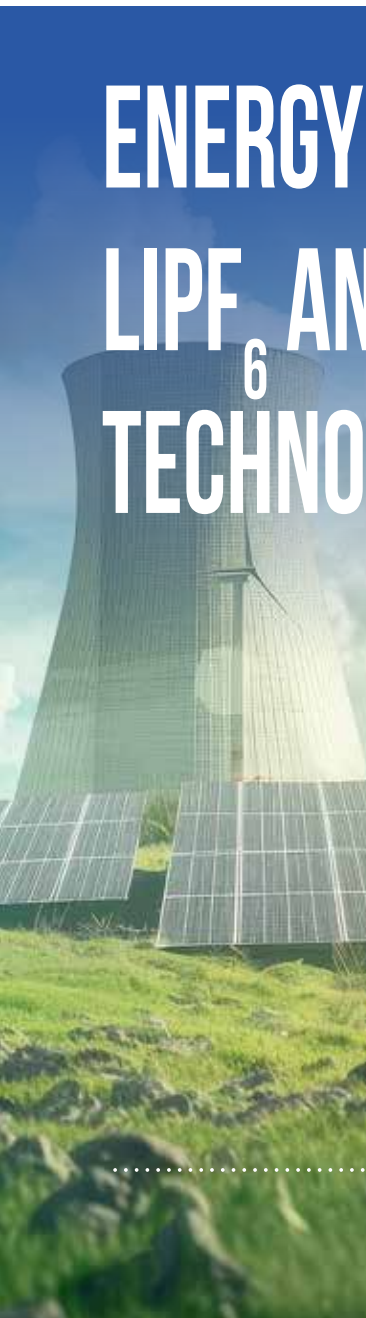


ENERGY STORAGE - LIPF₆ AND RELATED TECHNOLOGIES



NECSA'S VALUE ADD

Necsa is part of a national consortium, led by the DSTI and coordinated by SANEDI to contribute components to a South African Battery.

Necsa's contribution to the Consortium is the production of LiPF_6 and NaPF_6 electrolyte mixtures.

The process starts by mining fluorspar. It is then converted into anhydrous hydrogen fluoride (AHF), which is finally electrolyzed to produce fluorine gas.



ELECTROLYTES

Electrolytes salts are produced by Necsa using HF as a solvent. The salts produced are LiPF_6 and NaPF_6 . These salts are then dissolved to form liquid electrolyte mixtures in organic solvents.

Lithium hexafluorophosphate (LiPF_6) is highly hygroscopic, so as soon as it is produced, it is packaged into aluminum bottles to protect from further degradation in light.

These are then stored inside an inert glove box environment to prevent exposure to atmospheric moisture.



Packaging and storage of LiPF_6 electrolyte

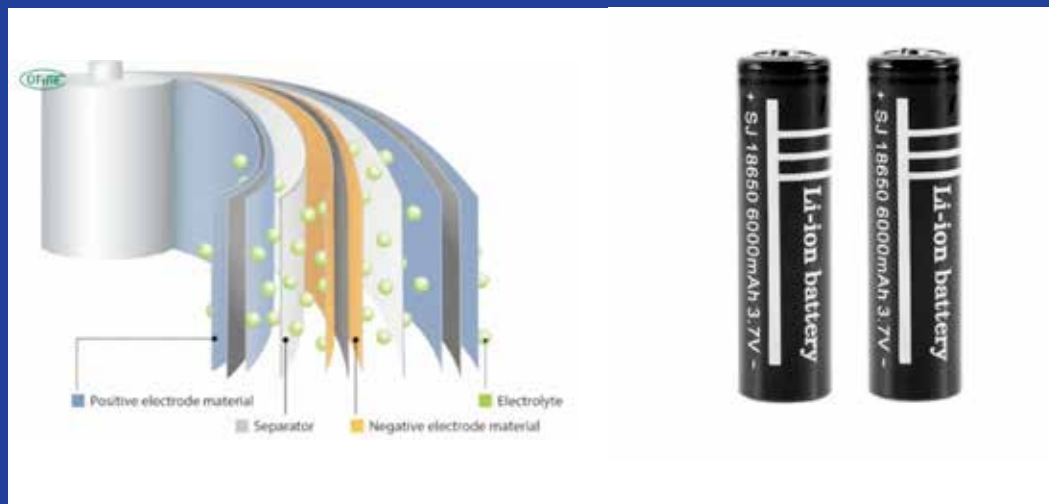


Prepared electrolyte packaged and labelled

BATTERY ASSEMBLY

The liquid electrolyte is injected into the battery assembly consisting of electrodes and separator materials by end user

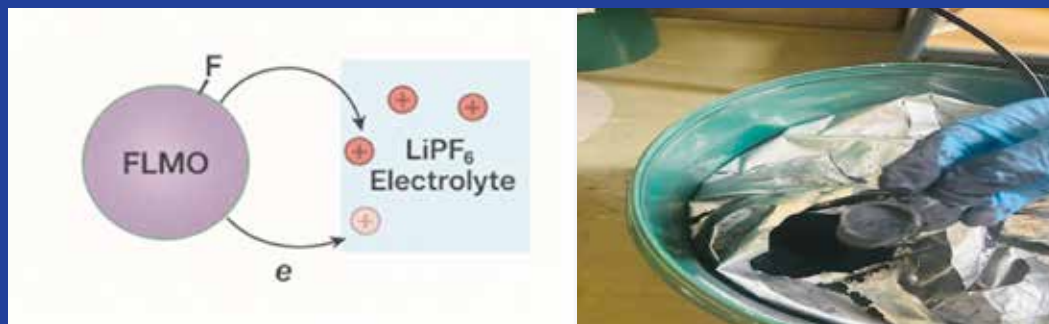
The electrolyte is kept dry by sealing the battery system.



CATHODE FLUORINATION

Necsa provides a cathode fluorination service using Fluorine gas for consortium members (CSIR and University of Limpopo).

Cathode fluorination is used to stabilize Manganese ions in lithium manganese oxide (LMO) and related cathode materials. This reduces Manganese leaching during battery operation.



TECHNOLOGY

PLATFORMS



Necsa technologies involve production of speciality precursors such as the PF_5 gas.

The PF_5 gas is stored in small, specialty gas cylinders.

LiPF_6 and NaPF_6 salt is made from PF_5 gas reaction with lithium source.

The electrolyte mixture must be HF free.

Necsa deploys molecular modelling techniques based on Ab-initio methods to unravel underlying process chemistry and ensure directed production approach.

PROTOTYPES



Necsa has developed reactor systems for cathode fluorination and production of LiPF_6 electrolyte.

CONCLUSIONS

Necsa has developed prototypes for a cathode fluorination system.

Furthermore, two prototype products were produced namely:

- Electrolyte mixtures version 1
- Fluorinated LMO version 1

Current work focuses on improving their performances to versions 2.

Necsa utilizes its own in-house IP to produce these products.