PILOT RESULTS

Preliminary results were generated to demonstrate the technical feasibility of the proposed lithium ore processing pathway and to validate the laboratory setup for subsequent large-scale testing. Pilot-scale beneficiation and roasting experiments were performed using representative Nigerian pegmatite ore samples prepared in accordance with ASTM D2013.

The research is still on the experimental stage and we have not published results in journals yet. We will carry out journal publications when a functional battery is achieved.

1. Ore Characterization

Initial mineralogical analysis using X-ray diffraction (XRD) confirmed the predominance of spodumene ($LiAlSi_2O_6$) with minor petalite and lepidolite phases. X-ray fluorescence (XRF) and ICP-OES assays indicated an average Li_2O grade of **2.5–3.0 wt.%**, suitable for concentration through flotation. Scanning electron microscopy (SEM-EDS) revealed liberated spodumene grains with moderate gangue association, supporting the selection of gravity and froth flotation techniques.

2. Beneficiation and Concentrate Quality

Pilot flotation tests achieved a spodumene concentrate with **5.5–6.0 wt.% Li_2O**, exceeding the minimum commercial specification of 5.0 wt.% Li_2O. Concentrate recoveries averaged **75–80%**, demonstrating process viability for scale-up. Particle size analysis confirmed an optimized grind size of **P80 = 150 µm** for maximum liberation.

3. Roasting and Phase Transformation

Thermal activation experiments conducted in a lab-scale muffle furnace at 1050 °C for 30 minutes successfully converted >95% of α-spodumene to the reactive β-phase, as confirmed by HT-XRD. This transformation improved lithium extraction efficiency during subsequent leaching.

4. Lithium Recovery

Water leaching of β-spodumene under optimized conditions yielded a lithium extraction efficiency of **85–90%**. ICP-MS analysis confirmed that impurity levels (Fe, Mg, Ca) in the leachate were within acceptable ranges for downstream precipitation into battery-grade lithium carbonate.

5. Energy and Environmental Data

Preliminary energy consumption data indicated an average specific energy requirement of **3.5–4.0 GJ/tonne of Li_2O concentrate** for roasting, consistent with published values in literature. Effluent water quality met local discharge limits after neutralization and filtration, providing early evidence of environmental compliance.

Conclusion

These pilot-scale results collectively demonstrate that Nigerian spodumene-bearing ores can be successfully upgraded and processed to produce battery-grade lithium precursors. The evidence supports the technical and environmental feasibility of the proposed flowsheet and provides a strong foundation for further scale-up, techno-economic assessment, and commercial partnership development.