Key Project Inputs

Mineralogy
Identify the lithium-bearing mineral and associated minerals.

Grain Size
Affects liberation requirement and method selection.

Liberation
Degree of liberation controls effective recovery and concentrate quality.

Gangue Composition
Impacts process choice, reagent regime and impurity management.

Spodumene-Bearing Pegmatite

Lithium occurs as spodumene within a complex pegmatite mineral assemblage.

Possible Beneficiation Routes

Ore Sorting
Dry pre-concentration to reject waste and upgrade lithium-bearing material before grinding.

Dense Media Separation (DMS)
Density-based separation of coarse particles to upgrade spodumene-bearing fraction.

Flotation
Surface-property separation after grinding to recover spodumene from gangue minerals.

Magnetic Separation
Removal of iron-bearing or magnetic impurities to improve concentrate purity.

No single beneficiation route is suitable for every spodumene deposit.

The optimal flowsheet depends on ore mineralogy, texture, grain size, liberation and metallurgical testwork.

2. Ore Sorting — Early Waste Rejection

Dry pre-concentration of coarse particles using sensor-based sorting technology.

Potential Lithium-Bearing Ore

Upgraded material proceeds to further processing.

Barren / Low-Value Gangue

Waste material rejected from the process.

Purpose

Remove waste before intensive grinding to reduce processing load, reagent consumption and equipment wear.

Best Suited Where

A reliable and measurable contrast exists between lithium-bearing particles and barren gangue in physical or sensor response.

Requires Sorting Testwork

Sorting performance must be validated through testwork under representative ore conditions and particle size distributions.

Ore sorting effectiveness depends on many factors including mineralogy, texture, grain size, particle shape, dust, moisture and ore variability. Decisions must be based on metallurgical testwork and project objectives.

3. Dense Media Separation — Coarse Pre-Concentration

Density-based separation of coarse particles to upgrade spodumene-bearing material before fine grinding.

Key Conditions for Effective DMS

Sufficient Coarse Liberation
Spodumene must be sufficiently liberated from gangue at the coarse size to achieve effective separation.

Useful Density Contrast
A clear density difference between spodumene-bearing minerals and gangue is required.

Controlled Particle Size
Feed size must be within a defined range to ensure stable separation performance and medium efficiency.

Fine or closely intergrown material may require grinding and flotation.

DMS is most effective for coarse, well-liberated spodumene-bearing particles.
Material that is too fine or tightly interlocked with gangue minerals may not respond well to density separation.

4. Grinding and Spodumene Flotation

Fine grinding to liberate spodumene from gangue minerals, followed by flotation to recover spodumene concentrate.

1. Grinding

Ball Mill

Reduce particle size to liberate spodumene from gangue.

2. Classification

Underflow (Coarse)

Return to Mill

Overflow (Fines)

To Flotation

Classify to create a closed-circuit, ensuring consistent feed size to flotation.

3. Flotation

Flotation Cell

Recover liberated spodumene using appropriate reagent systems.

Mineral Liberation Through Grinding

Before Grinding

Spodumene interlocked with quartz/feldspar and associated gangue minerals.

After Suitable Grinding

More liberated spodumene particles for improved flotation recovery.

Flotation conditions must be established by metallurgical testwork.

Because ore mineralogy, liberation, and gangue characteristics vary from deposit to deposit, metallurgical testwork is essential to determine the most effective grinding strategy and flotation reagent regime.

Key Control Variables

Mineral Liberation
The degree of liberation dictates flotation response and recovery.

Grinding Condition
Particle size, grind time and circulation influence liberation and recovery.

Pulp Chemistry
Affects mineral surface properties and reagent effectiveness.

Collector System
Collector type and strategy impact selectivity and recovery.

pH
pH influences collector adsorption and flotation performance.

Slime Content
Slimes can depress recovery and reduce flotation efficiency.

5. Magnetic Separation and Combined Beneficiation

Supplementary impurity removal

Magnetic field attracts and captures iron-bearing magnetic impurities.

Combined Beneficiation Flowsheet (Example)

Crushing
Reduce ROM to manageable size

Sorting / DMS
Remove coarse waste or upgrade early where applicable

Grinding
Liberate lithium minerals for downstream recovery

Flotation
Recover spodumene and reduce silicate contamination

Magnetic Cleaning
Remove iron-bearing magnetic impurities where required

Concentrate
Cleaned spodumene concentrate proceeds to dewatering

Magnetic separation removes iron-bearing magnetic impurities where present

Protects downstream equipment and improves product cleanliness.

Used as a supplementary cleaning stage

Not a primary recovery method for spodumene.

Applied only where mineralogy supports magnetic impurity removal

Effectiveness depends on ore characteristics and testwork.

Combined flowsheets depend on mineralogy, liberation and testwork

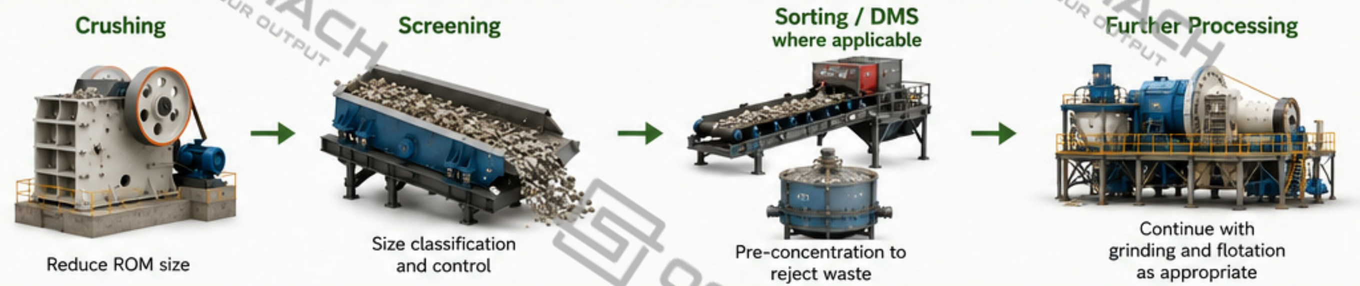
Design must be tailored to project-specific conditions.

6. Ore Texture Determines the Processing Route

Ore mineralogy, texture and liberation characteristics dictate the most appropriate beneficiation strategy.

Coarse-Grained Spodumene Pegmatite

Coarse crystals with good liberation potential.



Finely Intergrown Spodumene Ore

Spodumene interlocked with gangue minerals; requires fine grinding for liberation.

Weathered / Mica-Rich Ore

High mica and clay content, fine slimes may interfere with recovery.

Spodumene Concentrate

Upgraded lithium mineral ready for downstream processing.

Downstream Thermal / Chemical Conversion

Calcination, roasting or leaching to produce lithium compounds.

Flowsheet selection requires mineralogical and metallurgical testwork.
Testwork defines the optimal flowsheet, operating conditions and reagent strategy for your deposit.