



Investigating the impact of stirred milling to improve the fineness of grind for PGM tailings reprocessing– IsaMill™ Case Study

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Tailings reprocessing

A growing strategy to maximise PGE recovery ...but requires liberation



<https://fls.com/en/equipment/grinding/ball-mills>

Ball Milling

- High Energy Consumption,
- Excessive slime generation → metal losses

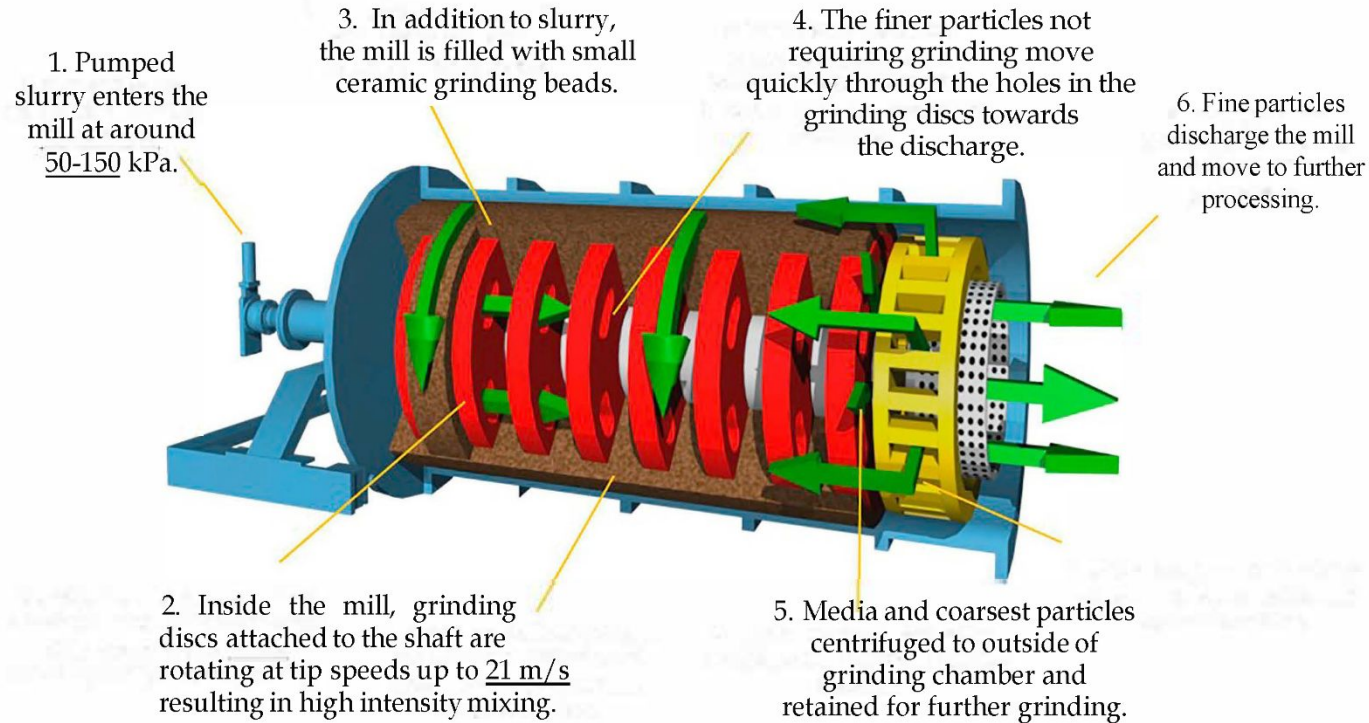


<https://www.glencoretechnology.com/en/technologies/isamill>

Stirred Milling

- Proven energy-efficient fine grinding (<45 μm)
- Produces a controlled and narrow PSD

The IsaMill™ Technology

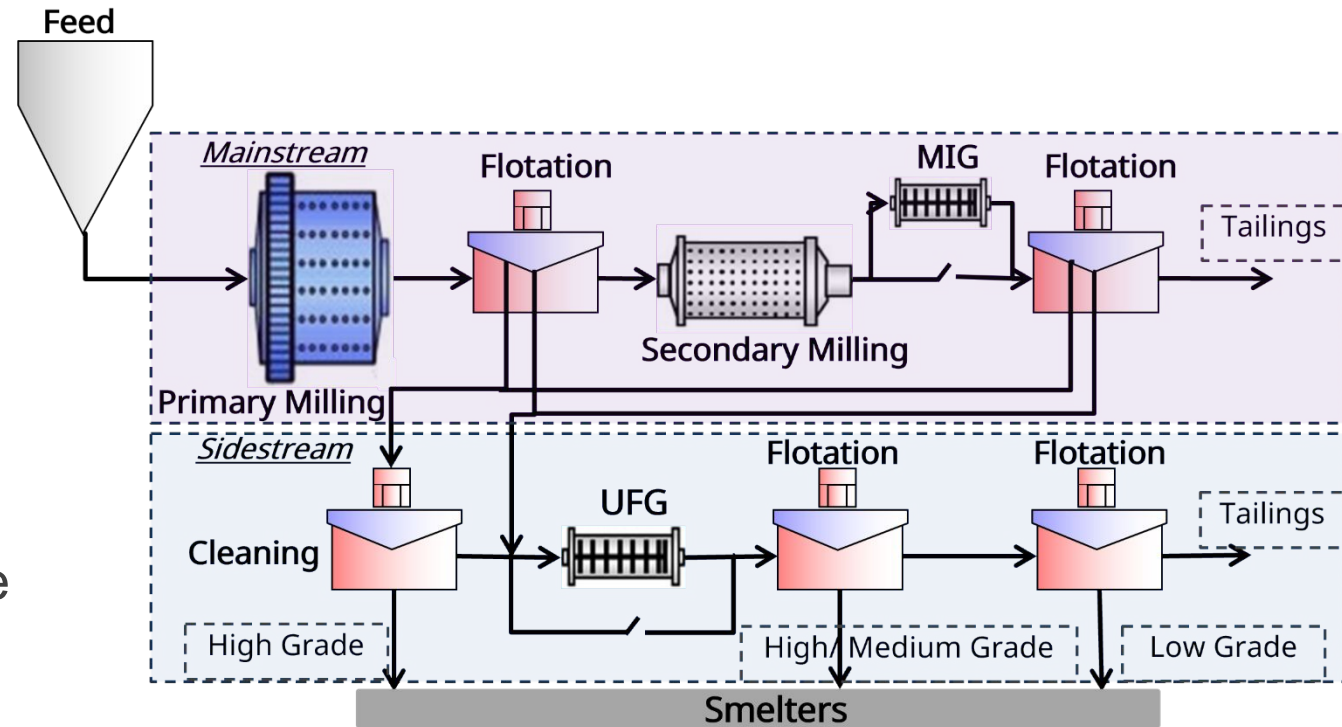


- Uses ceramic or steel media
- Operates staged grinds
- No external classification required
- Effective for fine to ultrafine grinding
- Proven industrial use in base & precious metals

Adapted from (Anderson and Bandarian, 2018)

Application of the Isamill™ in industry

- Initially developed to process fine-grained ore bodies at Mount Isa Mines
- Growth into the PGM industry led by Anglo Platinum (Now Valterra)
- Investigations proved that the Isamill™ enabled tailings retreatment on oxidised slow-floating PGMs
- Applications in the PGM industry include the MIG and UFG



Adapted from (Rule and Schouwstra, 2018)

Experimental Program

- **Grinding Media**

3.5 mm-Keramax® -
MT1™-IsaMill™

30 mm 21% chrome steel
balls-Ball Mill

- **Test Conditions**

1200, 1550, 1900 rpm

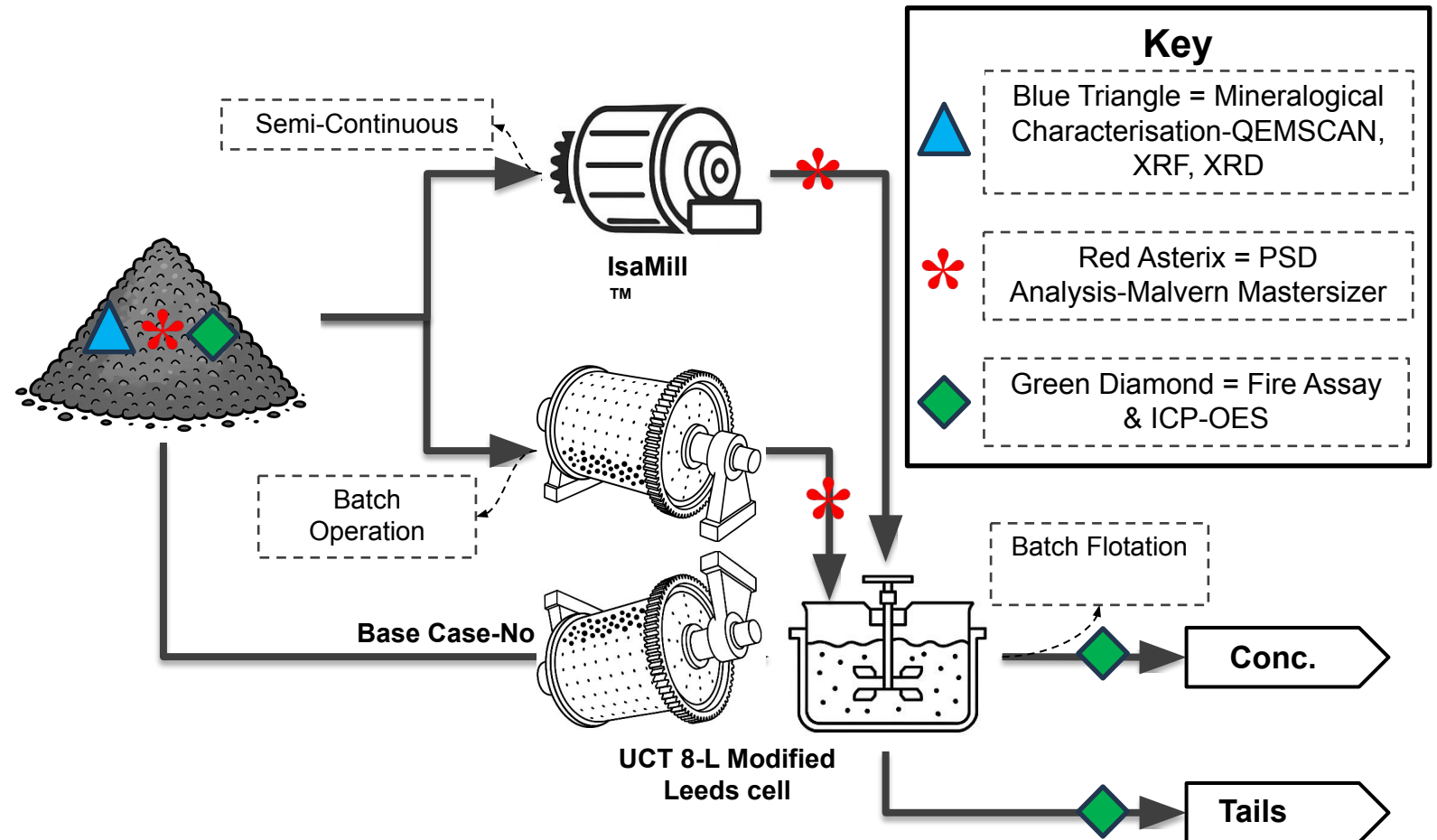
- **P80 Targets**

83, 74, 50, 28 µm

- **Flotation reagents**

SIBX-collector

Senfroth 516-Frother



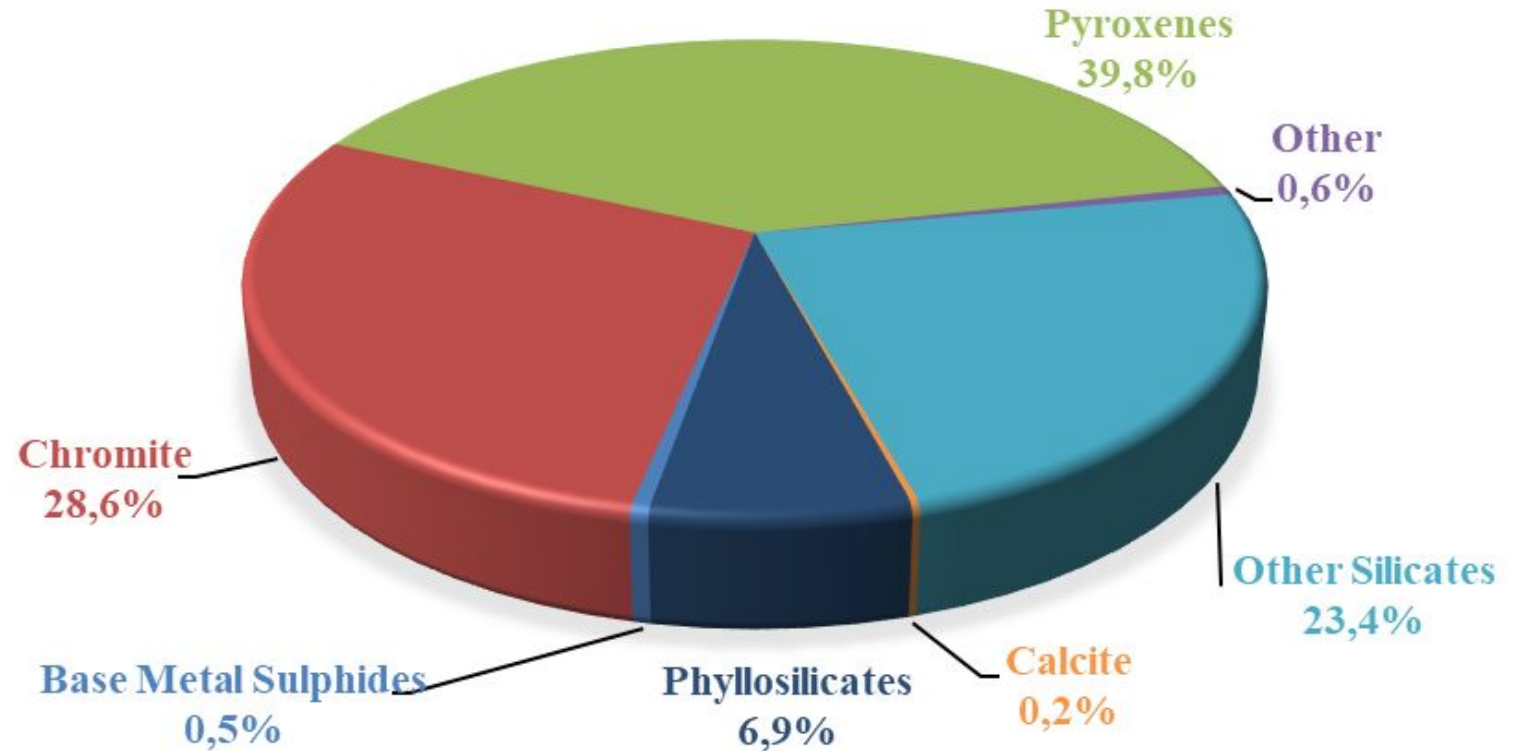
Feed Mineralogy

– Major minerals:

- Pyroxenes (39.8%),
- Other Silicates (23.4%),
- Chromite (28.6%).

– Minor Minerals:

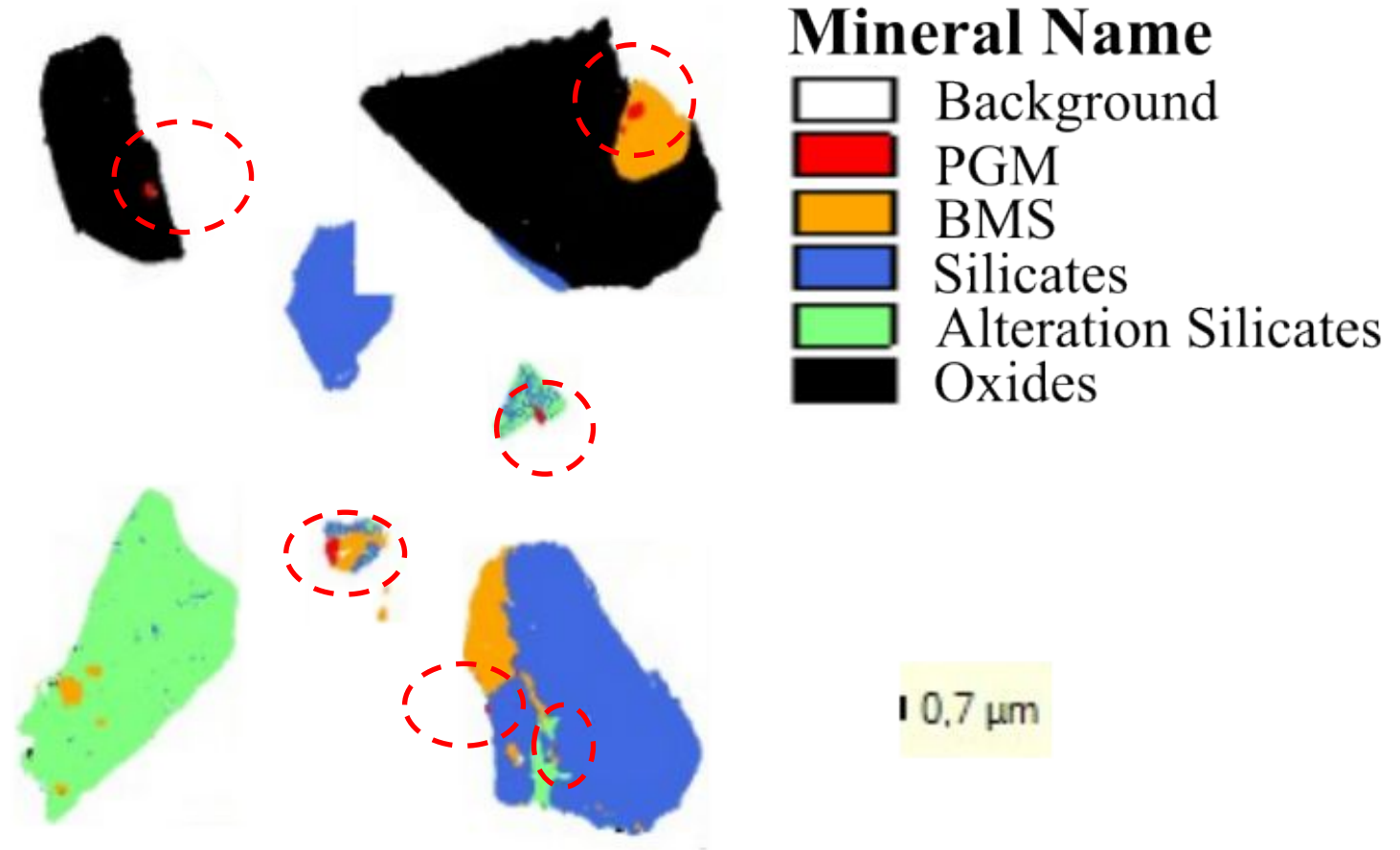
- Base Metal Sulphides (0.5%),
- Phyllosilicates (6.9%).



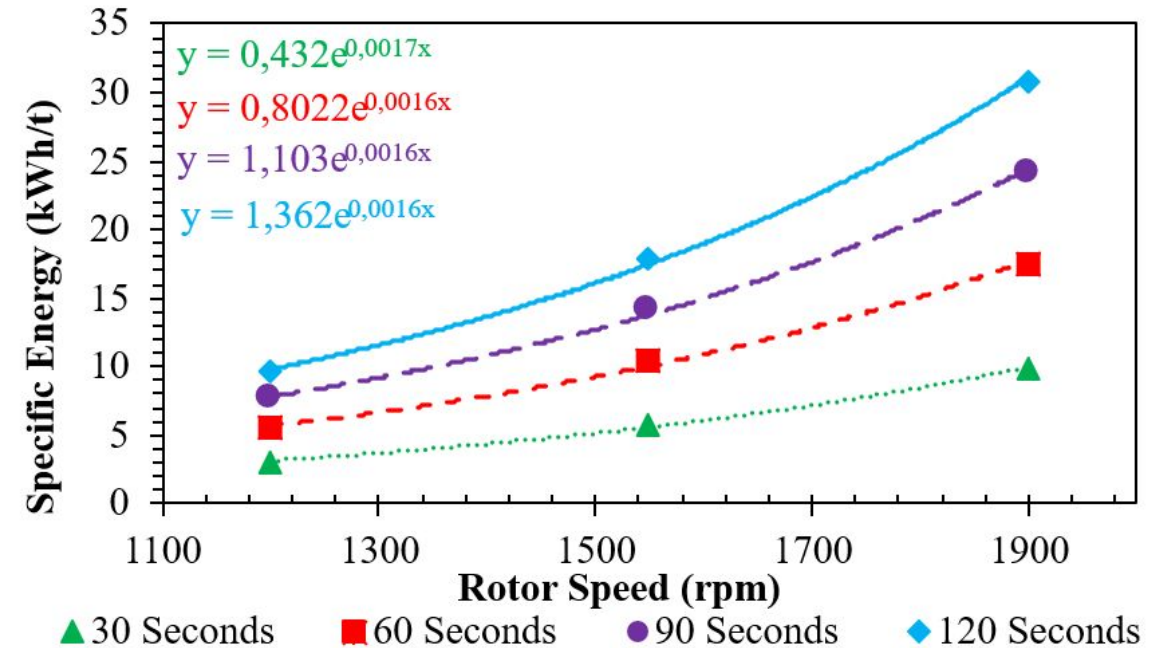
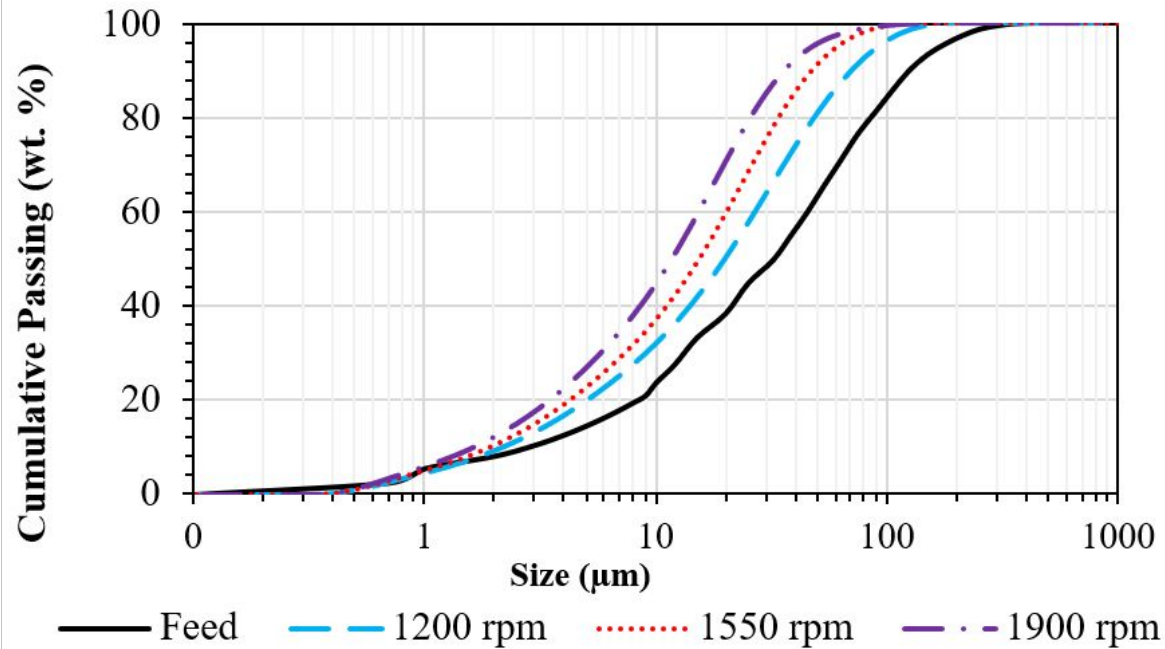
Feed PGM Occurrence

Preliminary PGM liberation and association analysis (QEMSCAN)

- Trace PGMs detected,
- Most PGMs locked in gangue,
- BMS also detected in significant amounts.



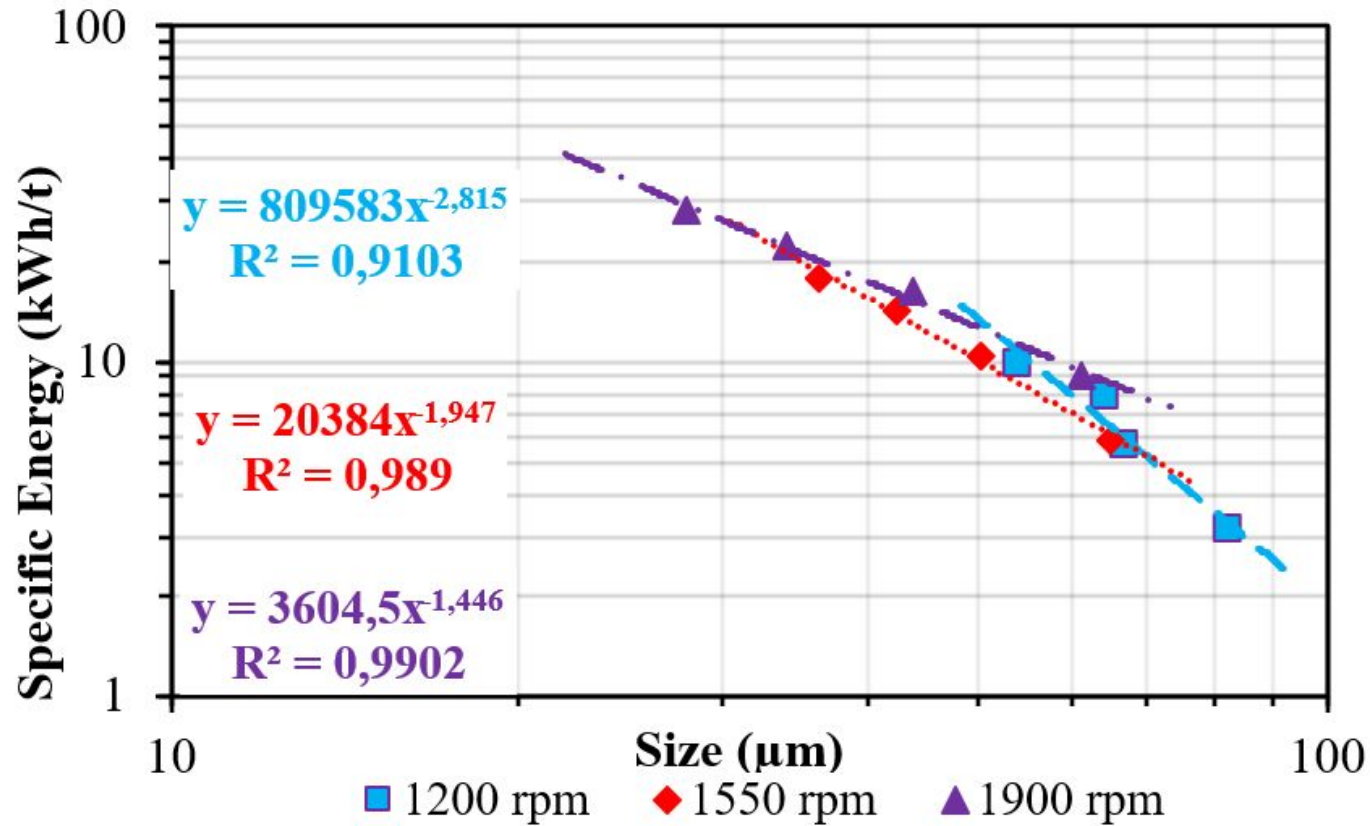
Grinding Behaviour



- Increasing rotor speed → **finer PSD** (narrower distribution)
- Preferential coarse particle grind

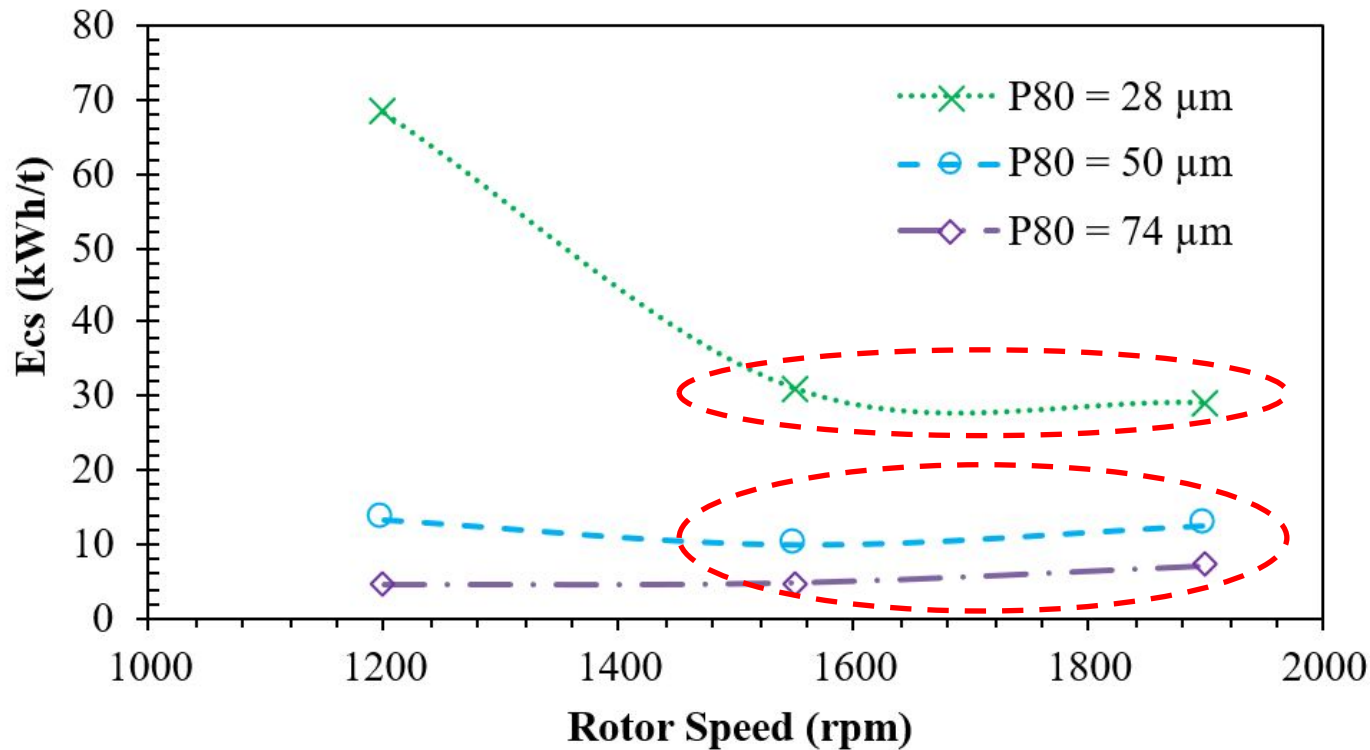
- Exponential specific energy vs rotor speed relationship.

Energy-Grind Relationship



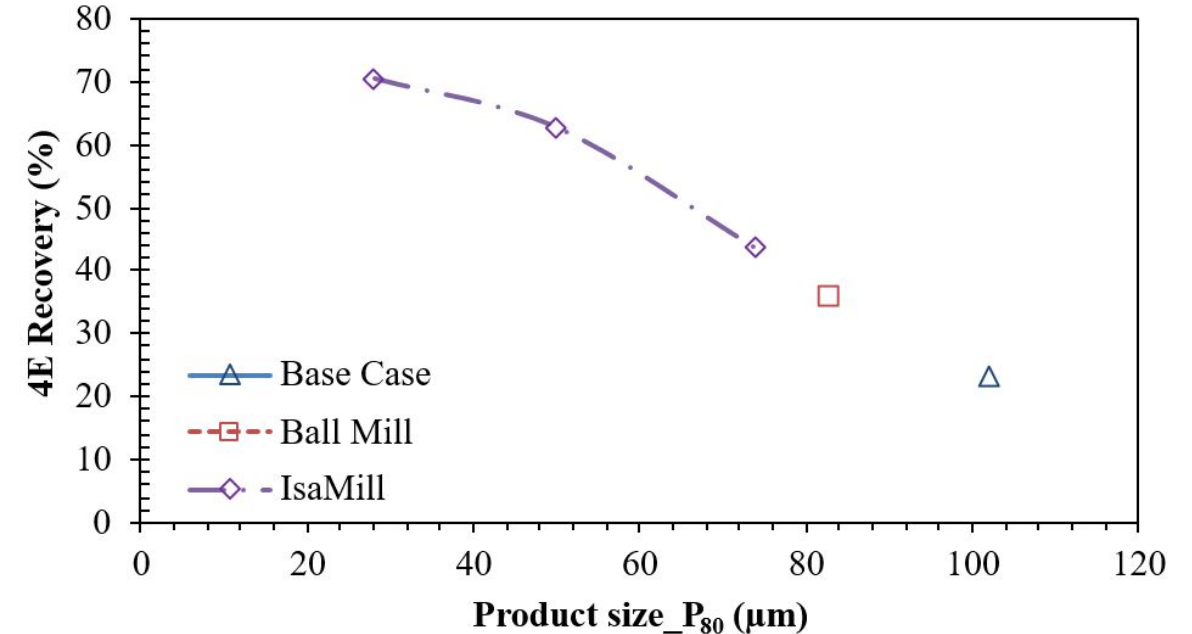
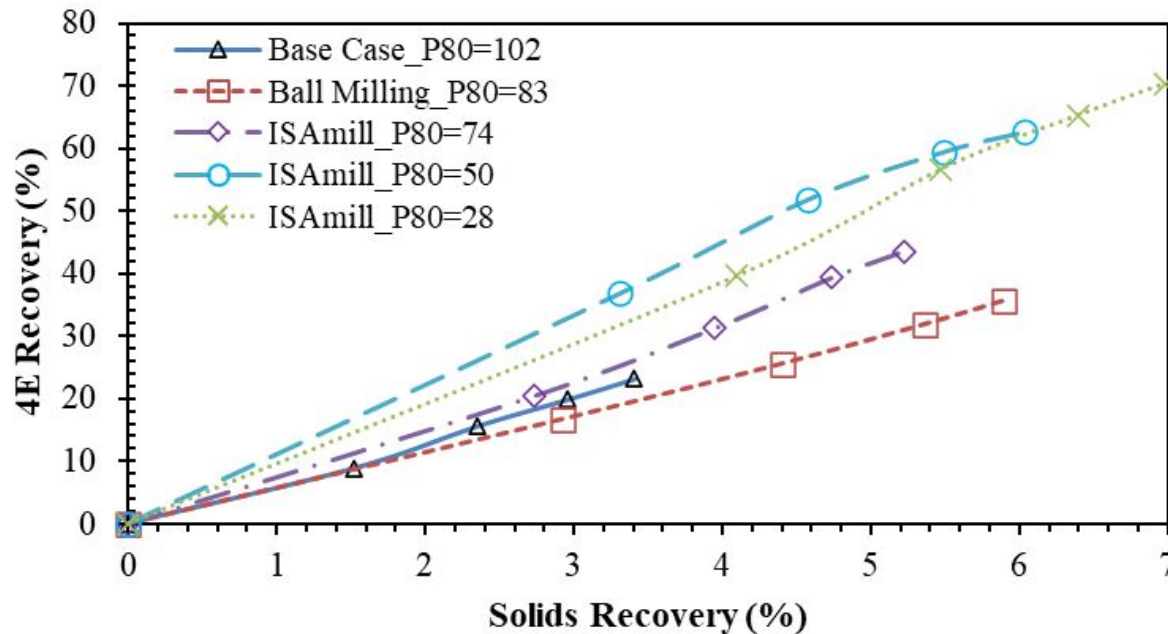
- Energy sharply rises as P80 decreases (Bond & Rittinger laws)
- Decreasing rate of energy increase with increasing shaft speed

Energy-Grind Relationship



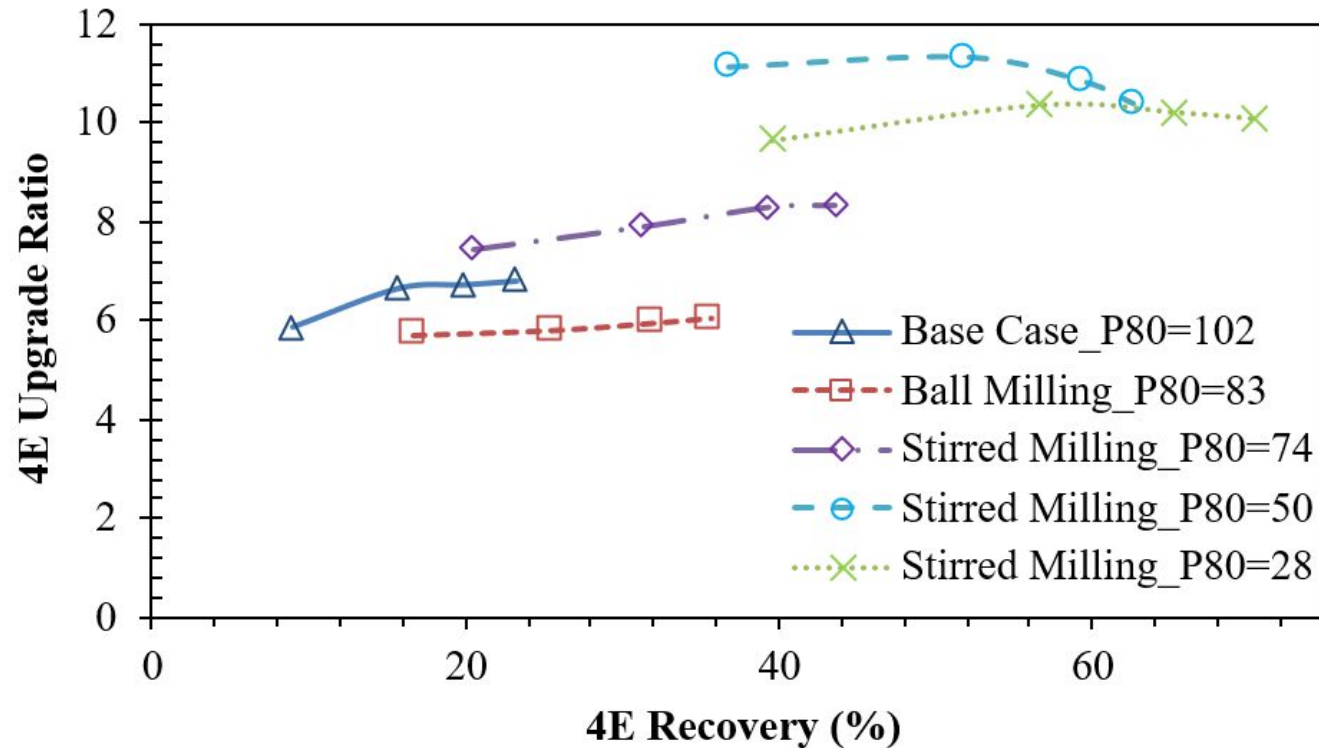
- Targeted coarse grind- low rotor speed, targeted fine grind, high rotor speed preferred
- The choice of operational speed also depends on the associated wear rate

Flotation Performance



- Increasing slope (4E vs solids recovery) with size reduction
- 4E recovery improved significantly with fine grinding

Flotation Performance



- Increased upgrade ratio: +10 vs <5 for ball milling and no regrind
- Results infer improved liberation and selectivity

Conclusions

- **Ball Milling**

- Improvements in grind size are limited by residence time,
- Minimal recovery improvement.

- **Stirred Milling (IsaMill™)**

- Improved recoveries,
- Energy-efficient operations.

- **Recommendations for further studies**

- In this study, the IsaMill™ and HIGMill™ were used, and both gave positive results; it is recommended to extend to other stirred milling technologies.
- Mineralogical characterisation of the feed and products should be performed to demonstrate an actual improvement in liberation.

Acknowledgements



Scholars
Program



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