

Study of Ball-Mill Size Reduction and Milling Laws

Practical 09 | Pharmaceutical Engineering

Aim

To study Ball-Mill Size Reduction and Milling Laws, and interpret the recorded observations.

Principle

- Kick, Rittinger and Bond relate energy to different size measures and ranges. Mill critical speed describes the idealized balance between centrifugal and gravitational effects.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

Materials and Apparatus

- Ball-mill demonstration, feed/product size records and power/energy data.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

Observation / parameter	Record / finding
Feed size d1	_____
Product size d2	_____
Net energy	_____
Mill diameter D	_____
Ball diameter d	_____

Calculations and Interpretation

- Kick: $E = KK \ln(d1/d2)$.
- Rittinger: $E = KR(1/d2 - 1/d1)$.
- Bond-form relation: $E = KB(1/\sqrt{d2} - 1/\sqrt{d1})$; keep the coefficient and size units together.
- Ideal critical speed in rpm: $N_c = (60/2\pi)\sqrt{2g/(D - d)}$, with lengths in metres and g in m/s^2 .

Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: _____

Conclusion: _____

Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

Viva Questions

1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

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