Grinding Media Charge: Filling Degree and Ball Mass

Filling degree of a ball mill from the measured free height, and the volume and mass of grinding media in a compartment from its size, filling and bulk density.

Method: Duda; Cement Data Book; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mill diameter inside the liners	2.5000	m
Compartment length	3.5000	m
Filling from	Filling degree entered	
Filling degree (charge volume / mill volume)	30.000	%
Free height (charge surface to top of the liner)	1.6000	m
Bulk density of the media (balls 4.55, Cylpebs 4.85 t/m³)	4.5500	g/cm³

Calculated results

Parameter	Value	Unit
Filling degree	30.000	%
Compartment volume	17.181	m³
Bulk volume of media	5.1542	m³
Media mass	23.451	t

Notes for this case

- Duda's recommended filling for a three-compartment mill: 30 %, 27 % and 24 % by volume with 100–60, 60–35 and 30–20 mm media. The bulk density of balls varies little with size.

Formula and method

$$\phi = \frac{\theta - \sin\theta}{2\pi}, \quad \cos\frac{\theta}{2} = \frac{D/2 - (D - H)}{D/2}, \quad M = \frac{\pi D^2}{4} L\,\phi\,\rho_b$$

Variables

D	Mill diameter inside the liners	m
L	Compartment length	m
input	Filling from	-
ϕ	Filling degree (charge volume / mill volume)	-
H	Free height (charge surface to top of the liner)	m
ρ_b	Bulk density of the media (balls 4.55, Cylpebs 4.85 t/m³)	kg/m³
V	Compartment volume	m³
V_b	Bulk volume of media	m³
M	Media mass	kg

Method and standards

Circular segment and bulk mass.

Assumptions and limits

- Level charge surface at rest.

References

- Duda

- Cement Data Book
- Vol. 1
- 3rd ed. (Bauverlag / Macdonald and Evans, 1985)
- secs. 5.7-5.10 (grinding ball charge, hints for mill charging)

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/cement/grinding-media-charge

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.