SAG Mill Charge Apparent Density

Apparent density of a SAG, AG or ball mill charge of balls, rock, voids and slurry, and the charge mass for a mill volume, from the fillings and densities.

Method: Wills and Finch; Wills' Mineral Processing Technology; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Ball filling (fraction of mill volume)	10.000	%
Rock filling	30.000	%
Voidage of the charge	40.000	%
Fraction of voids filled by slurry	100.00	%
Ball density	7.8500	g/cm³
Ore density	3.0000	g/cm³
Solids by volume in the slurry	10.000	%
Density of the slurry solids	3.0000	g/cm³
Mill internal volume	600.00	m³

Calculated results

Parameter	Value	Unit
Slurry density	1.2000	g/cm³
Apparent density of the charge	3.0075	g/cm³
Charge mass (balls, rock and slurry)	721.80	t

Notes for this case

• Power draw is roughly proportional to the apparent density at the same filling and speed, so replacing rock with balls raises power (Wills Example 7.1b). The charge mass is the balls, rock and slurry in the voids.

Formula and method

$$\rho_{ap} = \frac{J_b(1-f_v)\rho_b + J_r(1-f_v)\rho_r + (J_b+J_r)f_v U \rho_{sl}}{J_b(1-f_v) + J_r(1-f_v) + (J_b+J_r)f_v U}, \quad \rho_{sl} = \phi_p \rho_p + (1-\phi_p)$$

Variables

J_b	Ball filling (fraction of mill volume)	-
J_r	Rock filling	-
f_v	Voidage of the charge	-
U	Fraction of voids filled by slurry	-
ρ_b	Ball density	kg/m³
ρ_r	Ore density	kg/m³
ϕ_p	Solids by volume in the slurry	-
ρ_p	Density of the slurry solids	kg/m³
V	Mill internal volume	m³
ρ_{sl}	Slurry density	kg/m³
ρ_{ap}	Apparent density of the charge	kg/m³
M_c	Charge mass (balls, rock and slurry)	kg

Method and standards

Volume-weighted charge density.

Assumptions and limits

- Same voidage for balls and rock.

References

- Wills and Finch
- Wills' Mineral Processing Technology
- 8th ed. (Butterworth-Heinemann, 2016)
- ch. 7
- eqs. 7.8-7.9 and Example 7.1

Report details

Report reference	FCC-2QDX-JZYR (the same inputs always give the same reference)
Generated	17 November 2026, 19:49 UTC
Calculator	SAG Mill Charge Apparent Density
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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This calculator online

https://calc.firecad.com/civil/mining-minerals/sag-charge-apparent-density

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.