Roll Crusher: Nip Angle, Largest Feed and Capacity

Largest particle crushing rolls can grip for a gap and nip angle, the friction needed and its fall with speed, and the ribbon capacity of the rolls.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Roll diameter	1,000.0	mm
Gap between the rolls (setting)	10.000	mm
Angle of nip	20.000	°
Static coefficient of friction (steel on ore 0.2–0.3)	0.25000	
Roll speed	60.000	rpm
Roll width	600.00	mm
Density of the feed material	1.6000	g/cm³
Actual capacity as a fraction of the ribbon (about 0.25)	25.000	%

Calculated results

Parameter	Value	Unit
Largest particle gripped	25.581	mm
Reduction ratio	2.5581	
Largest nip angle for the static friction	28.072	°
Peripheral speed	3.1416	m/s
Kinetic coefficient of friction at this speed	0.056910	
Largest nip angle for the kinetic friction	6.5144	°
Theoretical ribbon capacity	108.57	t/h
Expected actual capacity	27.143	t/h

Notes for this case

- Rolls must be starvation-fed and run in closed circuit with a screen; actual capacity is about 25 % of the ribbon. Reduction ratios above 4 are rare.
- At this speed the kinetic friction is lower (Wills eq. 6.5): coarse feed may slip; slow the rolls or reduce the nip angle.

Formula and method

$$\cos\frac{\theta}{2}=\frac{R+a}{R+r},\quad \mu\geq\tan\frac{\theta}{2},\quad \mu_k=\frac{1+1.12v}{1+6v}\mu,\quad Q=188.5NDW\rho d\ \text{(kg/h)}$$

Variables

D	Roll diameter	m
$2a$	Gap between the rolls (setting)	m
θ	Angle of nip	rad
μ	Static coefficient of friction (steel on ore 0.2–0.3)	-
N	Roll speed	1/s
W	Roll width	m
ρ_s	Density of the feed material	kg/m³
η	Actual capacity as a fraction of the ribbon (about 0.25)	-

$2r$	Largest particle gripped	m
r/a	Reduction ratio	-
θ_{max}	Largest nip angle for the static friction	rad
v	Peripheral speed	m/s
μ_k	Kinetic coefficient of friction at this speed	-
$\theta_{max,k}$	Largest nip angle for the kinetic friction	rad
Q	Theoretical ribbon capacity	kg/s
ηQ	Expected actual capacity	kg/s

Method and standards

Nip geometry, friction and ribbon capacity.

Assumptions and limits

- Spherical particles; smooth rolls.

References

• Wills and Finch
• Wills' Mineral Processing Technology
• 8th ed. (Butterworth-Heinemann, 2016)
• ch. 6
• eqs. 6.3-6.7 and Table 6.1

Report details

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This calculator online

https://calc.firecad.com/civil/mining-minerals/roll-crusher-nip-capacity

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Reopens the calculator with the inputs of this report.