Batch Centrifugal Power: Running, Acceleration, Recovery

Running power of a batch centrifugal from Hugot's friction couple (eqn 35.38), the energy to accelerate it and the energy regenerative braking recovers.

Method: Hugot; Handbook of Cane Sugar Engineering; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Basket diameter	1.0650	m
Basket height	0.76000	m
Top speed	1,500.0	rpm
Moment of inertia of basket and charge From the maker; Hugot's Table 35.10 lists values for common sizes.	400.00	kg·m²
Acceleration time	60.000	s
Speed at which regenerative braking ends (share of top speed)	60.000	%

Calculated results

Parameter	Value	Unit
Running friction couple	100.68	N·m
Running power	15.814	kW
Kinetic energy at top speed	1.3708	kWh
Mean power to accelerate	82.247	kW
Energy regenerative braking returns	0.87730	kWh

Notes for this case

• Hugot's running couple C = D⁴Hn(1 + 4n) m·kgf, n in thousands of rpm. The acceleration power excludes friction during the run-up and the drive efficiency: size the motor above it.

Formula and method

$$C = D^4 H n_k (1 + 4 n_k)\ \mathrm{m\,kgf}\ (n_k = n/1000), \quad P_r = C\omega, \quad E_k = \frac{1}{2} I \omega^2, \quad P_a = \frac{E_k}{t_a}, \quad E_r = E_k (1 - f^2)$$

Variables

D	Basket diameter	m
H	Basket height	m
n	Top speed	1/s
I	Moment of inertia of basket and charge	kg·m²
t_a	Acceleration time	s
f	Speed at which regenerative braking ends (share of top speed)	-
C	Running friction couple	N·m
P_r	Running power	W
E_k	Kinetic energy at top speed	J
P_a	Mean power to accelerate	W
E_r	Energy regenerative braking returns	J

Method and standards

Hugot's couple with rigid-body energy.

Assumptions and limits

- Rigid basket; constant inertia during acceleration.
- P_a is the kinetic energy over the acceleration time: it excludes the friction power during run-up and the drive efficiency, so a motor sized on it alone is too small. E_r assumes the drive returns all of the braking energy; drive losses reduce it.
- For a 1 065 × 760 mm basket at 1 500 rpm the couple gives about 16 kW, as in Hugot's Table 35.11.

References

- Hugot
- Handbook of Cane Sugar Engineering
- 3rd ed. (Elsevier, 1986)
- ch. 35
- power of centrifugals
- eqns 35.33–35.40 and Table 35.11
- pp. 775–782
- Kinetic energy ½Iω²

Report details

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Release checks	2 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/sugar-ethanol/centrifugals-sugar-house/centrifugal-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.