Mill Drive: Steam Turbine vs Electric Motor Steam

Steam for a mill or shredder drive by a single-stage turbine, and by an electric drive fed from the turbo-generator, and the steam the electric drive saves.

Method: Steam = power × specific steam consumption; electric drive through the turbo-generator

Input parameters

Unit system: SI

Parameter	Value	Unit
Drive shaft power	1,000.0	kW
Mill turbine specific steam (incl. gearing) Hugot ch. 16: double-wheel mill turbines at 22 kg/cm², 350 °C exhausting at 1.5 kg/cm² (plant steam pressures, normally gauge) use 10–15 kg steam per metric hp·h, about 14–20 kg/kWh, worse at part load.	16.000	kg/kWh
Turbo-generator specific steam	6.5000	kg/kWh
Electric drive efficiency (motor, VFD, gearbox, cables)	90.000	%

Calculated results

Parameter	Value	Unit
Steam, turbine drive	16.000	t/h
Steam, electric drive (through the TG)	7.2222	t/h
Steam saved by the electric drive	8.7778	t/h

Notes for this case

- The comparison is in steam mass only: the mill turbine's exhaust goes to process, while the turbo-generator may condense part of its steam, so the saving is real only if the process does not need the extra exhaust.

Formula and method

$$\dot{m}_T = P SR_m, \quad \dot{m}_E = \frac{P}{\eta_e} SR_g$$

Variables

P	Drive shaft power	W
SR_m	Mill turbine specific steam (incl. gearing)	kg/J
SR_g	Turbo-generator specific steam	kg/J
η_e	Electric drive efficiency (motor, VFD, gearbox, cables)	-
$\dot{m}_T$	Steam, turbine drive	kg/s
$\dot{m}_E$	Steam, electric drive (through the TG)	kg/s
$\Delta\dot{m}$	Steam saved by the electric drive	kg/s

Method and standards

Definitions.

Assumptions and limits

- Steady load. Steam is compared by mass only; it is not a fuel or energy balance.
- Hugot quotes the steam pressures in kg/cm² without saying gauge or absolute; for plant steam they are normally gauge readings.

References

- Steam = power × specific steam consumption; electric drive through the turbo-generator

Report details

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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/milling/mill-turbine-vs-motor

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.