Diffuser vs Milling Tandem: Power and Steam

Power saved by a diffuser station over a milling tandem per tonne fibre, the steam that power takes at a turbine rate, and the extra heating steam of the diffuser.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Crushing rate	250.00	t/h
Fibre % cane	14.500	%
Milling station energy per tonne fibre Hugot (South Africa): 188 kWh/t fibre, 82 for preparation and 106 for the tandem.	188.00	kWh/t
Diffusion station energy per tonne fibre Hugot (South Africa): 125 kWh/t fibre including preparation and dewatering.	125.00	kWh/t
Steam rate of the drives or turbo-generator Hugot: about 15 kg/kWh for mill and shredder turbines, 11 for the turbo-generator.	15.000	kg/kWh
Extra heating steam of the diffuser per tonne cane	30.000	kg/t

Calculated results

Parameter	Value	Unit
Power saved by the diffuser	2,283.8	kW
Steam saved on the drives	34.256	t/h
Extra heating steam	7.5000	t/h
Net steam saved (negative: diffuser uses more)	26.756	t/h

Notes for this case

- Hugot also reports slightly more molasses and sucrose loss with diffusers (about 0.7 kg sucrose per t cane in one comparison).

Formula and method

$$\Delta P = (e_m - e_d) A f, \quad \Delta \dot{m}_P = SR\,\Delta P, \quad \Delta \dot{m}_H = s_x A, \quad \Delta \dot{m} = \Delta \dot{m}_P - \Delta \dot{m}_H$$

Variables

A	Crushing rate	kg/s
f	Fibre % cane	-
e_m	Milling station energy per tonne fibre	J/kg
e_d	Diffusion station energy per tonne fibre	J/kg
SR	Steam rate of the drives or turbo-generator	kg/J
s_x	Extra heating steam of the diffuser per tonne cane	kg/kg
ΔP	Power saved by the diffuser	W
$\Delta \dot{m}_P$	Steam saved on the drives	kg/s
$\Delta \dot{m}_H$	Extra heating steam	kg/s
$\Delta \dot{m}$	Net steam saved (negative: diffuser uses more)	kg/s

Method and standards

Energy comparison on the fibre rate.

Assumptions and limits

- Station energies from one survey; use plant data where possible.
- The net figure subtracts low-pressure heating steam from live drive steam by mass. It is not an energy or fuel balance: drive-turbine exhaust may itself supply process heat, so a positive net saving does not by itself mean less fuel.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 14 (station energies, p. 240) and ch. 23 (comparison, p. 398)

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/diffusion/diffuser-vs-mill-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.