Stillage Evaporator and DDGS Dryer Balance

Syrup, evaporation and evaporator steam from thin stillage, and DDGS, dryer evaporation and dryer heat from wet cake and syrup (Alcohol Textbook ch. 26).

Method: Jacques; Lyons and Kelsall (eds.); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Thin stillage to the evaporator	60.000	t/h
Total solids in thin stillage	6.0000	%
Total solids in syrup Alcohol Textbook: syrup of 25–50 % total solids.	30.000	%
Evaporator economy (kg vapour per kg steam) Four effects may approach 6–7.	3.5000	
Wet cake from the centrifuges	25.000	t/h
Total solids in wet cake Up to 31–38 % total solids.	35.000	%
Total solids in DDGS	90.000	%
Dryer heat per kg of water evaporated From the dryer maker; depends on dryer type and exhaust recycle. The dryer heat output is on the same basis: fuel heat input (on its heating value) or heat delivered, whichever you enter.	3,500.0	kJ/kg

Calculated results

Parameter	Value	Unit
Syrup	12.000	t/h
Evaporator evaporation	48.000	t/h
Evaporator steam	13.714	t/h
DDGS (cake and syrup dried)	13.722	t/h
Dryer evaporation	23.278	t/h
Dryer heat	22.631	MW

Notes for this case

• Water removed in the evaporator costs far less than in the dryer: push concentration to the syrup limit (25–28 % with suspended solids, up to 50 % with good clarification).

Formula and method

$$\dot{m}_s = \frac{\dot{m}_t x_t}{x_s}, \quad E = \dot{m}_t - \dot{m}_s, \quad \dot{m}_D = \frac{\dot{m}_s x_s + \dot{m}_c x_c}{x_d}, \quad E_d = \dot{m}_s + \dot{m}_c - \dot{m}_D$$

Variables

$\dot{m}_t$	Thin stillage to the evaporator	kg/s
x_t	Total solids in thin stillage	-
x_s	Total solids in syrup	-
$\mathcal{E}$	Evaporator economy (kg vapour per kg steam)	-
$\dot{m}_c$	Wet cake from the centrifuges	kg/s
x_c	Total solids in wet cake	-
x_d	Total solids in DDGS	-

q_d	Dryer heat per kg of water evaporated	J/kg
$\dot{m}_s$	Syrup	kg/s
E	Evaporator evaporation	kg/s
$\dot{m}_{st}$	Evaporator steam	kg/s
$\dot{m}_D$	DDGS (cake and syrup dried)	kg/s
E_d	Dryer evaporation	kg/s
$\dot{Q}_d$	Dryer heat	W

Method and standards

Total-solids balance.

Assumptions and limits

- No solids lost.
- The dryer heat is on the basis of the heat per kg entered (fuel heat input or heat delivered to the dryer).

References

• Jacques
• Lyons and Kelsall (eds.)
• The Alcohol Textbook
• 4th ed. (Nottingham University Press, 2003)
• ch. 26 (Meredith)
• dryhouse design
• Total-solids balance

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/ethanol/stillage-dryhouse-balance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.