Slop-Fired Boiler: Steam from Concentrate and Support Fuel

Steam raised by burning concentrated spent wash and the support fuel (coal or bagasse) to make up a steam demand, with IF97 steam and feedwater enthalpies.

Method: Energy balance with IAPWS-IF97 steam and feedwater enthalpies; concentrate NCV from analysis (see slop-concentrate-net-value)

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam demand	25.000	t/h
Steam pressure (absolute)	46.000	bar
Steam temperature	400.00	°C
Feedwater temperature	105.00	°C
Concentrate fired	10.000	t/h
Concentrate NCV (as fired)	6,500.0	kJ/kg
Efficiency on concentrate (net)	65.000	%
Support fuel NCV	21,000	kJ/kg
Efficiency on support fuel (net)	82.000	%

Calculated results

Parameter	Value	Unit
Heat per kg of steam	2,760.2	kJ/kg
Steam from concentrate	15.307	t/h
Support fuel	1.5538	t/h
Concentrate share of heat input	66.578	%

Notes for this case

- Combustion stability and ash behaviour set the minimum support-fuel share: follow the boiler maker's limit.

Formula and method

$$\dot{m}_{s,c} = \frac{\dot{m}_c NCV_c \eta_c}{\Delta h}, \quad \dot{m}_f = \frac{(\dot{m}_s - \dot{m}_{s,c})\Delta h}{NCV_f \eta_f}$$

Variables

$\dot{m}_s$	Steam demand	kg/s
p	Steam pressure (absolute)	Pa
T_s	Steam temperature	K
T_{fw}	Feedwater temperature	K
$\dot{m}_c$	Concentrate fired	kg/s
NCV_c	Concentrate NCV (as fired)	J/kg
η_c	Efficiency on concentrate (net)	-
NCV_f	Support fuel NCV	J/kg
η_f	Efficiency on support fuel (net)	-
Δh	Heat per kg of steam	J/kg
$\dot{m}_{s,c}$	Steam from concentrate	kg/s

$\dot{m}_f$	Support fuel	kg/s
s_c	Concentrate share of heat input	-

Method and standards

Energy balance.

Assumptions and limits

- Steady firing.
- Feedwater must be liquid at the steam pressure (below its saturation temperature).

References

• Energy balance with IAPWS-IF97 steam and feedwater enthalpies; concentrate NCV from analysis (see slop-concentrate-net-value)

Report details

Report reference	FCC-ASH9-DCTX (the same inputs always give the same reference)
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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/spent-wash-zld/slop-fired-boiler-support-fuel

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.