Fuel and Water Saving from Reduced Blowdown

Heat, fuel and water saved by lowering the boiler blowdown rate through better water treatment or automatic TDS control, per hour and per year.

Method: IAPWS R7-97(2012) IF97; first law heat balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam generated	10,000	kg/h
Blowdown now, as a share of steam	8.0000	%
Blowdown after, as a share of steam	4.0000	%
Drum pressure (absolute)	10.500	bar
Feedwater temperature	105.00	°C
Boiler efficiency (on GCV)	78.000	%
Gross calorific value of the fuel, as fired	18,600	kJ/kg
Operating hours per year	8,000.0	h

Calculated results

Parameter	Value	Unit
Fuel saved	9.1316	kg/h
Fuel saved per year	73.053	t
Treated water saved per year	3,200.0	t
Heat no longer blown down	36.801	kW
Heat per kg of blowdown above feedwater	331.20	kJ/kg

Notes for this case

- Gross saving with no blowdown heat recovery; if a flash vessel and cooler already recover blowdown heat, the real saving is smaller. Blowdown is a share of steam: a share of feedwater b_fw converts as b = b_fw / (1 − b_fw).

Formula and method

$$\Delta \dot{Q} = S\,(b_1 - b_2)\,(h_f - h_{fw}) \qquad \Delta \dot{m}_f = \frac{\Delta \dot{Q}}{\eta_1\, GCV}$$

$$\Delta m_f = \Delta \dot{m}_f\, t_{op} \qquad \Delta m_w = S\,(b_1 - b_2)\, t_{op}$$

Variables

S	steam generated	kg/s
b_1	blowdown now, share of steam	–
b_2	blowdown after, share of steam	–
p	drum pressure, absolute	Pa
T_{fw}	feedwater temperature	K
η_1	boiler efficiency on GCV	–
GCV	gross calorific value	J/kg
t_{op}	operating hours per year	s
$\Delta \dot{m}_f$	fuel saved	kg/s
Δm_f	fuel saved per year	kg

Δm_w	water saved per year	kg
$\Delta \dot{Q}$	heat no longer blown down	W
$h_f - h_{fw}$	heat per kg of blowdown above feedwater	J/kg
h_f	saturated water enthalpy at drum pressure	J/kg
h_{fw}	feedwater enthalpy	J/kg

Method and standards

Blowdown leaves the drum as saturated water; each kg was heated from the feedwater temperature. Enthalpies by FireCAD's IAPWS-IF97; fuel from the boiler efficiency on GCV.

Assumptions and limits

- No blowdown heat recovery; same steam output and efficiency.
- Water saved counted as treated make-up water; the treatment chemicals saved are in proportion but not calculated.
- Blowdown is a share of steam. If yours is quoted as a share of feedwater b_{fw}, convert with $b = b_{fw}/(1 - b_{fw})$.
- With existing blowdown heat recovery the saving is smaller than shown; a note on the result says so.

References

- IAPWS R7-97(2012) IF97
- first law heat balance

Report details

Report reference	FCC-38W8-JNCB (the same inputs always give the same reference)
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Release checks	3 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/boilers-power-plant/boilers/blowdown-fuel-saving

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.