Evaporator Chemical Cleaning: Caustic and Acid

Caustic soda and hydrochloric acid for boiling out an evaporator vessel at chosen strengths, as commercial products, with the inhibitor (after Hugot ch. 32).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Solution volume in the vessel	20.000	m³
Solution density	1,050.0	kg/m³
Caustic strength (NaOH) Hugot: 2–5 % (Java); 4 % (USA); stronger in some countries.	5.0000	%
NaOH in the commercial soda	98.000	%
Acid strength (HCl) Hugot: start at about 2.5 %, never above 2 % in long contact; 1–2 % usual.	2.0000	%
HCl in the commercial acid	30.000	%
Commercial acid density	1,150.0	kg/m³
Inhibitor per 100 kg HCl Hugot: 6 L of formalin per 100 kg HCl.	6.0000	L

Calculated results

Parameter	Value	Unit
NaOH (100 %)	1,050.0	kg
Commercial soda	1,071.4	kg
HCl (100 %)	420.00	kg
Commercial acid	1,217.4	L
Inhibitor	25.200	L

Notes for this case

- Hugot: soda boil 3–4 h, rinse, then acid about 1 h with inhibitor; soda can be reused about a dozen times.

Formula and method

$$m_{NaOH} = V\rho w_c, \quad m_s = \frac{m_{NaOH}}{p_c}, \quad m_{HCl} = V\rho w_a, \quad V_a = \frac{m_{HCl}}{p_a \rho_a}, \quad V_i = \frac{m_{HCl}}{100} i$$

Variables

V	Solution volume in the vessel	m³
ρ	Solution density	kg/m³
w_c	Caustic strength (NaOH)	-
p_c	NaOH in the commercial soda	-
w_a	Acid strength (HCl)	-
p_a	HCl in the commercial acid	-
ρ_a	Commercial acid density	kg/m³
i	Inhibitor per 100 kg HCl	m³
m_{NaOH}	NaOH (100 %)	kg
m_s	Commercial soda	kg
m_{HCl}	HCl (100 %)	kg

V_a	Commercial acid	m³
V_i	Inhibitor	m³

Method and standards

Solution make-up.

Assumptions and limits

- Batch made up to volume.
- One solution density is used for both the caustic and the acid solution; the commercial acid density is entered separately and should match its strength (about 1150 kg/m³ for 30 % HCl).
- A note appears for acid above 2 %.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 32
• chemical cleaning
• pp. 546–550

Report details

Report reference	FCC-4XD9-4SZJ (the same inputs always give the same reference)
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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/evaporation/evaporator-chemical-cleaning

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Reopens the calculator with the inputs of this report.