Boiling-Point Elevation of Juice and Syrup

Boiling-point elevation of juice or syrup from brix and pressure (Hugot, with vacuum correction), the high-purity rule 2B/(100 − B) and the boiling temperature.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Brix	65.000	%
Absolute pressure over the liquid	16.000	kPa

Calculated results

Parameter	Value	Unit
Vacuum below the 76 cmHg standard barometer	639.99	mmHg
Boiling-point elevation (Hugot)	3.1617	K
High-purity rule 2B/(100 − B)	3.7143	K
Water saturation temperature at p	55.314	°C
Boiling temperature of the juice	58.476	°C

Notes for this case

- Hugot's formula is for pure sucrose solutions; impurities raise the elevation a little. Add the hydrostatic rise for the temperature in the tubes.

Formula and method

$$e = 0.025\,\frac{B(30+B)}{103.6-B}\left(1-\frac{0.54h}{229-h}\right), \quad e_2 = \frac{2B}{100-B}\ [^\circ C;\ B\ \%;\ h\ \text{cmHg vacuum}]$$

$$T_b = T_s(p) + e$$

Variables

B	Brix	-
p	Absolute pressure over the liquid	Pa
h	Vacuum below the 76 cmHg (101.325 kPa) standard barometer	Pa
e	Boiling-point elevation (Hugot)	K
e_2	High-purity rule 2B/(100 − B)	K
T_s	Water saturation temperature at p	K
T_b	Boiling temperature of the juice	K

Method and standards

Hugot's empirical formulae (Handbook of Cane Sugar Engineering, 3rd ed.): the high-purity rule e_2 = 2B/(100 − B) on p. 497 and the formula with the vacuum correction on pp. 497–499, where h is the vacuum in cmHg. Hugot does not name the barometer; his Table 32.2 is at 760 mm and the Othmer–Silvis chart (Fig. 32.1) puts 0 cm vacuum at 100 °C, so the vacuum is taken from the 76 cmHg standard barometer. Water saturation temperature from IAPWS-IF97.

Assumptions and limits

- Pure sucrose basis; brix up to about 90. Impurities raise the elevation, so for low-purity syrups and molasses it is underestimated.
- In the formula h is the vacuum in cmHg (1 cmHg = 1333.224 Pa) below 76 cmHg, whatever the local barometer; enter the absolute pressure over the liquid.

References

- Hugot
- Handbook of Cane Sugar Engineering

- 3rd ed. (Elsevier, 1986)
- ch. 32
- boiling-point elevation: high-purity rule p. 497
- vacuum formula pp. 497–499 (unnumbered)
- Water saturation temperature from IAPWS-IF97

Report details

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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/sugar-ethanol/evaporation/juice-boiling-point-elevation

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Reopens the calculator with the inputs of this report.