

ANNEX: Dew point temperature for acid gases

Sulfuric acid (H_2SO_4) dew point ^{[1] [2]}:

$$(EQ 1) \quad 1000/T = 1.7842 - 0.0269 \cdot \log_{10}(P_{H_2O}) - 0.1029 \cdot \log_{10}(P_{SO_3}) + 0.0329 \cdot \log_{10}(P_{H_2O}) \cdot \log_{10}(P_{SO_3})$$

or this equivalent form ^{[3] [4]}:

$$(EQ 2) \quad 1000/T = 2.276 - 0.02943 \cdot \ln(P_{H_2O}) - 0.0858 \cdot \ln(P_{SO_3}) + 0.0062 \cdot \ln(P_{H_2O}) \cdot \ln(P_{SO_3})$$

Sulfurous acid (H_2SO_3) dew point ^{[5] [6]}:

$$(EQ 3) \quad 1000/T = 3.9526 - 0.1863 \cdot \ln(P_{H_2O}) + 0.000867 \cdot \ln(P_{SO_2}) + 0.000913 \cdot \ln(P_{H_2O}) \cdot \ln(P_{SO_2})$$

Hydrochloric acid (HCl) dew point ^{[7] [8]}:

$$(EQ 4) \quad 1000/T = 3.7368 - 0.1591 \cdot \ln(P_{H_2O}) - 0.0326 \cdot \ln(P_{HCl}) + 0.00269 \cdot \ln(P_{H_2O}) \cdot \ln(P_{HCl})$$

Nitric acid (HNO_3) dew point ^[9]:

$$(EQ 5) \quad 1000/T = 3.6614 - 0.1446 \cdot \ln(P_{H_2O}) - 0.0827 \cdot \ln(P_{HNO_3}) + 0.00756 \cdot \ln(P_{H_2O}) \cdot \ln(P_{HNO_3})$$

where:

T = The acid dew point temperature for the indicated acid, in kelvins

P = Partial pressure, in atmospheres for equation 1 and in mmHg for equations 2, 3, 4 and 5

REFERENCES:

1. F.H. Verhoff and J.T. Banchero (1974), "Predicting Dew Points of Gases", Chemical Engineering Progress, Vol. 78, Issue 8, pp. 71 - 72
2. R.R. Pierce (1977), "Estimating Acid Dewpoints in Stack Gases", Chemical Engineering, Vol. 84, Issue 8, pp. 125 - 128
3. Same as References 2 and 4.
4. V. Ganapathy (1993), Steam Plant Calculations Manual, 2nd Edition, CRC Press, ISBN 0-8247-9147-9. See Table 2.9 on page 94. Available online here in Google Books.
5. Same as References 2 and 8.
6. Yen Hsiung Kiang (1981), "Predicting Dewpoints of Gases", Chemical Engineering Vol. 88, Issue 3, p. 127
7. Same as References 2 and 8.
8. Yen Hsiung Kiang (1981), "Predicting Dewpoints of Gases", Chemical Engineering Vol. 88, Issue 3, p. 127
9. Same as References 8 and 12.