Erratum

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Viscosities of Carrier Gases at Gas Chromatograph Temperatures and Pressures

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Due to an error in printing the equations for helium and argon in the above article were given incorrectly. Please find the corrected equations below:

Helium

The definitive algorithm is that of Kestin et al. [4]. It is horrendously esoteric, but can be rigorously translated to the following for temperatures above 104 K (– 169 °C):

$$a = -0.126516$$
$$b = -1.230553$$
$$c = +2.171442$$
$$T^* = T/10.40$$
$$\alpha = 13.65299 - \ell n\, T^*$$

$$\Omega = 0.00635209\, \alpha^2 \left\{ 1.04 + \frac{a}{(\ell n\, T^*)^2} + \frac{b}{(\ell n\, T^*)^3} + \frac{c}{(\ell n\, T^*)^4} \right\}$$

$$E = 1 + \frac{1}{4\Omega} \left\{ \frac{-2\Omega}{\alpha} + 0.00635209\, \alpha^2 \left(\frac{-2a}{(\ell n\, T^*)^3} - \frac{3b}{(\ell n\, T^*)^4} - \frac{4c}{(\ell n\, T^*)^5} \right) \right\}$$

$$f = 1 + \frac{3}{196}\, (8\,E - 7)^2$$

$$\eta\, (\mu\, Pa.s) = 0.7840374\, T^{1/2}\, f/\Omega$$

This algorithm predicts the best experimental viscosities in the GC temperature range with a maximum deviation of about 0.5 % for any one value. However, the deviation plot from the data the authors classify as "primary data" seems to show systematic deviation, rather than random scatter. Over the range 300 – 700 K (25 – 425 °C) this is corrected by multiplying the calculated value thus

"best" value = algorithmic value {0.995 + (T – 300) 2.5 × 10⁻⁵}.

The "best" value reproduces the best experimental data within 0.1 %.

Argon

The data were again calculated from the algorithm of Kestin et al. [4], which is rigorously translated to the following for temperatures between 170 K and 1450 K (– 103 °C to 1177 °C).

$$T^* = T/141.5$$

$$\Omega = \exp\left[0.46641 - 0.56991\, \ell n\, T^* + 0.19591\, (\ell n\, T^*)^2 - 0.03879\, (\ell n\, T^*)^3 + 0.00259\, (\ell n\, T^*)^4 \right]$$

$$E = 0.8575225 + 0.097955\, \ell n\, T^* - 0.0290925\, (\ell n\, T^*)^2 + 0.00259\, (\ell n\, T^*)^3$$

$$f = 1 + \frac{3}{196}\, (8\,E - 7)^2$$

$$\eta\, (\mu\, Pa.s) = 1.5035\, T^{1/2}\, f/\Omega$$

As with helium, there is systematic deviation of the best or "primary" data from the results of this algorithm. This is worst at ~ 300 K (~ 25 °C) where the calculated result is higher by 0.3 % than the consistent values from five primary publications, but 0.1 % lower at ~ 375 K (~ 100 °C) and is within 0.1 % at higher temperatures up to ~ 700 K (~ 425 °C). It is more awkward to allow for this because correction is needed only at temperatures below 100 °C. It is also more uncertain because there is no "primary" data between 25 °C and 100 °C and the less reliable "secondary" data quoted by Kestin et al. do not suggest a trend. As the best estimate of the corrections I suggest:

"best" value (T < 375 K) =
algorithmic value × [0.997 + (T – 300) 4 × 10⁻⁵].
"best" value (T > 375 K) = algorithmic value