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Erratum to "Valid Geometric Solutions for Indentations with Algebraic Calculations", [Advances in Pure Mathematics, Vol. 10 (2020) 322-336]

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The original online version of this article (Gerd Kaupp 2020) Valid Geometric Solutions for Indentations with Algebraic Calculations, (Volume, 10, 322-336, https://doi.org/10.4236/apm.2020.105019) needs some further amendments and clarification.

The Deduction Details for the Spherical Indentations Equation

The incorrect proportionalities (16) and (17) in the published main-text are useless and we apologize for their being printed. They were not part of the deduction of the Equation (18_v). The deduction of (18_v) follows the one for the pyramidal or conical indentations (4) through (8). The only difference is a dimensionless correction factor $\pi(R/h-1/3)$ that must be applied to every data pair due to the calotte volume. The detailed deduction of (18_v) = (6S), is therefore supplemented here.

Upon normal force (F_N) application the spherical indentation couples the volume formation (V) with pressure formation to the surrounding material + pressure loss by plasticizing (p_{total}). One writes therefore Equation (1S) (with $m + n = 1$)

$$F_N = F_{Nv}^m F_{Nptotal}^n \tag{1S}$$

There can be no doubt that the total pressure depends on the inserted calotte volume that is $V = h^2\pi(R-h/3)$. It is multiplied on the right-hand side with $1 = h/h$ to obtain (2S). We thus obtain (3S) and (4S) with $n = 1/3$.

$$V = h^3\pi(R/h-1/3) \tag{2S}$$

$$F_{\mathrm{N}p\mathrm{total}} \propto h^3 \tag{3S}$$

$$F_{\mathrm{N}p\mathrm{total}}^{1/3} \propto h_{p\,\mathrm{total}} \tag{4S}$$

(4S) with pseudo depth "$h_{p\mathrm{total}}$" is lost for the volume formation. It remains (5S) with $m = 2/3$ on $F_{\mathrm{N}v}$ or the exponent 3/2 on h_v.

$$F_{\mathrm{N}v}^{2/3} \propto h_v \quad \text{or} \quad F_{\mathrm{N}v} \propto h_v^{3/2} \tag{5S}$$

The proportionality (5S) must now result in an equation by multiplication with the dimensionless correction factor $\pi(R/h - 1/3)$ and with a materials' factor k_v (mN/µm$^{3/2}$) to obtain Equation (6S) that is Equation (18) in the main paper.

$$F_{\mathrm{N}v} = k_v h^{3/2} \pi(R/h - 1/3) \tag{6S}$$

For plotting of (6S) for obtaining k_v the $\pi(R/h - 1/3)$ factor is separately multiplied with $h^{3/2}$ for every data pair.

An additive term F_a can be necessary for the axis cut correction if not zero due to initial surface effects of the material.