Bakelite resistivity

The Temperature correction saga

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The story never changes...

✓Since the beginning of the HPL story (about 1999) the resistivity correction for temperature has been a 'leitmotiv' and from time to time someone raises again this subject...

✓ Since in these days (12 years later) the same argument has been raised ...here again the same answer:

→Correction for the temperature in CMS is/was

$$\rho_{20} = \rho_T \times e^{\alpha(T-20)}$$

$$\alpha = 0.128\,°C^{-1}$$

→ Correction for temperature in ATLAS is/was

$$\rho_{20} = \rho_T \times 4.4^{\frac{(T-20)}{12}}$$

→Correction for temperature in Puricelli is

$$\rho_{20} = \rho_T \times 4.4^{\frac{(T-20)}{12}}$$

$$\rho_{20} = \rho_T \times e^{\alpha(T-20)}$$

$$\alpha = 0.128\,°\mathrm{C}^{-1}$$

CMS

Q: Where does this value come from ?

A: from our measurements

But....since the neighbour's courtyard is always nicer than ours...

As discussed in Section 2.2 the temperature dependence of the RPC resistance should be the same as for bakelite bulk resistivity. i.e. it should have the form:

$$R \approx R_{20} \exp[\alpha(\theta_{20} - \theta)]$$

where θ is the temperature in °C and $\theta_{20} = 20°C$. Measuring directly the bulk resistivity on three different bakelite samples we obtained $\alpha = 0.12 \pm 0.01$.

In Fig. 8, the measurements of the resistance of RPC A and B are shown as a function of the temperature. An exponential fit of these data gives a temperature coefficient $\langle\alpha\rangle = 0.126 \pm 0.008$ in nice agreement with that of the bakelite itself, thus confirming our interpretation of temperature effects.

The neighbour's courtyard

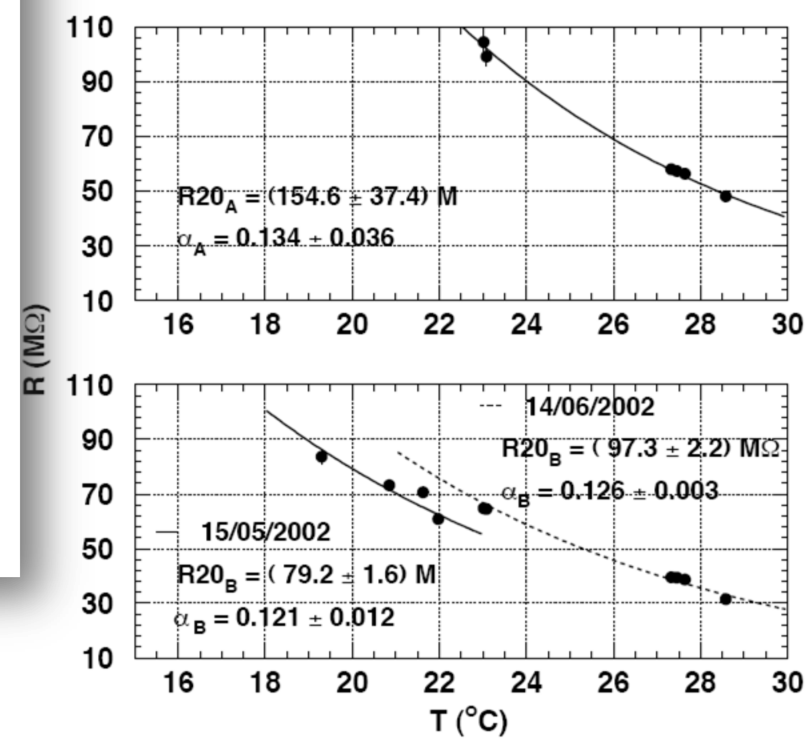
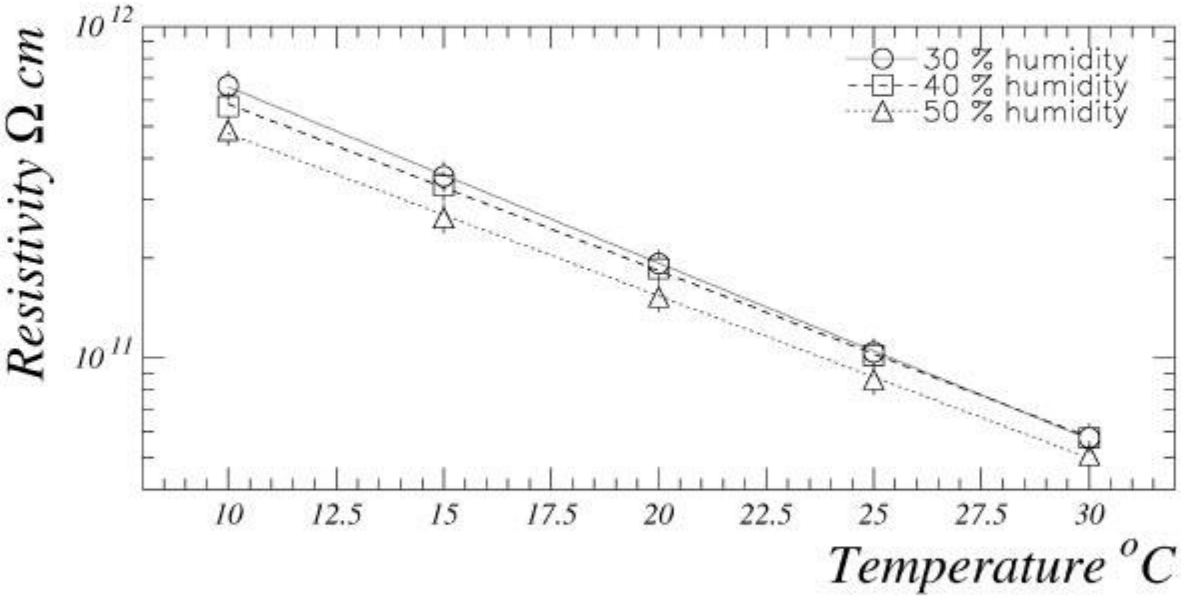
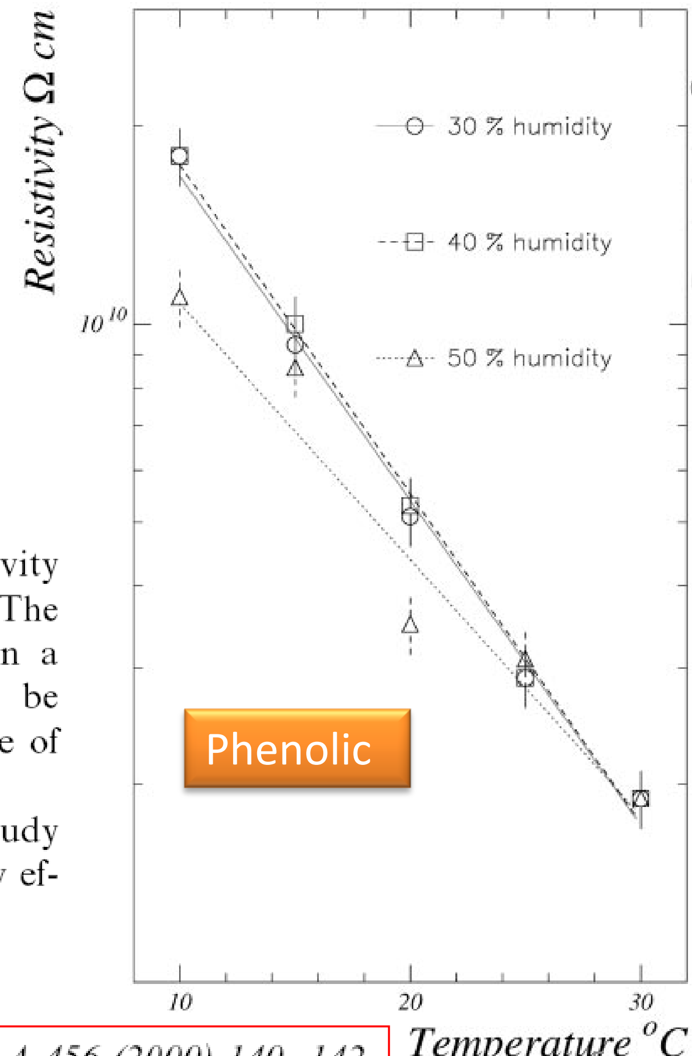


Fig. 8. Resistances of RPC A and B plotted versus temperature. The temperature coefficient α is fitted using the exponential dependence discussed in the text.

Melaminic bakelite by metal deposition technique



Metal deposition technique



1) According to us It is exponential....
2) A factor 10 within a 20 °C interval is about 0.115

Finally there is an evident dependence of resistivity on temperature in the investigated interval. The resistivity decreases by a factor of 10 within a 20°C interval. Long conditioning times will be necessary to properly understand the influence of the humidity.

Among the future experiments, we plan to study the effect of linseed oil and resistivity memory effects after heating at more than 60°C.

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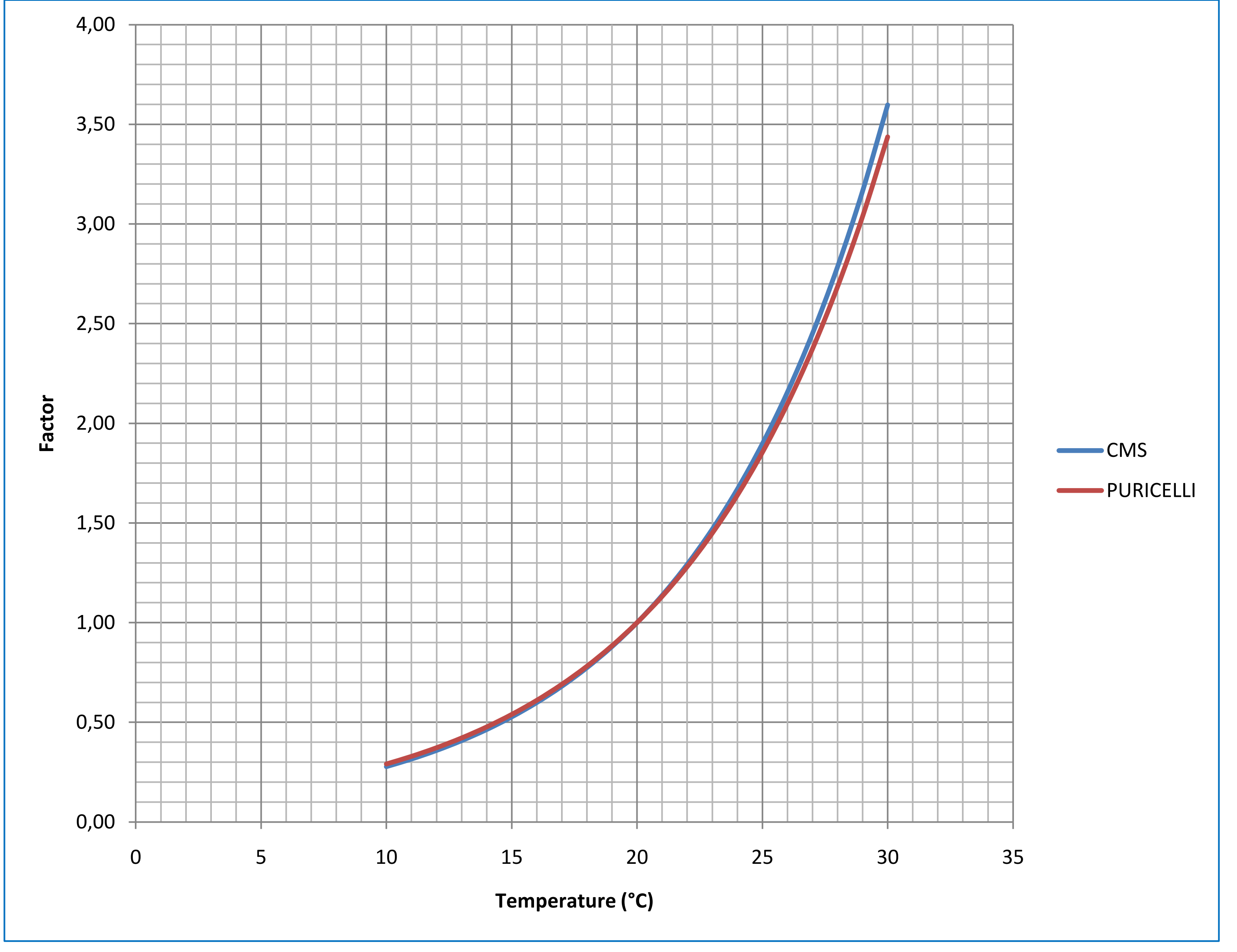
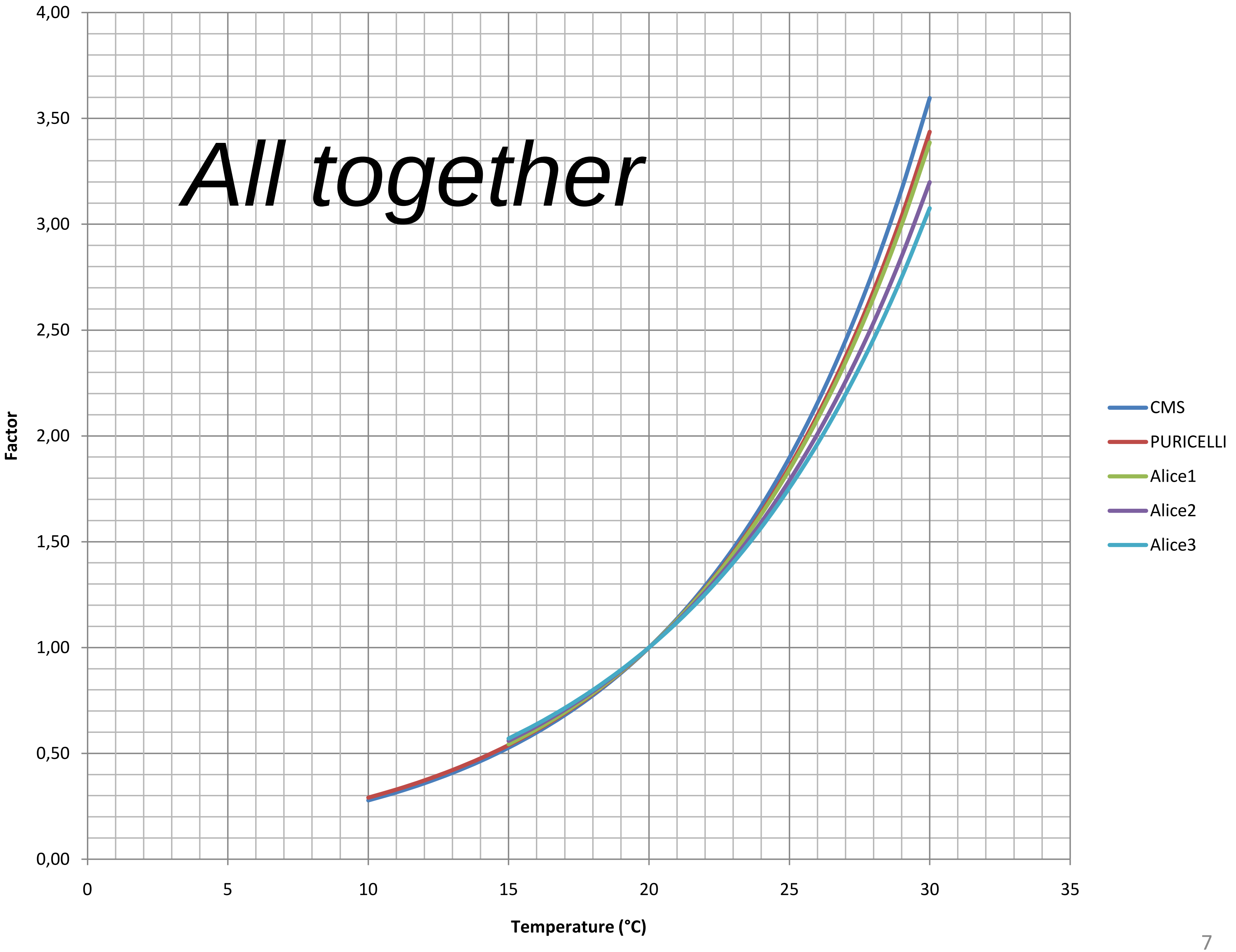
T	CMS	PURICELLI	1-Pur/CMS
10	0.28	0.29	-5%
11	0.32	0.33	-4%
12	0.36	0.37	-4%
13	0.41	0.42	-3%
14	0.46	0.48	-3%
15	0.53	0.54	-2%
16	0.60	0.61	-2%
17	0.68	0.69	-1%
18	0.77	0.78	-1%
19	0.88	0.88	0%
20	1.00	1.00	0%
21	1.14	1.13	0%
22	1.29	1.28	1%
23	1.47	1.45	1%
24	1.67	1.64	2%
25	1.90	1.85	2%
26	2.16	2.10	3%
27	2.45	2.37	3%
28	2.78	2.69	4%
29	3.16	3.04	4%
30	3.60	3.44	4%



Correction factor: CMS vs PURICELLI

All together



CONCLUSION

$$\rho_{20} = \rho_T \times 4.4^{\frac{(T-20)}{12}}$$

Puricelli/Atlas

Q: Where does this equation come from ?