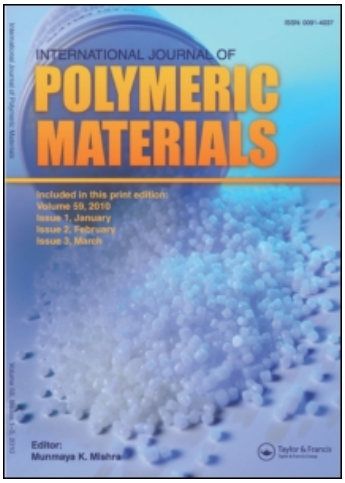

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Moduli of Composites in Dry and Swollen States

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Letter to the Editor

Moduli of Composites in Dry and Swollen States

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Sir—With reference to a recent paper by Ilavský *et al.*,[1] it seems possible to suggest a different interpretation of the dependence of the modulus on filler content for the data obtained in the swollen state. More precisely, in Eq. (1) moduli relative to 2-hydroxyethyl methacrylate networks filled with SiO_2 obtained in the rubber-like region were correlated with two different equations for the dry and the swollen state respectively. The decrease in the activity of the filler in the swollen state was explained as reflecting the weaker polymer-filler interaction with respect to that between polymer and water.

However, it is indeed possible to correlate the swollen data by means of the same equation used for the dry ones. To this end, we define the filler content in a way different from the one previously used. In Eq. (1), the filler content V_f did not account for the amount of water contained by the swollen composites, while a more appropriate definition could be:

$$V_f' = \frac{\text{filler volume}}{\text{filler volume} + \text{polymer volume} + \text{water volume}} \tag{1}$$

Of course, in the dry state V_f' and V_f coincide, while in the swollen state V_f' can be calculated from the known values of V_f and V_{2P} according to:

$$V_f' = \frac{V_f}{1 + (1 - V_f)\,[(1 - V_{2P})/V_{2P}]} \tag{2}$$

where V_{2P} is the degree of swelling of the pure polymer in a filled system as defined in Eq.(1).

In Table I, all data relative to swollen samples obtained in Eq. (1) are reported together with the corresponding values of V_f' calculated from Eq. (2). In

TABLE I

Characteristics of swollen poly(2-hydroxyethyl methacrylate) gels containing SiO_2

Sample	V_{2P}	V_f	V_f'	$(G_0/G_0^0$
1	0.527	0	0	1
2	0.526	0.033	0.0176	1.075
3	0.525	0.065	0.0353	1.20
4	0.526	0.093	0.0511	1.48
5	0.528	0.119	0.0665	1.62
6	0.529	0.130	0.0733	2.11
7	0.535	0.170	0.0988	3.26
8	0.536	0.194	0.1143	3.81

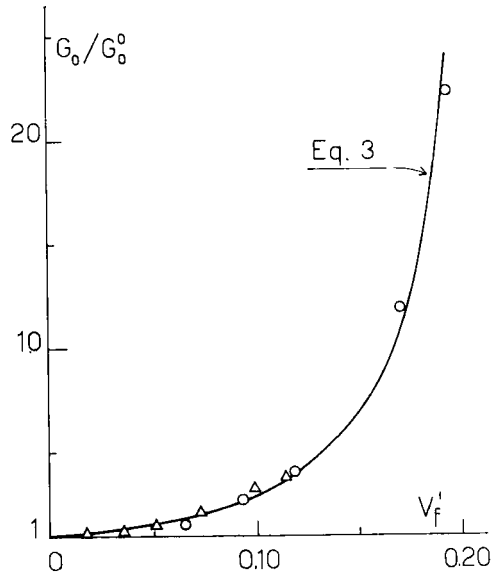

FIGURE 1 Relative moduli G_0/G_0^0 vs. volume factions of filler V_f'. ○ in the dry state, T = 180°C; △ in a state swollen in water to equilibrium, $T = 25$°C.

Figure 1, the relative moduli G_0/G_0^0 are plotted vs. V_f'. Both dry and swollen data are correlated by the Eilers equation[2] with $a = 4.26$ and $b = 4.05$:

$$\frac{G_0}{G_0^0} = \left(1 + \frac{aV_f'}{1 - bV_f'}\right) \tag{3}$$

This result shows that no decrease of filler activity must be invoked and thus that the interaction between polymer and filler is actually stronger than between water and filler. On the other side, this conclusion is indeed confirmed by

other results which are reported in Ref. 1 We refer to the observation that V_{2P} was found not to depend on filler content which indicates that no water is absorbed on the filler surface. That such absorbed water, if present, would contribute significantly to V_{2P} is shown by the calculations also reported in Ref. 1.

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