Table 2. Parameters used for calculating toughness of various elastomers and gels.

	***cis*-polyisoprene**	**PDMS**	**Polyacrylamide**	**Poly(*N*-vinyl pyrrolidone)**
Backbone bond energy (kJ/mol)	346[i]	367[i]	360[ii]	360
Backbone bond length (nm)	0.115[i]	0.143[i]	0.154[iii]	0.15
Dry polymer density (kg/m^3)	920[i]	970[i]	1440[iv]	1160[v]
Strand unit molecular weight (kg/mol)	0.017	0.037	0.035	0.056
Backbone units per rigid link (z)	1.74[vi]	6.25[vi]	3.32[vii]	4.87[vii]

[i]Gent and Tobias1982; [ii]Webber et al. 2007; [iii]Orwoll and Chong 1999; [iv]Munk et al. 1980; [v]Guner and Kara 1998; [vi]Treloar 1958; [vii]Xin et al. 2013.

The correlation between the fracture toughness of dry and solvent-swollen networks, respectively $G_{c,o}$ and G_c, are obtained by combining the above equations:

$$G_c = G_{c,o}\left(\frac{1}{q}\right)^{2/3}\left(\frac{1}{q_o}\right)^{1/3} \qquad 43$$

From this expression it is seen that the fracture energy for a given elastomer decreases with increasing swelling and this behaviour has been confirmed experimentally (Gent and Tobias 1982). The situation is more complex, however, for gels made with different crosslink densities. As illustrated in Fig. 8, the toughness can either increase or decrease with strand length, depending on the synthesis conditions. As illustrated in two separate studies on polyacrylamide hydrogels (Zhang et al. 2005; Tanaka et al. 2000), the toughness increases with increasing strand length when a series of gels were prepared at the same monomer concentration but with decreasing ratio of crosslinker to monomer (Tanaka et al. 2000). In contrast, a decrease in toughness with increasing strand length occurred in gels made with the same crosslinker to monomer

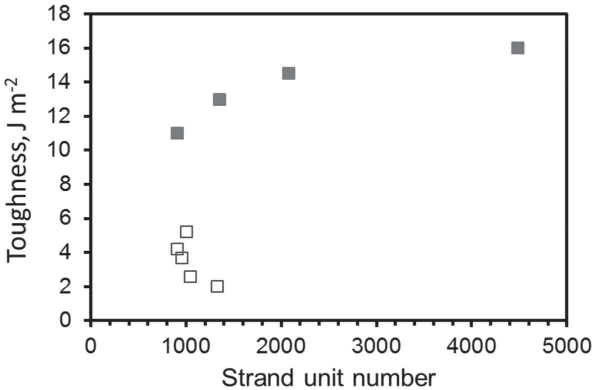

Fig. 8. Calculated strand lengths and measured toughness as for experimental data for polyacrylamide hydrogels reported by Tanaka filled squares and Zhang unfilled squares.