Unique Tetra-Acrylate Silicone Resins for Cross-Linking in UV Cured Systems

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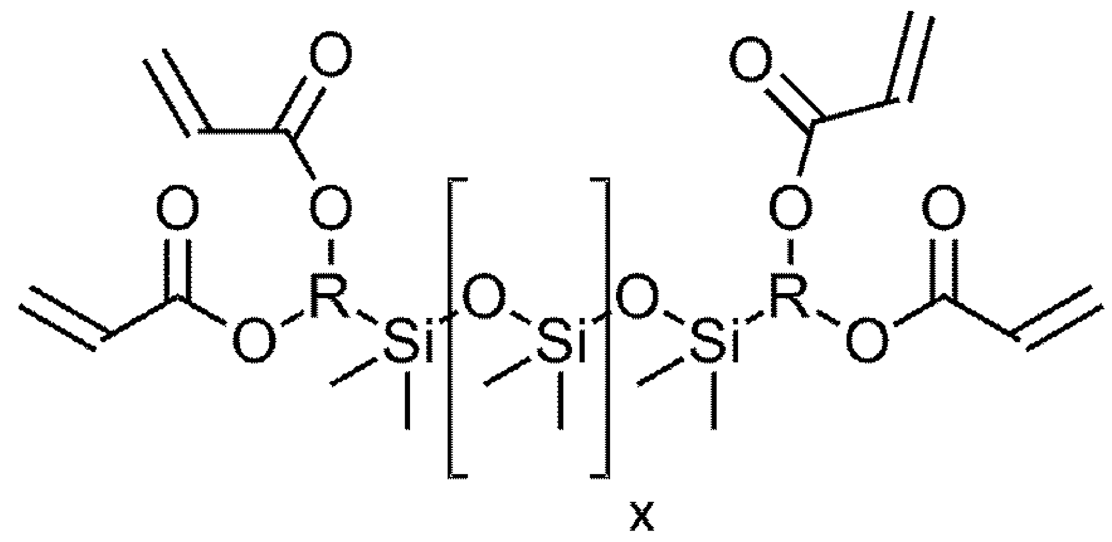
Purpose: Tetra-functional cross-linking polymers tend to give more hardness and toughness, better release and more slip than less functional polymers. However, standard silicones are polydisperse and made with a kinetic process so that a tetra-functional silicone is a broad distribution centered around four. These new materials have four reactive groups on each polymer and will therefore give cleaner, more predictable reactions.

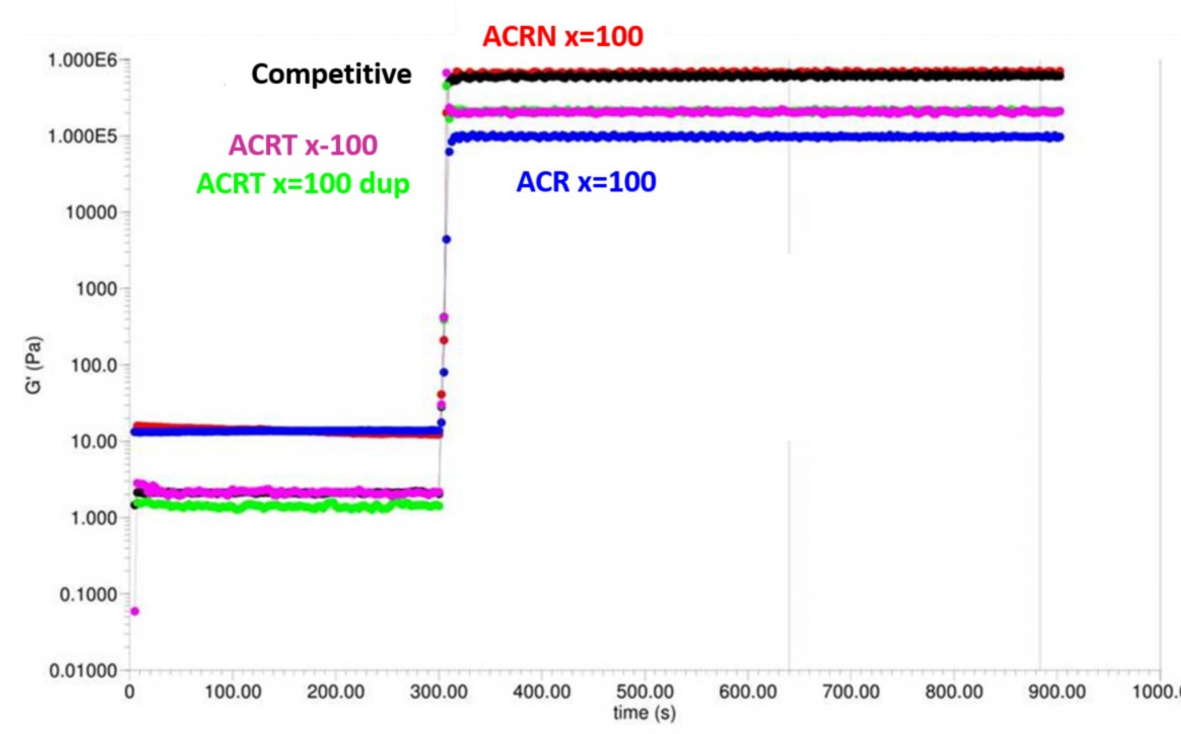


Experimental: Two products labeled ACRN and ACRT (with differing R groups) were evalauted against standard Silmer ACR type products and a commercial competitive product. The experiments were conducted in a TA Instruments AR-G2 SN 10G4421 Rheometer with a UV reactive chamber. The rheological properties including G', G'', tan (δ) and cure rate are analyzed and obtained by the TA Rheology Advantage software. 1 mil drawdowns on Aluminum Q panels were cured with a ND362 UV light under Nitrogen purging. The tape release was measured using Tesa 7475 tapes and the ChemInstruments Coefficient of Friction instrument.

Results: The x=100 polymers are cured as homopolymers with 5% Irgacure 1173. The tetra-functional ACRN and ACRT materials gave higher modulii and faster cure rates than the di-functional traditional ACR type. The ACRN (x=100) is very similar to the commerical competitive material.

Property	ACR	ACRN	ACRT	Competitive
G' (Pa)	9.66E+04	6.79E+05	2.08E+05	6.14E+05
G'' (Pa)	1.08E+03	2.74E+04	1.12E+03	1.07E+04
tan(delta)	0.011278	0.040847	0.005494	0.017504
Cure Rate (Pa/Sec)	5.85E+03	4.08E+04	1.61E+04	2.74E+04

To the right, we look at results directly from the Rheometer across the three chemistries keeping x=100. The dark blue data is the traditional product, which is softer than the ACRT in purple and duplicated in green. The ACRN (red) and competitive product (black) are very similar.



In a more formulated example below, the impact of changing x is examined using the ACRN chemistry. One sees that x=25 is the strongest whereas higher values of x (increased MW) provide more tape release. Release is maximized at x=100, perhaps due to the increased softness of the x=400 cured material. The traditional ACR type (tri-functional) is out performed in both categories. The competitive material is similar to x=50, albeit not quite as strong.

	x=25	x=50	x=100	x=400	ACR tri-functional	Competitive
G' (Pa)	4.80E+06	1.68E+06	7.36E+05	1.60E+05	6.41E+05	4.48E+05
G'' (Pa)	2.67E+05	1.09E+05	2.68E+04	4.58E+03	1.43E+04	5.66E+03
Tan delta	0.056	0.0636	0.0365	0.0289	0.0224	0.0127
Release (mN/mm)	0.936	0.78	0.702	0.78	0.858	0.78

Conclusions: The new structures with their precise control of functionality, offer superior toughness and release over the traditional silicone polymers. The performance is benchmarked against a competitive standard where it shows similar behavior, although perhaps tougher for comparable release.

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