

Polysulfone Residual Stress Testing

The purpose of this testing was to determine the amount of residual stress in the polysulfone tubes used for water filtration. After the parts are extruded, they need to undergo a finishing procedure by drilling holes throughout the tubing. The end goal was to produce parts with <600 psi residual stress to meet the customer's requirements.

Initially, attempts to obtain lower residual stress were made by altering the extrusion process, but this was only successful in achieving levels around 1700psi while not significantly impacting production output. Next, trials were conducted to reduce the residual stress that remained after the extrusion process by oven annealing. The stress test was recommended by the material supplier, which consisted of immersing the ends of the tubes for one minute in varying mixtures of ethanol and ethyl acetate. The parts were then inspected for any cracking or crazing. The table below was used as a reference for stress levels (provided by material supplier).

Reagents for Residual Stress Test

Mixture	Mixture Composition		Critical Stress, psi (MPa)
	% by volume Ethanol	% by volume Ethyl Acetate	
1	75	25	2,800 (19)
2	50	50	2,200 (15)
3	43	57	1,700 (12)
4	37	63	1,300 (9)
5	25	75	800 (6)

If cracking and crazing were not observed in a particular mixture, it was known that the residual stress was less than the referenced stress level of that mixture. Initially, trials were conducted in lab scale ovens in order to understand the size and capability needed for a commercial oven when in normal production.



Several trials were conducted at different temperatures and it was found that a heating program from ambient temperature up to 330°F over several hours, and a gradual cool down produced parts with residual stress levels below the required 600 psi.



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