Optimization of Polymer Separation by Gradient Polymer Elution Chromatography

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High Performance Liquid Chromatography (HPLC) has been a versatile separation method for polymers for many years. Analysis of different polymers by HPLC is typically done by utilizing the differential solubility of the polymers by mixing a good solvent and an anti-solvent in various compositions. This method is called Gradient Polymer Elution Chromatography (GPEC). While GPEC has been used extensively, it commonly uses a linear gradient to separate components. Linear solvent gradients consume a lot of solvent and take a relatively long time (> 30 minutes) to complete. The goal of this study is to develop a step gradient from a linear gradient in order to allow quick separation while retaining high resolution of the individual polymers. In this study, 6 different polymers are dissolved separately in a strong solvent. The polymers are then analyzed using a linear gradient. Using the results from the linear gradient, a step gradient is constructed and a known mixture of the pure polymers is analyzed to determine the effectiveness of the step gradient. Two strong solvents and four anti-solvents were used to test the generality of the results. It was found that the step gradient could achieve the same resolution of polymers as the linear gradient, but with as little as half the solvent in some cases. This analytical method of changing a linear gradient into a step gradient can reduce both analysis time and solvent requirement to achieve the desired separation of polymers.