Novel "All Acrylic" Block Copolymers: Morphology, Mechanical Properties And Application As Adhesives

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Nowadays, waterborne Pressure Sensitive Adhesives hold an important share of the market. However, problems such as moisture sensitivity, high processing energy and most importantly, insufficient adhesive performance (loss of dimensional stability, poor resistance to shock, gasoline, …) for many applications (automotive industry, sign and marking, …) are major shortcomings.

Yet, adhesive manufacturers who want to retain the high-performance properties of solvents in alternative formulations that do not emit VOCs can turn to the solvent-free Hot-Melt (HM) technology. Hot-Melts are mostly based on formulated triblock thermoplastic elastomers (TPE). Typically, these TPE, in which all three segments are hydrocarbon in nature (e.g. styrene-isoprene(butadiene)-styrene), are systems obtained by living anionic polymerization.
The highly stringent conditions required for such syntheses affect and limit the range of monomers and functionality that can be utilized. Moreover, those systems usually suffer from the poor oxidation stability of the unsaturated mid-block and to their limited upper service temperature.

Attempts to use polyacrylates in HM systems proved to be inadequate as they do not build up as much cohesive strength as conventional hot-melts on cooling. An elegant way to circumvent this issue was introduced with the concept of UV-curable polyacrylates. HM polymers where chemical cross-links formed upon irradiation ensure enough cohesive strength.

However, one might expect that a combination of high cohesive strength with good aging properties could be achieved with "full acrylic" TPE. Furthermore, thanks to their physical crosslinks, these TPE should allow a thermally reversible curing of the systems and lower viscosity at processing temperature.

The synthesis of block copolymers is often difficult or impossible in conventional free radical polymerization. However, thanks to the advent of the Controlled Radical Polymerization (CRP), acrylic block copolymers can now be synthesized in a one-pot process under much less stringent conditions than in ionic methods.

This presentation will show how to take advantage of the CRP to design new "full-acrylic" TPE's as valuable alternatives for the traditional systems. A special attention will be paid to the morphology, mechanical and adhesive properties of a series of linear and radial acrylic block copolymers.