What is emulsion polymerization?

Emulsion polymerization (EP) is a two-phase, free-radical polymerization process which has industrial application in the manufacture of a wide range of polymers. The product is a fine dispersion of polymer particles in water - a latex.

Monomers polymerized by EP processes must be immiscible with water and include, styrene, butadiene, acrylics, chloroprene, vinyl chloride, vinyl acetate, acrylonitrile, acrylamide and ethylene. The product latexes find application in synthetic rubber, floor coatings, paints, adhesives, binders, high-impact foams, concrete and cement additives and thickeners. The first latex products were poly(vinyl acetate) and styrene-butadiene co-polymers developed in the ‘30’s.

Why is EP so prevalent in industry?

EP offers several advantages over other polymerization processes. The large amount of water present, usually 40-50% of the total weight of the reaction, allows for much better heat transfer capabilities. The water also results in lower reaction mixture viscosities. The mechanism of the EP process allows for high molecular weight polymers to be formed at a high reaction rate, two properties which are mutually exclusive by other methodologies. Other properties which are easier to control by an EP process include latex particle size and copolymer composition.

Why should Pilot be interested in EP?

There are four main constituents in all EP processes; water, the oil-soluble monomer(s), a water soluble initiator and a surfactant. In general, the surfactant represents up to ~3% of the total weight of the reaction mixture. This technology represents one of the largest industrial uses of surfactants in the world today.

How does the surfactant affect the EP process?

It is generally thought that the actual polymerization reaction in EP occurs in micelles. For a given concentration of surfactant, the number of micelles in a system is both constant over the course of the reaction and reproducible from reaction to reaction. The number of micelles, therefore influences the total number of particles formed, and thus, the particle size and distribution. I.e. if the surfactant concentration is increased, the number of particles formed will increase resulting in a size decrease.

The presence of the surfactant also stabilizes the particle dispersion both during the reaction and in the resultant product latex.

What surfactants are used in EP?

Surfactants commonly used in EP include several Pilot products, sodium lauryl sulfate (SLS), sodium alkylbenzene sulfonates (LAS) and alkylphenoxypolyethylene disulfonates (Calfax). Non-Pilot products used include sulfosuccinates, phosphates and ethoxylated alkylphenol nonionics.