JULY 2021

RubberWorld

132 years

THE TECHNICAL SERVICE MAGAZINE FOR THE RUBBER INDUSTRY VOLUME 264, No. 4

Selection and use of water based dispersions in latex

Latex Today with Jim Finn

www.rubberworld.com

Latex Today with Jim Finn

Selection and use of water based dispersions in latex

In the March issue of *Rubber World*, we introduced an article attempting to make a case for bringing the glove industry back to the United States. When you step back and take a broader view of that industry, it can be viewed as a three-legged stool with three key elements: process/machinery, latex and chemical dispersions. These elements work in concert to provide a baseline for eventual success. This article will discuss the third element: dispersions.

It has been said that you cannot make great products from latex with poor dispersions. In my 53 years in the latex industry, I can assure you that this is a true statement. They are literally the driver of polymer performance.

The chemical dispersions added to the latex will allow the compounder to achieve, enhance and stabilize the polymer's unique chemical and physical properties. These chemicals, in dispersion form, are many of the same chemicals used in tire and non-tire dry rubber products. There are five general categories:

- Curatives: sulfur, zinc oxide
- Accelerators: dithiocarbamates, thiazoles, thiurams, etc.
- Antioxidants: phenols, amines
- Fillers: clays, carbonates
- Modifiers: plasticizers, stabilizers.

Dispersions are defined as water insoluble compounding ingredients added to the latex in the form of a stable, fine particle size, heterogenous, water based system. The first "Law of Latex Compounding: Do no harm!" is a key requirement that any addition of materials to the latex must not cause a reduction in latex stability or a diminution of its properties. Fine particles in dispersion form have a tendency, because of their high surface area, to potentially cause de-stabilization of the latex by adsorbing some of the soaps used in the latex for stabilization. The latex system, because it is now "sharing" its available soap stabilizers with the additional particles, may be less stable after the addition.

Typically, additional soaps must be added to the system to compensate for this effect; which brings us to the second "Law of Latex Compounding: Gravity always wins!" All particles, over time, will eventually make their way to the bottom of the drum, tank or vessel. Keep in mind that some of these materials may have a density six times heavier than water, like zinc oxide. This settling or sedimentation is directly related not only to the particle density, but its particle size. Stokes' Law demonstrates that a particle with a diameter of "2a" will settle in a viscous fluid (latex) four times greater than a particle with a diameter of "a," or half its size. Keeping the particle small will be helpful. In addition, a finer particle size will enhance its reactivity in the latex system. The finer particle will inherently have a greater surface area and potentially more reactive sites. Any improvement in particle size reduction will go a long way in reducing sedimentation and producing a more uniform, stable latex compound.

Particle size reduction is accomplished with a series of processes. The first is the introduction of the dry chemical, typically a powder, into the water medium. Here, the "wetting" of the powder is critical and can be enhanced with the addition of a suitable wetting agent.

The next stage is the de-agglomeration or separating of the agglomerated particles by a shearing action with high speed mixers. This is the slurry stage.

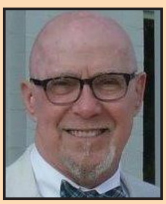
The third stage is the actual pulverizing of the particles to reduce the particle size. Whether one is using a ball mill, attritor or horizontal mill, the underlying action is one of utilizing a cascading motion of the grinding media, point contact and grind time to achieve a fine particle size.

The remaining objective is to keep the particles separate by the introduction of a dispersing agent; and the finished dispersions stable for months by the incorporation of stabilizers. These might be added prior, during or post processing. The wetting, dispersing and stabilizing functions may be accomplished by the addition of one or more agents.

The finished dispersion can be characterized by its total solids, active solids, pH, viscosity and thixotropy, the extent to which it is shear thinning, like ketchup, yogurt or quicksand.

The completed dispersion is either a single dispersion, like sulfur, with a 60% activity, or a masterbatch dispersion at 50% activity made up of multiple ingredients such as sulfur, zinc oxide, accelerators, antioxidants, etc. These masterbatches have a number of distinct benefits, like reducing stock keeping units (SKUs); reducing compounding time; single addition to the latex during compounding, thereby minimizing the variability of additions; and finally, the improved performance in final latex physical properties because of the maturation or "marinating" effect of these materials in contact with one another during storage.

The chemical dispersions can now be added to the latex by the compounder. Using two simple calculations, the compounder can determine the correct amount of dispersion to add



Jim Finn is president of Akron Dispersions, a provider of dispersions and emulsions, and a processor of finely powdered chemicals, elastomers and formulations serving the polymer, chemical, coating and adhesive industries. Finn has authored technical papers on latex and has chaired many latex conferences.

to the latex, or as a predetermined part per hundred rubber (PHR). The calculations are listed below:

$$Q_D = \frac{Q_L \text{ x } TS_L \text{ x } PHR_D}{ACT_D \text{ x } 100}$$

$$PHR_D = \frac{Q_D \text{ x } ACT_D \text{ x } 100}{Q_L \text{ x } TS_L}$$

Where:

Q_D = quantity of dispersion needed
Q_L = quantity of latex
TS_L = total solids of latex (%)
PHR_D = part per hundred rubber needed of dispersion
ACT_D = activity of dispersion (%)

Some have said that if we could get a material to sit still long enough, we will make a dispersion out of it. This is probably a true statement. Many dry chemicals are candidates for dispersions. For those materials with a lower melting point, they may be candidates for water based emulsions. But that is another story.

My purpose here was to provide you with a brief overview of the process and practice of producing and using water based dispersions in latex. It is an important element in the possible return of glove manufacturing back to the U.S.