How Polymers Work

Just as it took 30 years for the use of alum to be accepted by the swimming pool industry, it also took a long time for the industry to be introduced to the use of organic polymers for water clarification.

A polymer (pronounced "POL-imer") is a huge molecule that contains many repeating parts. Poly means "many;" mer means "part." Wood, hair and rubber are natural polymers. Humans have imitated these natural polymers in synthetic polymers that have many different uses.

Synthetic polymers form the basis of our modern plastics industry. The process of forming a polymer (called polymerization) was developed in Germany in 1922 by a scientist named Hermann Staudinger. In 1945, organic polymers were first used to clarify water. But it was not until around 1970 that polymers were introduced into the pool industry.

The polymers that we use in water clarification are called organic because they contain the element Carbon. If we were to look at a polymer through a high-powered microscope, it would resemble a long chain of repeating units.

To make it a bit clearer, try picturing a chain in your mind. It can be a necklace, an ID bracelet or a chain used to tow your car. Each link of the chain is a unit and is identical to all the other links. Chemically, a polymer is a chain of identical, repeating units called monomers. The prefix mono means "single."

How do organic polymers work to clarify water? To understand this, we need to define a few more terms.

First of all, you need to know that polymers used for water clarification depend on tiny electrical charges to do their job. There are many chemical substances - called electrolytes that, when you dissolve them in water, come apart or dissociate into electrically charged parts, called ions. This process is called ionization.

Ions can be either positively or negatively charged. Positive ions are called cations (pronounced "KAT-ions"). Negative ions are called anions (pronounced "AN-ions").

Each link of an organic polymer can ionize, so an electrically charged polymer is called a polyelectrolyte. If it has positive charges along its links, it is said to be cationic. If it has negative charges along its links, it is said to be anionic. (Just in case you were wondering, if it has both positive and negative charges along its links, it is said to be ampholytic.)

Now, that's a lot of scientific information to absorb in one sitting. But if you understand it, you will be sure to understand this next sentence, which sums up all of the properties of organic polymers used for water clarification:

A polymer used to clarify water is an organic, cationic polyelectrolyte.

Now here's the part where it all comes together. Earlier I told you to remember that colloidal particles are negatively charged. The fact is that most all dirt particles in water are negatively charged.

OK, so we know that dirt is negatively charged, and we now know that the polymers we use to clarify water have little positive charges all along their length. Are you starting to get the picture?

We've got these huge polymer molecules, all coiled up in a bottle. When we add them to water, they uncoil, exposing little positive charges all along their length as they float through the water. We've also got these tiny, little negatively charged dirt particles floating in the water. We all know that opposites attract. So when a dirt particle gets close to a polymer, it is drawn in - just like Luke Sky Walker’s ship in "Star Wars" is drawn in to the Death Star by a tractor beam.

All along the length of the polymer, the same thing is happening - little bits of dirt are drawn in, and their electrical charges are neutralized a process called coagulation. As the polymer fills up with dirt, it begins to coil up again. And then a bunch of coiled polymers hook up with one another, forming large bundles or flocs.

These flocs can easily be filtered out of the water, or they may settle to the bottom. They are not nearly as large or heavy as the deposits formed by the use of alum.

Polymer-based water clarifiers are generally added at the rate of 2-2 1/2 ounces per 10,000 gallons. You must dilute the dosage with large amounts of water before you pour it in the pool, then "walk" it around the pool as you add it. If you pour it right out of the bottle into the pool, the polymer never dilutes and is attracted to the main drain, where it will be sucked into the filtration system and will neutralize and coagulate all of the dirt that is already trapped on the filter. You may as well have flushed it down the toilet.

Polymers are not pH sensitive, but they may be oxidized by high levels of chlorine. So you should check with the manufacturer to see what level of chlorine his polymer-based clarifier can tolerate.

There are no fewer than 200 different polymers used for water clarification, and each has its own individual characteristics. Some manufacturers blend several different polymers in their clarifiers to give it a variety of effective uses - such as the ability to withstand high temperature, extreme turbulence and floc breakdown. Some polymers are better at removing soap and oil, and some are more chlorine-resistant than others.

Clearing Up the Confusion

There are a good many terms used to define water clarifiers as well as their clarifying action. The three you hear most often are agglomeration, coagulation and flocculation. These terms seem to be used interchangeably, but there are slight differences.

So to set the record straight, here's what these terms really mean:

- Agglomeration -The gathering together of fine particles into a larger mass.
- Coagulation- - The neutralization of the charges of colloidal matter.
- Flocculation - The process of agglomerating coagulated particles into settleable flocs.

All of these terms are grouped together into a catch-all term called clarification.

To Sum it All Up . . .

I hope that this has helped clear up some of the murkier points regarding water clarification.

Alum is a tried-and-true water clarifier, but it does involve a bit more work - you have to adjust the pH to use it; you have to adjust the pH and alkalinity after you have used it; and you have to vacuum up the gel-like flocs and dirt particles that settle on the pool floor. You also need to use about 4 pounds of alum to clarify a 10,000-gallon pool.

But alum does remove almost everything from the water - large and small particles; positive and negative particles; soap and oil - because it travels through the water like a blanket.

Polymer-based water clarifiers require no pH adjustment; they will not affect pH or alkalinity; and the coagulated particles formed by their use often can be filtered out without vacuuming. They also are highly concentrated, requiring only about 2 ounces to clarify a 10,000-gallon pool.

However, polymers must be diluted before you use them; and although they are very good at removing small, negatively charged particles, they are not very good at removing larger, positively charged contaminants. Their ability to remove soap and oil varies from polymer to polymer.

Alum should be used for major clean-up jobs, where the water has become extremely murky due to neglect or accident. Polymers should be used in a well-maintained pool or spa as part of your regular chemical routine, to "polish" the water by removing tiny suspended particles and to give the water that elusive snap.