



Handling and Storage of Emulsions, Polyacrylamides

Polyacrylamide Emulsions Guidelines, Storage and Handling of Emulsions

Basic Principles

An emulsion polymer is described as a heterogeneous suspension of hydrated polymer in oil. After adding the emulsion to water, a homogeneous solution of polymer in water is produced. Emulsions must be stored inside a building at a constant temperature between 5 and 30°C. During the storage and handling of the product the emulsions must not be contaminated by water. Emulsions must not be stored in such a way that the surface of the product can be subject to ventilation. Emulsions should not be subjected to shearing forces. Pumping, filtering, and stirring should be applied with maximum care.

Lumps, Skins, Gels in the Emulsion

Emulsions are filtered at the end of their production process and are free of any heterogeneousness upon production. However, during transport or storage in non- recommended conditions, situations can arise where lumps, skins or gels can appear in the emulsions. The more common causes of this problem are: emulsions are subjected to very cold or freezing temperatures; cycles of warming cold temperatures are experienced.

This can happen when emulsions are stored outdoors. This type of phenomenon is sometimes called a “rain cycle” which may be described as the following. A shipping container of the emulsion initially at a temperature of 20°C in a warehouse is placed for several hours out-of-doors where the temperature has dropped to 5°C. The water vapor contained in the free space above the product in the container condenses and therefore drops of water formed on the roof of the container precipitate onto the surface of the emulsion, creating local coagulations or gels.

How to Restore the Product

In such a situation we recommend that the emulsion be transferred by gravity, without previous agitation, in a free flowing mode to another container, while passing through a large area bag filter having a mesh size between 500-1,000 μ . It is common to place a filter bag in a funnel in the top bung of the drum or tote bin and drain an affected drum or tote bin through the filter into a clean container. For bulk deliveries, filtration at the reception point is recommended between the delivery truck or tank car and the emulsion storage tank.

General Observations

In storage a layer of mineral oil appears at the top of the emulsion and a second layer of the emulsion containing heavy solids appears at the bottom of the storage tank. The reason for this is that the internally dispersed phase (the hydrogel of polymer) has a higher density than the continuous oil phase, so the emulsion has a natural tendency to separate. This is the physical nature of emulsions. Emulsions start the cycle when they are left quiescent. It is difficult to predict the rate of settling of an emulsion. The settling rate depends upon many parameters including temperature, humidity, the type of the emulsion and other factors of the emulsion's composition.

How to Avoid Problems

Emulsions which are going to be stored for more than a month should be homogenized before use. Homogenization should be done by gentle agitation of approximately 400 RPM and for short periods of time no longer than 30 minutes per incident.

Recommendations for Agitating Emulsions

Care must be taken not to shear the emulsion and destabilize it by agitating it at higher speed or for too long a time. We do not recommend that agitation be accomplished by the recirculation of the emulsion. In cases where there is no other way to agitate the emulsion other than by recirculation, care should be taken to avoid the use of pumps which produce a strong shear force and avoid any device which creates an increase in pressure drop in front of the pump, such as, check valves. Agitation can also be accomplished by air sparging but only when the air is extremely dry. This method can be effective but it is not our first choice.

The Color of Emulsions

Most emulsions are opaque. Some are slightly translucent. Emulsions have colors that range from off-white, yellowish and even greenish. Because emulsions are a multi-phase system and are composed of many components, slight color changes which are impossible to control may occur. Variations can come from the stabilizers, the catalytic system, mineral oil, surfactants and other raw materials. Furthermore, slight differences in statistical distribution of the molecular weight of the polymer and the size of the beads of polymer may generate changes in the refractive index of the components and lead to slight color variations. Color changes can also occur during the storage due to temperature differences, UV light and the like. Color fluctuations have been proven to have no impact on the performance of the emulsion.

Pumping an Emulsion

For a large flow rates of five or more gallons per minute of emulsion, use pneumatic pumps, gear pumps, rotating piston pumps, or progressive cavity pumps. The latter is the most highly recommended. We recommend that centrifugal pumps be avoided because the emulsion can be sheared in the high-speed mechanical seal.

For a small flow of up to 5 gallons per minute, use a progressive cavity pump with a stainless steel rotor and a stator made of Viton or buna N. Avoid running the progressive cavity pump dry as this may damage the stator.

For flow rates from 0 to 1 gallon per hour it is possible to use diaphragm pumps or peristaltic pumps, however, sometimes there are problems of destabilization of the emulsion using these pumps. When piston or diaphragm metering pumps are used for dosing the emulsion, we recommend 30 or less strokes per minute.

Common Difficulties

Lumps

Sometimes an emulsion contains lumps, gels or skins which can plug pumps and small passages. The remedy is to filter the product. The agglomerates, since they are water soluble, can be pumped and dissolved in the emulsion itself except in paper mill applications where all non-totally dissolved polymer has to be avoided.

Shearing

As previously mentioned shearing must be avoided. Typically shearing occurs when check valves are present in electromagnetic pumps. The shear destabilizes and locally coagulates the emulsion on the seats of the closure balls. The polymer beads start to stick together and gel appears in the springs of the check valves. This results in a blockage of the pump.

Pressure Drop in Front of the Pump

This condition increases the shear in the pump and in the piping in front of the pump resulting in a destabilization of the emulsion and the formation of gels. We recommend that you avoid the use of any device which increases the pressure drop in front of the pump, such as valves and filters. We further recommend that you avoid any configuration where the pump injects the emulsion into a pipeline in which the pressure is high.

Water Contamination

The emulsion should not be contaminated with water during the storage or handling process. Pump components should be thoroughly dried before handling the emulsion again. The design of the make down system is critical and should be made in a way such that there was no possibility of dilution water back flow from its source into the meat emulsion piping or storage vessels. Aspen Polymers offers a wide range of both emulsion and granular polymer make down systems.

Filtering an Emulsion

At the Aspen Polymers plant our emulsions are filtered through a 300 μ filter both after production and before packaging. Filtration should only be done when emulsion gels have been observed. We suggest you avoid filtration at mesh sizes below 500 μ . Avoid use of narrow piping and passages. In-line filtration before use is not recommended. Do not agitate the emulsion before filtration.