Using Pemulen with the MCP

by Chris Stavroudis

Pemulen can be used two ways. While it always gels an aqueous solution, it can function as an ersatz surfactant, as demonstrated in the Holy Innocents Mural Project, and it can be used to build and stabilize an emulsion. While building an emulsion that would stay together for more than a few seconds used to be a matter of luck and trial and error, Pemulen makes it work almost every time.

By combining Pemulen with the MCP, one can make a range of emulsions with different properties very quickly. As with the other modules of the MCP, this allows for more thorough testing and, hopefully, finding the best formula.

The trick to integrating Pemulen into the MCP is making stock Pemulen gels that are concentrated and pre-set to the pHs of interest. In practical terms, a gel concentrate made at twice (2x) the desired working concentration seems to work best. A 2x concentrate can be easily mixed with other aqueous components but still allows the addition of two additional components (surfactant, chelating agent, ionic strength buffer).

Generally, a 1% Pemulen gel is good to begin making emulsions, so a 2% Pemulen concentrate is the starting point for use with the MCP.

pH 6.5: Suspend 4g Pemulen TR-2 into 100mL distilled or deionized water, stir until uniform and well dispersed. Mix approximately 3.15g (2.8mL) triethanolamine into 95mL water. With vigorous stirring, mix the Pemulen suspension with the TEA solution. Using the procedure below, adjust to pH 6.5 with additional TEA; and bring final volume to 200mL.

pH 7.5: Suspend 4g Pemulen TR-2 into 100mL distilled or deionized water, stir until uniform and well dispersed. Mix approximately 5.9g (5.2mL) triethanolamine into 90mL water. With vigorous stirring, mix the Pemulen suspension with the TEA solution. Using the procedure below, adjust to pH 7.5 with additional TEA; and bring final volume to 200mL.

pH 8.5: Suspend 4g Pemulen TR-2 into 100mL distilled or deionized water, stir until uniform and well dispersed. Mix approximately 10.48g (9.44mL) 10% sodium hydroxide solution into 85mL water. With vigorous stirring, mix the Pemulen suspension with the TEA solution. Using the procedure below, adjust to pH 8.5 with additional 10% NaOH solution; and bring final volume to 200mL.

To measure the pH of a Pemulen gel, remove a small amount of the gel and dilute with distilled or deionized water until the solution is a thick, evenly dispersed liquid. A pH meter can be used to measure the pH of the thinned gel. If the pH is low, add a bit more base to the stock gel, mix well, and repeat the testing process. You should rinse your pH electrode in dilute sodium hydroxide (~1%) to ensure that the Pemulen is dissolved away before rinsing the electrode in tap or distilled water between measurements.

To prepare the 1% working solution dilute the stock Pemulen gel 1:1 with other aqueous preparations.

To use the stock Pemulen gel with the MCP, dilute as follows: for each 5mL of stock Pemulen, add 2mL of a concentrated MCP stock solution and 3mL water. If adding two MCP components, add 2mL of each MCP concentrated stock solution and 1mL water to the 5mL of stock Pemulen gel.

Once the Pemulen is diluted to a working concentration, the magic can begin. Typically, a very small amount of a non-water miscible solvent is added to the Pemulen solution and shaken to form the emulsion. Suitable candidates are benzyl alcohol, xylene, and mineral spirits.

Start at something like 2% solvent. The solvent concentration can be increased if the emulsion proves to be ineffective. According to the spec. sheet, Pemulen TR-2 is supposed to be able to form a stable emulsion with up to 50% solvent. I've never been able to get more than 30-40% into suspension.

By varying the polarity and aromaticity of the solvent, the "power" of the emulsion can be changed. I will usually make up a smallish working batch of the 1% Pemulen with components like chelating agent or resin soap added. I will then take smaller amounts of that solution and shake in 2% of benzyl alcohol. If that's too aggressive, I'll try 2% xylene; and if that's still too strong, 2% VM&P naphtha. One can also play with increasing the solvent concentration.

As with any cleaning system with a non-volitile component, the Pemulen must be cleared from the surface. Water will work, but I prefer to use pH adjusted mixtures of dilute ammonium hydroxide and acetic acid.

One of the really nice things about a Pemulen-based emulsion is that it often will work on a cleaning that would have required solvents. Not only are the Pemulen based solutions largely aqueous, they are cleared with an aqueous system as well. This can often afford the conservator the opportunity to clean a surface that would have required unhealthful and smelly organic solvents with a water-based system.

Making the pH adjusted water for clearing:
(These work for clearing aqueous MCP solutions as well.)

pH 6.5 solution, 1000μS conductivity: 1mL acetic acid (glacial – 100%) in 1L distilled or deionized water. Set the pH to 6.5 with 10% ammonium hydroxide solution (1mL concentrated ammonium hydroxide added to 9mL water). Dilute to 2,000 mL.

pH 7.5, 1000μS conductivity: 1mL acetic acid in 1L distilled or deionized water.
Set the pH to 7.5 with 10% ammonium hydroxide solution. Dilute to 1,900 mL.

pH 8.5, 1000μS conductivity: 1mL acetic acid in 1L distilled or deionized water. Set the pH to 8.5 with 10% ammonium hydroxide solution. Dilute to 3,000 mL.