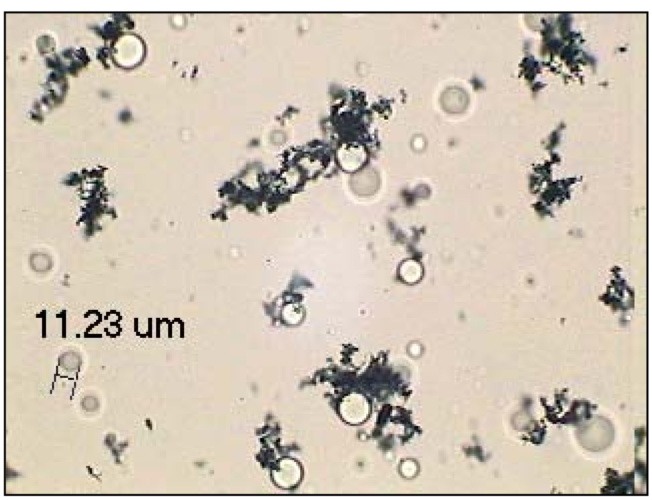
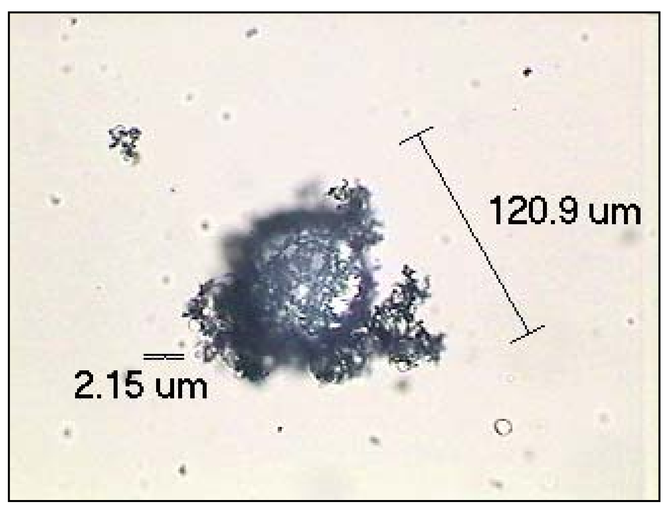
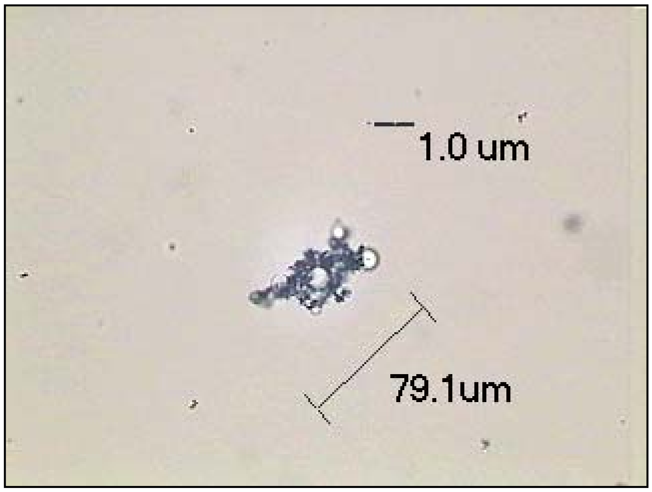
A Tough MDEA Example of What SigmaPure Can Do

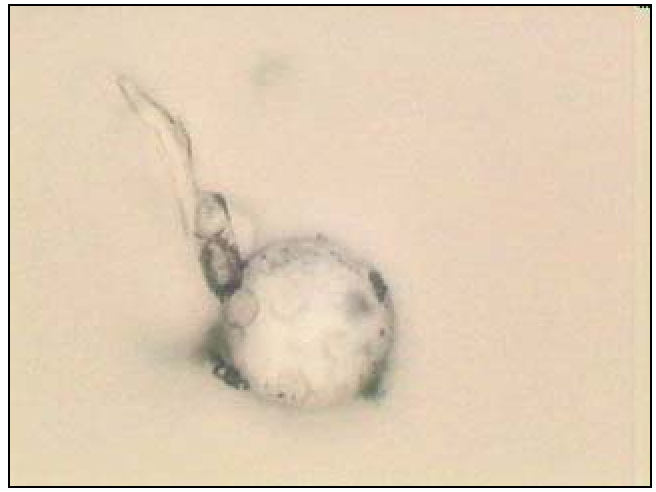
Initially the MDEA was in pretty bad shape, although the plant was meeting its AG specs. The problems were foaming and replacement filter costs. As you would expect, antifoam was continuously being injected to counter the foaming.

The solution was very turbid and loaded with suspended solids. When allowed to sit for a few hours, solids began to settle to both the bottom and the surface of the sample bottle. Microscopic examination of the floating settlant is shown below (left). The bulk sample looked the same way, but with much smaller agglomerates. The individual iron sulfide solids averaged 0.5 microns when not agglomerated with the immiscible liquid(s). Upon closer examination (top right pg 2.), the immiscible liquid bubbles were made up of at least two, and probably more, immiscible liquids (bubbles within bubbles). Droplets below 1 micron had adsorbed solids.





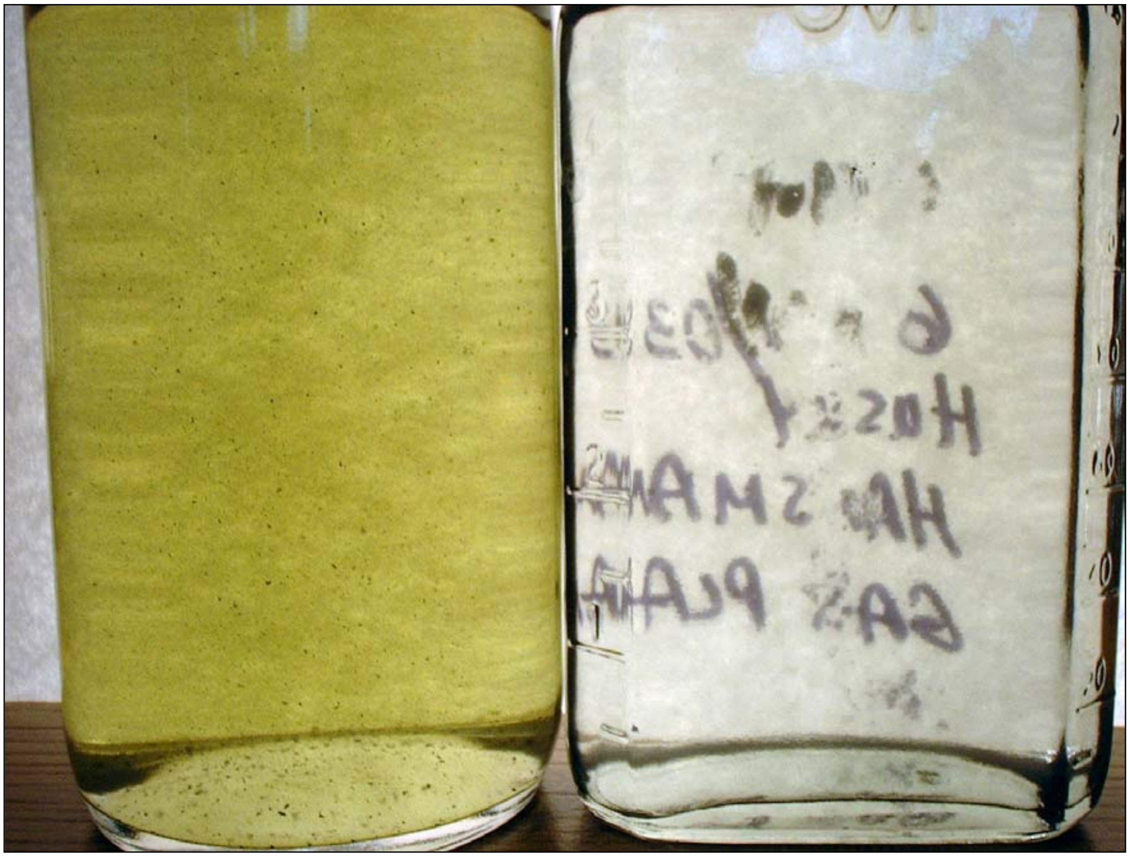




The SigmaPure unit had been operating a week when the samples below were taken. The photo was taken of the back side of the samples to demonstrate optical clarity. The bottle on the left is lean post activated carbon. Obviously it’s not doing much. The bottle on the right is the SP unit feed. The SP discharge is in the middle.

The plant had completely eliminated antifoam injection within 6 hours of SigmaPure unit start up. However, the filter changeout frequency had not improved. The plant had just installed a high efficiency inlet gas coalescer that immediately began to collect pipeline liquids. However, as is shown in the feed sample above, the color was still green, indicating solids. Microscopic examination showed a significant reduction in liquid hydrocarbon/solids agglomerates, but they hadn’t completely been removed. The hydrocarbon was inhibiting the particle removal efficiency of the SP unit by keeping them from being incorporated in the foam.

The photo below shows a rich MDEA sample before the SP unit, and the unit's rich discharge after being on line approximately three weeks. The color of the SP unit discharge steadily improved as the hydrocarbon concentration we down. The solids were better able to ehnance foaming in the unit without their hydrocarbon piggy back droplet.



Also, the filter changeout frequency hadn't changed to speak of. However, the type of filter the plant was using was extremely sensitive to deformable particles like immiscible liquids, especially when they contained solids that kept them on the filter's surface. The plant changed to a more rigid depth type filter.

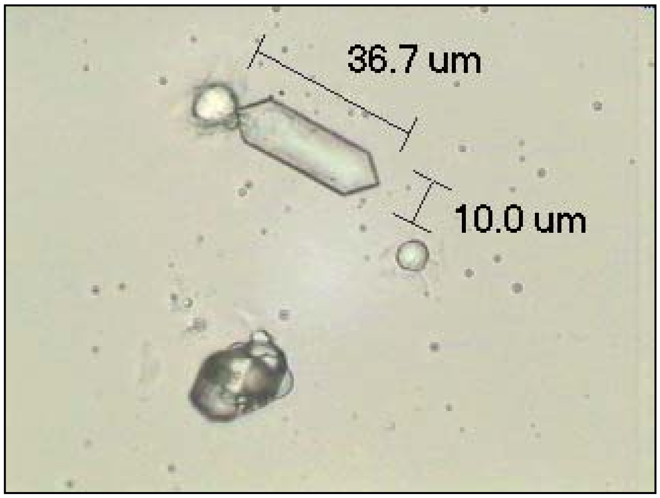
If the SigmaPure unit were sending this quality of MDEA back to the plant, and the inlet gas coalescer all but eliminating the hydrocarbon in the feed gas, where were the solids and remaining liquids coming from?

The photos below are of the reflux water (one back lit, the other not).

Microscopic examination showed what was really going on. The large white flakes were too dense to photograph under indirect light, but consisted of solid, white material saturated with immiscible liquid bubbles.

Most of the white solid material melted when the sample was heated to 104 °F. The photos below are of the 104 °F sample cooling to 80 °F. Although certainly not quantitative, the experiment showed that there were definitely multiple immiscible liquids, some of which crystallized below 104 °F. The material was probably mixed paraffin.

This photo shows a nest of solidifying liquids, liquids, and solids clumped together. When this thing was finished it looked like a Swiss cheese of solid paraffin and solids with immiscible liquid filling the holes.



The bubble at the end of the largest crystal is solidifying like the first one in this series. It's obviously something different. There are also droplets that don't appear to solidifying.

Summary and Conclusion

There was a contaminant concentration loop established between the top of the still and the reflux drum. Pipeline liquids were coming in periodically with the inlet gas. Their antifoam injection was keeping the foaming down while the filters and carbon were removing most of the contaminant. Life was good. Eventually, however, the carbon was being spent in hours, and the filters being changed out in hours or just a few days despite continuous antifoam injection. The high efficiency gas – liquid coalescer was working well, but the problems persisted.

The SigmaPure unit had stopped the foaming and antifoam injection, but when taken off line for only a few hours, the symptoms returned. The filter changeout problem persisted. The carbon was changed out on the lean side, producing pristine MDEA, but the samples foamed worse than without it. Plus it only lasted a few hours before exhausting.

It turned out that the immiscible liquids were concentrating in the reflux drum and being introduced slowly as carryunder to the rest of the system from the regen tower. Increasing the reflux temperature eliminated both the regen foaming and filter problems. SigmaPure waste analysis showed primarily carboxylic acid degradation products, liquid hydrocarbon, and heat stable salts. The solids were iron sulfide.

Although the SigmaPure unit wasn't individually responsible for eliminating the foaming problem in this plant as it has in others, this case clearly demonstrates its use as both a treating method and troubleshooting tool. Used alone, the SP unit would have cleaned up the inventory, but it would have taken several weeks. If as unit had been permanently installed in the plant and the reflux water quality monitored periodically, the problems wouldn't have occurred.