SigmaPure™ Applications - Foaming Symptoms

Solvent Foaming Tendency Testing

Samples of rich and lean solvent, absorber overhead knockout, and reflux liquid should be tested for foaming on a routine basis. Accepted ASTM tests for foaming include: ASTM D-892-74, D-1881-86, D-1173-53, D-3519-76, D-3601-77. The first two tests require bubbling gas through the solvent sample, and the last, a simple jar shaking method. D-Foam, Inc. also recommends collecting foam produced by the samples for detailed analysis. The contaminating surfactants will be incorporated in the foam. Quantitatively identifying the surfactant(s) allows the troubleshooting engineer to positively identify the source of the contaminant(s).

1. High solvent foaming tendency and breaktime

Foaming tendency demonstrates surfactants present in the solvent. The generally accepted volume at which a problem is indicated is >50 ml.

Foam breaktime is a measure of the foam's stability. The generally accepted indication of a problem is a foam column that doesn't break to the interface in <5 seconds. Anything in the solution or environment that inhibits film drainage affects the foam's breaktime, i.e., surfactant viscosity, fine solids, polymerization, low shear environment.

2. Unexplained solvent losses, or high make up requirement

Solvent losses that haven't been shown by other symptoms could be caused by foaming in the upper section of either the contactor or stripping towers, or losses to the fuel gas system through the flash drum overhead. Differential pressure cells are usually not placed high enough, or are not sensitive enough to detect the slight increase in differential pressure across the top few trays of either tower. Liquid residence time in the flash drum has nothing to do with foam evacuation with the flash gas. If the volume of gas flashed from the solvent or the amount of surfactant is high, fresh wet foam can be carried out with the gas.

3. Higher than normal contactor differential pressures

The density of foam formed in the tower is lower than the liquid solvent and higher than the gas being treated. Foam restricts gas flow through the tower by filling the vapor spaces through which the gas normally flows to the next stage. The restriction to gas flow causes increased differential pressure.

4. Decreasing tower differential pressure with the addition of antifoam

Small amounts of antifoam may temporarily break the foam present in the tower. Extreme care must be taken when adding antifoam. It will temporarily mask the effects of foam causing contaminants allowing their build up in the system. Eventually, the contaminant level will increase to the point where antifoam is ineffective at masking the problem, and may actually promote foaming. Further, antifoam has no effect on surfactant film formation. Surfactant filming has been shown to reduce solvent gas transport efficiency.

5. Foam present when the solvent sample is collected or agitated

Low foaming tendency solvents won't foam with simple shaking. Solvent that foams when agitated in a sample jar should be considered to have a high foaming tendency. Bubbles formed by flashing gas during sampling may cause the sample to foam. This should be considered a positive foaming tendency.

7. Increased liquid level in the contactor overhead knockout

Some solvent in the contactor overhead knockout is normal. However, if the gas rates are relatively constant the liquid levels in the KO should also be constant. Any increases in this liquid level will almost certainly be caused by solvent being carried over with foam. If there is no corresponding increase in differential pressure across the tower, foaming is occurring in the top of the tower above the DP cell, i.e., mist eliminator.

6. Unexplained low flash drum liquid levels

Most level controls can't recognize foam - liquid interfaces because of increased foam densities. This causes a false liquid level indication, and subsequent solvent dumping or foam carryunder.

7. Decreased liquid level and higher than normal differential pressure on the activated carbon bed

Foam carryunder from the flash drum will accumulate at the top of the carbon vessel producing a "vapor lock". This vapor lock causes the carbon bed to channel by restricting the free flow of solvent from the inlet distributors. The result is increased differential pressure across the carbon bed.

8. Gas accumulation in rich solvent particle filters or activated carbon bed

Foam carryunder caused by a false flash drum liquid level is the primary cause for gas pockets in the rich side particle filters and activated carbon bed. High density foam created by flash gas in the drum can be mistaken as liquid by level controls.

9. Charge and booster pump cavitation

Pump cavitation is caused by two phase flow. If the liquid level controls on the flash drum appear to be functioning properly, the gas is probably being carried under due to solvent foaming in the bottom of the tower or flash drum.

10. Foam in the liquid hydrocarbon blowdown lines from the flash drum

High density foam can fool liquid level controls and indicators. When this happens, false high liquid levels cause the blow down valves to open in an effort to maintain set levels.

11. Solvent carryover to the fuel gas system

Solvent carryover to the fuel gas system can be caused by foam filling the vapor space in the flash drum. One concern with using antifoam is that increasing concentration actually enhance foaming. If the solvent in the fuel gas system contains silicone based antifoam silica deposits will form in the engines and burners using this fuel.

12. Visible liquid hydrocarbon settled in solvent samples with or without added water

Liquid hydrocarbon visible in the solvent means that the solvent is saturated with soluble and insoluble liquid hydrocarbon. A film of free liquid hydrocarbon actually reduces solvent foaming tendency. However, when removed, the remaining dispersed and soluble liquid hydrocarbon cause solvent foaming tendency to increase dramatically. This is one reason why carbon bed changeouts may tend to increase system foaming. If there is any free liquid hydrocarbon in the solvent, the activated carbon is exhausted and needs to be changed. The fresh carbon may also adsorb antifoam, thereby enhancing foaming tendency.

13. Liquid hydrocarbon in the regenerator/stripper overhead cooler or reflux samples

Free liquid hydrocarbon can vaporize in the stripper, condense and concentrate in the reflux. A vaporization - condensation loop is established that increases the concentration of liquid hydrocarbon in the reflux. As the concentration of hydrocarbon increases, reflux liquid foaming tendency increases until it foams and causes carryover from the still, through the overhead condenser and into the SRU.

14. Stripper overhead condenser temperature fluctuations.

Foam carried over from the stripper will cause temperature fluctuations in the overhead condenser. This can cause unstable reboiler operation.

15. Liquid hydrocarbon in the rich solvent filters

Particle filters will remove small volumes of suspended liquid hydrocarbon because they exist as stable droplets. The presence of liquid hydrocarbon on particle filters indicates that the solvent is saturated with soluble liquid hydrocarbon. Horizontal lines across the filters, or a change in top to bottom color indicates a phase hold up in the vessel, i.e., foam, liquid hydrocarbon, etc.

16. Liquid hydrocarbon visible in the surge drum

Settleable liquid hydrocarbon in the surge drum means that the entire solvent inventory is contaminated with free liquid hydrocarbon. It also means that the activated carbon bed is exhausted and needs to be changed.

Foaming Abatement Specialists

P.O. Box 1393, Weatherford, TX 76086-1393 - (817) 598-1438 - d_foam@hotmail.com