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Lean Amine Filtration Basics

Lean amine filtration can be better defined as lean amine conditioning because filtration is not the only event taking place. Lean amine filtration comprises of three (3) separate components or stages. Each component has a distinct function and requirements. None of these should be replaced or by-passed and all of them are necessary for proper lean amine conditioning.

Perhaps the core of all lean amine conditioning is the activated carbon bed. The activated carbon bed is not a filter as the correct definition of filtration is the separation of solid particles by a porous medium. Activated carbon beds do not operate in a filtration mode, but rather in an adsorption mode (weak interaction of the contaminants with the carbon grains). These devices are designed to remove only dissolved species present in the fluid by a surface attraction phenomenon called adsorption. Therefore, as it functions via surface separation, it is always necessary to keep the surface of the activated carbon clear of solids. To obtain this, activated carbon beds should always use a pre-filtration stage designed to remove suspended solid particles. Its purpose is to protect the activated carbon bed from the ingression of solids. A carbon bed should never see a differential pressure (DP) increase. If this is the case, the system is likely saturated with solids, and the activity of the activated carbon has likely long been extinguished by obstruction. Carbon beds are usually tested for lifetime and activity using an empirical foaming test method. Other more sophisticated analyses are available; however, these are difficult to perform while the activated carbon bed is operational.

In cases where the absorber tower has structured packing, it is better to have full flow lean amine filtration. Afterwards, a percentage of the flow can be routed to the activated carbon bed and its associated post-filter. Filtration systems in general, and lean amine circuits in particular, are typically installed on the coolest stream section, just before the absorber feed and at the discharge of the lean amine pumps (if available). It is better to avoid high temperatures for amine filtration due to the limited material compatibility of many filters at these higher temperatures. The post-filter should be sized consistent with the flow entering the activated carbon bed.

As far as the systems to be used, to date the best filtration devices are made of disposable cartridge filters. Automatic filters are not suitable for highly fouling streams such as amine solutions. The interaction of the solids and the metal filter elements is very strong and both backwashing and dislodging the contaminants are not effective in cleaning the elements. Other systems such as centrifuges have been used with some success. Still there are a few technical hurdles to overcome for this technology to be appropriate for amine clarification. Filter-Aid systems also have been used but are far less common due to excessive waste generation and their complex maintenance procedures.

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For cartridge filtration, numerous filter medium have been utilized in amine service: wound cotton (with either plastic or metal cores), pleated cellulose, pleated and non-pleated polypropylene, fiber glass, melt-blown and resin bonded. Field tests confirm that the best filter media are pleated cellulose, pleated propylene or fiber glass. Care has to be taken to utilize media that will not induce foam due to components or cause foaming by material incompatibilities with contaminants in the amine solution.

Lean Amine Filtration Recommendations

Activated Carbon Beds: The activated carbon type of choice is a bituminous or sub-bituminous grade. If this is not available, we need to have a list of available sources to properly make a recommendation. However, bituminous activated carbon has the best balance of small pores, medium pores and large pores, with a higher concentration on smaller pores. This has been shown to be the most suitable for amine streams, being capable of adsorbing most typical low to medium molecular sized contaminants. Sizing of carbon beds is a simple calculation based on a cross-sectional velocity and it is dependent basically on residence time in order to provide enough contact time for contamination removal via adsorption. Carbon beds are always loaded wet, generally using water as the carrier medium. The vessels are provided with corrosion resistance distributor heads; key for an even solvent distribution and avoiding channeling effects. The lifetime of activated carbon beds is typically between 6 and 12 months depending on contaminant loadings. Beds should be changed out after a maximum of 12 months to ensure that the bed has enough capacity to handle any potential hydrocarbon ingress emergencies.

Pre-Filtration: The final and optimal micron ratings and efficiency has to be determined while the filter is on-line. However, a good recommendation is to use a 50 micron, Beta 5000 filter as a starting point. It is also recommended to use a less efficient filter (150 micron, Beta 5000) if the unit is being commissioned as initial contamination concentrations tend to be extremely high. As the unit operates over time, the filter efficiency can be gradually increased. Filter materials should be compatible with the amine and with potential amine contaminants such as hydrocarbon contaminants. Filter change-out lifetimes can't be easily assessed; however some modeling programs are available for that purpose. After the unit is operational, sampling of the amine streams is necessary for a final filter recommendation.

Post-Filtration: The final and optimal micron ratings and efficiency has to be determined while the filter is on-line. This will highly depend on the type and mechanical resistance of the activated carbon bed in use and the type and size of carbon fines present downstream of the carbon bed. As was the case for the pre-filter, a good recommendation is to use a 50 micron, Beta 5000 as a starting point. We can recommend a less efficient filter (150 micron, Beta 5000) if the unit is being commissioned as initial contamination concentrations tend to be extremely high. Additionally is best to keep the activated carbon bed off line until the systems stabilizes and removed initial suspended solids contamination. The same comments on compatibility and filter lifetime apply for the post filter as well.

For more information, please contact **Amine Filtration** at Help@AmineFiltration.com