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SELECTION OF RETURN LINE TREATMENT PROGRAM

The return line system is an area where the water treatment program can easily fail. Incorrect selection of the proper neutralizing amine or blend of amines can result in high levels of line corrosion. Overfeed of a filming amine can cause line restriction and trap plugging. Use of a neutralizing amine in high alkalinity water where a filming amine could be used can result in excessively high treatment costs. Corrosion by-products returning to the boiler from the condensate can limit the effectiveness of the boiler internal program. They can even result in deposit formation in what should have been a clean boiler.

Therefore, the proper treatment program for a condensate system is one which effectively retards the rate of corrosion in the condensate lines, while remaining cost effective.

In order to be able to recommend the proper return line treatment program, you must first identify the type of system that is to be treated and potential problem areas that could be a determining factor in the selection of the type or types of products that need to be used. The following questions are some of the qualifiers that should be asked;

* How many different runs are on the system?
* How long is each of the runs in length?
* What is the raw water total alkalinity in ppm?
* How much make up water does the system use daily?
* Is the return line system pump, pump & gravity or gravity?
* If the system uses a pump, is the condensate receiver open to the atmosphere?
* Are there vacuum breakers in the system?
* Are there pressure reducing stations in the system?
* Does the plant use steam dryers?
* What process contaminants could the condensate bring into the system if there was a process leak?
* Is the plant regulated by either USDA or FDA?
* Does the plant generate electricity with steam turbines?
* Have condensate lines been removed recently?
* If lines have been removed, do they show a grooving on the bottom of the line with a thinning of the threads, are there pits on the top of the line or are both conditions present?
* What type of treatment program is presently being used?

* Where in the boiler system is the return line treatment product added?

The answers to these questions will allow you to determine some of the areas which will dictate what type of condensate return line program which will need to be used.

A system with a number of different types of runs of varying length could mean that a blended amine program will be needed. It could also require the use of remote pumping stations. The system could take a short run to a low pressure turbine, then a medium length run for a process and then a series of long runs that go through pressure reducing stations. In this case, a blend of three neutralizing amine would be required. Cyclohexylamine for the long run and for the reducing station, DEAE for the medium run and Morpholine for the short run turbine line.

By using a 35% solution of each of these amines and varying the amount of each amine in the mix tank, you will be able to come up with a blend that will work for that particular system.

After you have determined how many runs there are, you need to determine the length of the runs. This will determine if one or more amines will be needed in this system. Cyclohexylamine will stay in the condensate system over long runs and in low pressure situations. DEAE is a good medium range amine, but does not have the ability to pass over the long runs and through pressure reducing stations below 15 psi. Morpholine is used for short runs and will have to be blended with one or both of the other neutralizing amines if the system is more than a short run.

It is important at this point to realize that DEAE as a 25% or 50% solution is the most widely used neutralizing amine. DEAE will adequately protect the return line system in most middle market water treatment accounts. Its success is also its vulnerability. In many accounts, Diethylaminoethanol is being fed where there is one long run and some low pressure reducing stations. In these cases, the largest part of the system is protected, but a small section is not. One condensate return line run has a pH of 8.2 and the other has a pH or 6.8. In these cases, Cyclohexylamine needs to be blended in with the DEAE. The new combination product now protects both the long and the medium runs of the system.

The total alkalinity of the raw water and the quantity of raw water will determine the use rate of the neutralizing amine. 1 ppm of 35% neutralizing amine is required for every ppm of total alkalinity in the feed water. Multiply this times the millions of pounds of feed water and you can establish the feed rate in pounds for the neutralizing amine. Use this check to see if the present amine program is being under or over fed. The feed rate could point out where the real problem is.

In a pump and gravity system, a condensate receiver that is open to the air can pull oxygen into the condensate lines. The account now has severe pitting in some of the lines and not in others. The use of a blend of a neutralizing amine and a filming amine will help this condition. Sealing the receiver is what really needs to be done.

Vacuum breakers in a line will pull oxygen in during operation. This will show up as oxygen pitting in the lines. Neutralizing amines have no effect on oxygen and a filming amine will need to be added to the system.

Where steam dryers and pressure reducing stations are part of the system, you are limited to the use of neutralizing amines. Filming amines by their nature drop out as a wax coating. Any restriction in flow or pressure acts as a trap for the filming amine. The result is a clogged system. Where this problem exists, the use of neutralizing amines will thin the filming amine build up and slowly remove it from the system. Should oxygen prove to be a problem in this system, the filming amine will have to be added after the dryer or pressure reduction area. It should also be a dilute filming amine solution that has been blended with neutralizing amines, or it will not carry down the lines.

Where process leaks are acidic, the problem in the condensate lines could be process related and have nothing to do with the amine program that is in use. Check this before you start to change the amines that are being used.

If the plant is under USDA or FDA control, then the type of product used and the amount allowed in the system are established by these agencies. If the account is a Dairy, the only acceptable amine for the system is aqueous ammonium hydroxide. In this case, consult the plant agency inspector as to what they will allow.

Where a plant is generating electricity, you will have to use Morpholine. Without it, the turbine will not be protected. If the steam is then used in other parts of the plant after it has passed through the turbine, then other neutralizing amines will need to be blended into the product based on the length and type of systems that come off of the turbine. Do not feed any type of filming amine to a turbine. It will gum up the blades and slow down or stop the turbine. Should filming amine be required due to oxygen in the system? feed it into the steam header on the discharge side of the turbine.

Where a condensate line can be cut open and examined, you will be able to confirm the system condition. Pitting means oxygen is present and grooving indicates
insufficient neutralizing amine in the system.

Once you have determined the problem areas, you need to check as to what amines are presently being used. This will help to determine what additional amines need to be blended into the product.

The injection point of the amine is important. Filming amines need to be fed to the steam header, as they do not leave the boiler with the steam in any effective quantity. Neutralizing amines can be added directly to the boiler. They will volatilize and carry with the steam. They should not be added to a deareator or feed water tank. In these vessels, water is heated to drive off the oxygen. The neutralizing amine is also a volatile gas and portions of it will be volatilized and carry off with the removed oxygen. This drives up the feed rate requirements.

Once the type or the blend of amines has been selected, you need to begin feeding them with care. You are going into a dirty system, which can come back and plug traps as it cleans up. Because of this problem, the filming amine is usually started at 25% of the recommended feed rate based on the

steam produced by the boiler. Over the next few weeks, slowly increase the feed rate and watch the traps for any sign of fouling from return line corrosion by-products.

Conversely, when a filming amine has been improperly used or over fed and a wax build up has occurred, the neutralizing amine needs to be started at 25% to 50% of the recommended feed rate until the filming amine has been cleaned up from the system. Check soluble iron levels during this period to assure that the neutralizing amine feed rate is not too low to protect the system during the clean up.

There are economic reasons for the use of a filming amine where a neutralizing amine has been used. Take a system with 1,000,000 pounds of steam produced daily. The condensate return percentage is 50% and the boiler make up cycles are 15. This boiler will then produce 1,000,000 pounds of steam a day and approximately 517,000 pounds of make up daily. A filming amine selling for $3.00/lb and fed at 1 lb for every 100,000 pounds of steam produced would cost $30.00 per day to use. A 50% neutralizing amine at $4.00/lb would require 15.7 lbs per day or $62.80 if the total alkalinity was 100 ppm or $31.40 if the total alkalinity was only 50 ppm in the raw water. To assist your account in cost savings, the use of a filming amine over a neutralizing amine may be a choice. Be careful in this as they will need a new feed system to pump the filming amine. Filming amines are difficult to pump and to handle and could be too much of an inconvenience for the operators. Also, if there is a turbine, a dryer, a pressure reducing station, or a long run, the filming amine will not be effective. It could even prove to stop production as it plugs a dryer or a station and end up costing the customer far more than they saved from changing amines.

The selection of the proper amine or amines for a condensate system needs to be a detailed procedure. Learn the system and its problems so that the proper product can be used. Look to use a blended amine product for sophisticated or multi run systems. Be careful in the use of filming amines whether it is Octadecylamine or the newer Tallow Amine derivatives.