

Evolution of Condensate Management in Condensing Appliances

During the past decade, the number of condensing boilers, furnaces and water heaters being installed has continued to rise every year. All indications are that this trend will continue and in some cases is already mandated by federal authorities. Provisions for dealing with the corrosive condensate from these appliances are covered by the Plumbing Codes on the national, state and local levels. Because of the long term effects of the sustained introduction of this corrosive condensate into drains and sewer lines, there is a growing awareness of the need to educate code enforcement officials, contractors and homeowners of the need and the means to neutralize this corrosive outflow.

Multiply by 10

When condensing appliances first appeared in the US, some manufacturers stated that the condensate had a pH of between 3.8 and 4.2 which is lower than the generally accepted range of between 5 and 10 or sometimes 12, for the disposal of aqueous solutions into drainage, sewer and septic systems. Any aqueous solution with a pH below 5 is considered corrosive. We have found some condensate to have a pH as low as 2 which means that it is 1000 times more acidic than the minimum of 5, which allows disposal without treatment. How can this be? The pH scale goes from 0-14 with 7 being neutral. Anything below 7 is considered acidic. The pH scale is logarithmic, meaning that each jump of one is a tenfold increase or decrease in acidity. Many of us have seen the damage that this condensate can cause and realize why it must be treated.

How to Treat Condensate

There are basically two ways to treat this condensate; neutralization or dilution.

- Dilution is accomplished by mixing the condensate with pure water to raise the pH. An example would be 1 gallon of condensate at a pH of 3 would need to mix with 10 gallons of pure water to bring it to a pH of 4. Then you would have 11 gallons with a pH of 4 and it would take 110 more gallons of pure water to bring the pH up to 5 to meet the disposal requirement. Now you have used 120 gallons of pure water to dilute one gallon of condensate with a pH of 4. If the original gallon of condensate had a pH of 2 you would have needed an additional 1210 gallons or a total of 1330 gallons to dilute one gallon of condensate! As you can see, this is not a very environmentally sound way of doing it and in some, if not most areas, there are clean water regulations that would make this process illegal. This brings us to the alternative – neutralization.
- Neutralization is accomplished by running the condensate through a container of some kind which is filled with media to raise the pH to an acceptable level. At first, most thought that regular limestone or marble rock or chips could be used to do this. Many got their own

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containers or drum traps and went to the big box home store and bought a bag of landscape marble or limestone chips. Although these chips contain one of the compounds used for neutralization – calcium carbonate - the material itself is so hard that it does not dissolve and the surface of the rock becomes coated with salts and loses its effectiveness. Performance is also adversely impacted by rock size; a collection of large rocks will have less surface area than an equal quantity of smaller rocks.

The Correct Mix is Important

Calcium carbonate is found in all marble, limestone and even sea shells. Calcium carbonate is regarded as being self-regulating which means that it cannot over correct and cause an alkaline condition. Calcite, a very common and widespread mineral form of calcium carbonate is best recognized by its relatively low Mohs hardness (3) and its high reactivity with even weak acids, such as vinegar. The low Mohs hardness allows it to dissolve as it reacts with the acidic solution thus reducing the likelihood of coating the surface as with the harder marble chips. Magnesium oxide and magnesium hydroxide are also used to raise pH in an aqueous solution. Magnesium hydroxide is basically magnesium oxide that has not had all of the water removed. Magnesium oxide and magnesium hydroxide are not self-regulating and care must be taken not to cause an alkaline condition. The magnesium products are quicker acting than the calcium carbonate and help to increase the performance. In a proper mix these two materials do an excellent job in neutralizing acidic aqueous solutions. Calcite, magnesium oxide and magnesium hydroxide are all used in the treatment of potable (drinking) water and are environmentally friendly.

In Conclusion

We know that condensate from condensing appliances is acidic and corrosive to many materials and should be treated to bring the pH up to at least 5 before disposal. We know that dilution is not an environmentally acceptable method of treating this corrosive aqueous solution. We know that calcite, magnesium oxide and magnesium hydroxide are good sources of media to treat condensate. We also know that there can be a wide variation of the pH of condensate from condensing appliances due to the chemical make-up of the gas being combusted or from the way in which the appliance is operating in a particular application. And let's not forget that a fully condensing appliance will produce up to 1 gallon of condensate per hour for every 100,000 BTUH input.

Neutralizer manufacturers provide sizing guidelines but because of the varying range of condensate pH, it is necessary for the contractor to verify that the particular unit he has installed will work on that application. Remember that the media is reacting with the solution to raise the pH and does need to be replaced. Most manufacturers recommend replacing media and checking operation at least annually. This can be done along with the annual servicing of the appliance as recommended by appliance manufacturers.