

Intellihot

Threats to the environment from high-efficiency condensing devices

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Background

All high-efficiency, gas-fired condensing appliances such as boilers, water heaters, and rooftop units capture the latent heat in the flue gases and condense it to a liquid that drains out as a condensate (figure 1). This condensate is acidic with a pH level between 3 to 5 and contains a concentration of hydrochloric acid, sulfuric acid, and nitric acid. When the untreated acidic condensate flows directly into the ground, it not only affects the environment but also damages drains, pipes, and sewer systems. It also threatens the life of terrestrial plants and organisms due to its acidity.

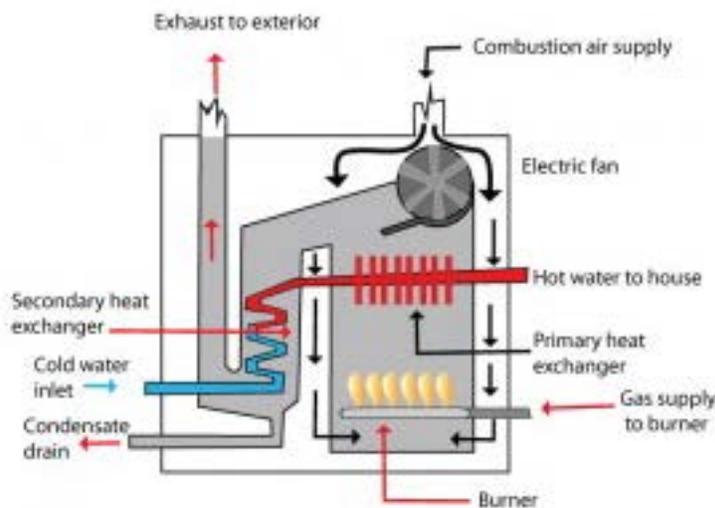


Figure 1 - A typical condensing boiler creating acidic condensate

As a rule of thumb, condensing appliances produce 1 gallon of condensate for every 100,000 BTUH. In the US, it is estimated that there are 2 million high efficiency condensing devices operating in the 200,000 BTU/H range, producing 2 GPH of acidic condensate (AHRI, 2015). Based on the assumption that each condensing appliance is running for 5-6 hours a day, they collectively expel nearly 8,760,000,000 gallons of acidic condensate per year (Calculations based on data from AHRI, 2015).

To put these large numbers in perspective, these appliances are producing 443 gallons of condensate per person per year in New York, or 27 gallons per person per year in the US.

Existing code for treatment of acidic condensate

According to International Plumbing Code (IPC) section 803.1, the acidic condensate should be diluted or neutralized before discharging into the drainage systems and should maintain a pH level between 7.5 and 8.5 (The National Board of Boiler and Pressure Vessel Inspectors, 2015). Diluting the condensate with clean water is an inefficient strategy since it takes approximately 10 gallons of clean water to dilute 1 gallon of condensate from pH 3 to pH 4. Needless to say, this strategy of neutralizing the condensate is clearly not environmentally friendly, since water is an increasingly scarce environmental resource. Thus, in practice, the condensate is generally neutralized by passing it through a neutralizer kit, which is typically a plastic box containing a neutralizing media, such as, lime stone, marble chips, or calcium hydroxide pellets. This neutralizing media aims to increase the pH level of the acidic condensate to be between 7.5 and 8.5 before expelling it. However, in reality the acidity is seldom neutralized effectively or in a consistent fashion, by current condensate neutralizers.



The Problem

There are two key reasons for the inefficient treatment of acidic condensate by current condensate neutralizers in the market. First, most of the existing condensate neutralizers are ineffective due to their poor design. The acidic condensate is ideally required to pass through a bag of neutralizing media, which increases the pH value before discharging it into the drain. However, due to the ineffective design of most of the current neutralizers, the path taken by the acidic condensate flows only partially through the neutralizing media and exits without being fully treated and neutralized. The hot condensate rises to the top and exits without fully passing through the media without being neutralized (figure 2). This phenomenon is akin to an oil film on water skimming the surface.

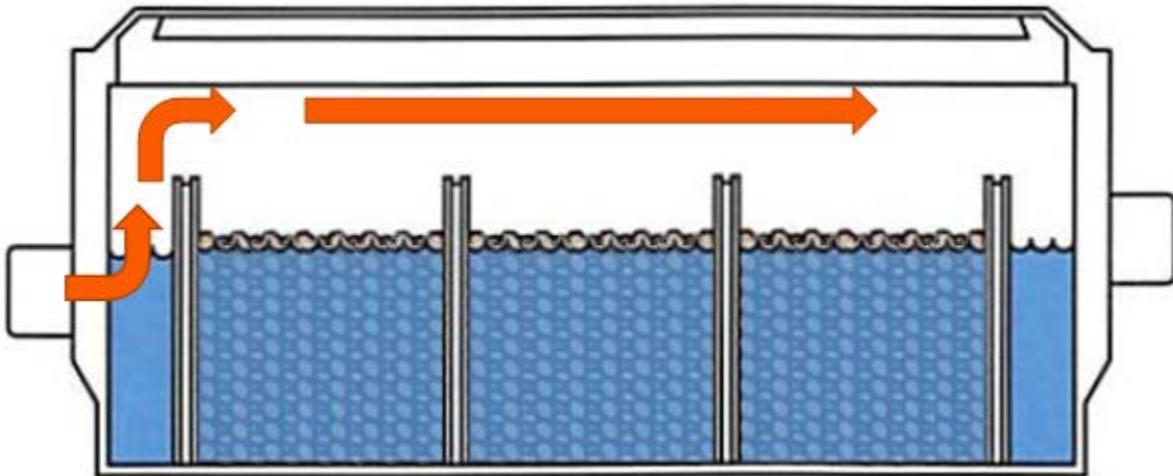


Figure 2 - Hot condensate rising to the top and exiting without being neutralized.

Second, the neutralizing media is a consumable and should be replaced at regular intervals. Most manufacturers recommend that the neutralizing media should be changed at least annually, or when the pH level drops below 5. As a practice, users should use methods such as pH sensor testing or litmus paper testing to measure the pH value on a regular basis, and refresh the media as soon as the pH value falls below 5. Failure to measure the pH values regularly, and therefore a failure to refresh the media, results in untreated condensate exiting into the drain, which causes corrosion of drains and pipes (figure 3), and environmental contamination. Hence, in practice, the current condensate neutralizers in the market fail to accomplish any neutralization effectively.



Figure 3 - Drain corroded by acidic condensate.



The Solution

Intellihot's telliBot (figure 4) is the world's first smart condensate neutralizer with a built-in pH sensor, in addition to being IoT and Wi-Fi enabled for remote connectivity. telliBot is a state-of-the-art smart condensate neutralizer, and it also includes robotic features that can "smartify" any boiler room by transforming every water heater or boiler into a smart device.



Figure 4 - telliBot, the world's first smart condensate neutralizer

How telliBot treats condensate

telliBot's advanced design ensures that all the acidic condensate from high-efficiency condensate devices passes only through the neutralizing media bag (figure 5) due to its innovative upward-downward, two-pass flow design.

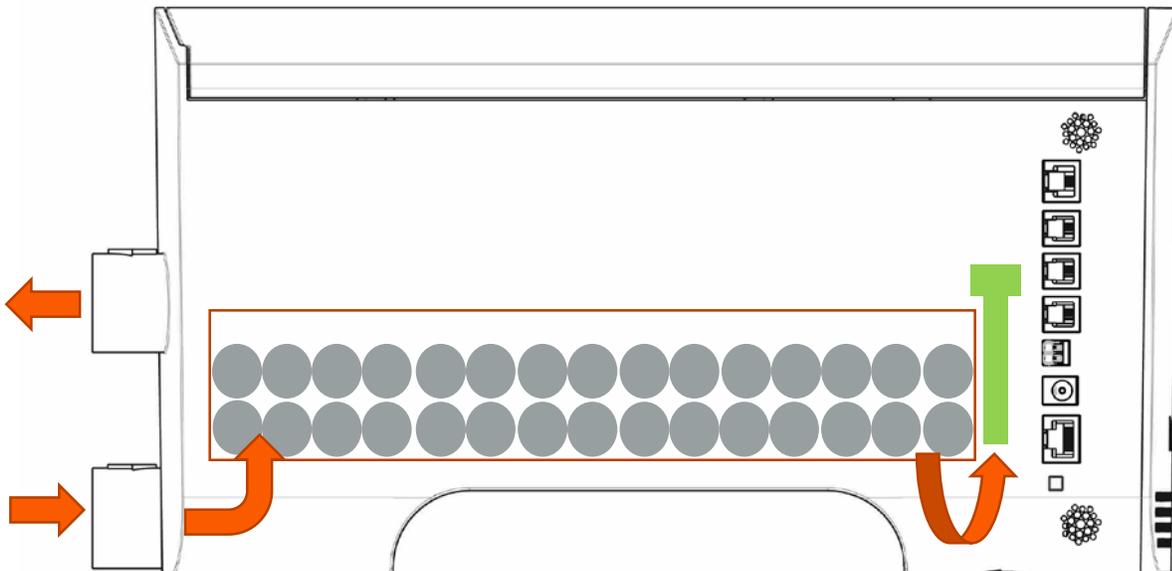


Figure 5 - The path of the condensate through telliBot, using an upward-downward, two-pass flow design.



Intellihot's patented upward-downward, two-pass flow design ensures that all the condensate flows through a pre-defined path through the media which completely neutralizes the condensate, before it is discharged into the sewage pipes or drains. The pH sensor is placed in a position where it can monitor the pH level continuously, and it notifies the user in advance when the media needs to be replaced, through a mobile app, SMS or e-mail. In fact, media shipment can be automatically scheduled to arrive ahead of time so that the media can be replaced in a timely fashion so that the condensate is always treated correctly. telliBot also has an interlock which can be set up to prevent the boiler or water heater from firing in case of media runout, again preventing damage to the drain system and the environment.

Smartify Your Boiler Room™



Figure 6 - The various sensors in telliBot

telliBot comes with a host of other sensors that can not only monitor your boiler room but can also transform any water heater or boiler into a smart device (figure 6). These sensors are: pH, Carbon-monoxide, Natural Gas/Propane, water leak, water flow rate and several temperature sensors.

Capabilities of telliBot

Monitor water temperatures - Using a clip-on probe, the user can monitor the boiler or water heater supply/return temperatures.

Prevent leak damages - A built-in leak sensor notifies the user of any water leaks in the boiler room or condensate back-ups. If the optional water valve kit is installed, telliBot can shut off the water and turn off the boiler or water heater.



Gas and Carbon monoxide safety - A carbon monoxide and flue-gas sensor notifies the user of any leaks. If the optional gas valve kit is installed, telliBot can shut off the gas.

Calculate cost savings opportunity – The user can monitor hot water demand and draw profile if the optional flow sensor kit is installed.

Mobile app - telliBot comes with a mobile app that sends automated notifications.

Prevent corrosion damage - telliBot monitors the neutralizer media usage and sends a notification through the mobile app when it is time to replace it. No more guessing when to reload the media and risk corrosion damage.

Never out of media - when subscribed to telliBot service, the user is notified when the media needs to be replaced and media is shipped before it is used up.

Predictive Analytics Service (PAS)

telliBot comes with a service that monitors the boiler room on a comprehensive set of parameters, and offers various predictive analytics to the user:

Monitoring & Predictive Analytics - telliBot monitors the supply/return temperatures of any water heater or boiler, and send alerts for any out of range activity. In addition, telliBot PAS predicts the health of the unit(s) based on historical performance.

Water Leakage & Condensate Backup - telliBot monitors for any leaks that might be starting and sends alerts if that happens.

Carbon Monoxide and flue-gas leakage - telliBot monitors for any Carbon Monoxide and flue-gas leakage and sends alerts if that happens.

Neutralizer media - telliBot PAS monitors the media usage and ships out the neutralizer media before it is used up.

Remote On/Off - In the event that the condensate is blocked, telliBot can turn off the water heater or boiler via a remote interlock output.

Buzzer/Alarm - telliBot has an audible buzzer and a visual alarm to alert building personnel about any issues.

Conclusion

The current condensate neutralizers in the market, are unable to ensure that - a) all the acidic media passes through the neutralizing media due to their ineffective design; and b) the neutralizing media is replaced frequently and regularly by the user since there is no user-friendly mechanism for the users to be notified when it is time to replace the media. This results in large amounts of acidic condensate not being neutralized effectively across the US. This, in turn, has a very negative impact on the environment, because these large amounts of acidic condensate are being discharged in sewage pipes and drains all over the country.



telliBot provides an elegant, economical and effective solution to these problems. Firstly, telliBot has the built-in smarts to monitor the neutralizer media usage and send a notification through the mobile app when it is time to replace it. Thus, the user doesn't have to guess when to reload the media and risk corrosion damage. Secondly, telliBot ensures that all the acidic condensate passes through the neutralizing media before it is drained out, through its patented upward-downward, two-pass flow design.

telliBot is environmentally friendly and comes with a host of robotic features that transforms any boiler or water heater into a smart device, one that can be monitored remotely. telliBot acts as a guardian of the boiler room, by warning the user about the conditions that might cause damage to the equipment or building, or contaminate the environment.

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