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The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U_j U_i)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}_i\overline{U}_j)=-\frac{\partial \overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}_i\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial \overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Water Leak Detection Systems for High Value Assets

Detecting water leaks is critical to protecting high value assets from irreparable damage and significant repair and replacement costs. Leaks can range from a small drip from a water container or pipe to a flooding event from a burst pipe to an overflow event that creates a volume of standing water that may leak though small openings or penetrations. Any unrecognized or unintended leak can become disastrous over time if left unattended. Furthermore, without auditory or visual recognition of the leak or the ability to identify the source, no leak detection system will reliably protect property from damage. Although there are many simple, inexpensive methods to detect the presence of water, utilizing a single leak detection methodology may be short-sighted, providing a short-term solution without necessarily determining the source and extent of the leak. This article reviews several leak detection methods, their mechanisms, and considerations when selecting a system.

Assessment

A building assessment should be performed prior to selecting a water leak detection system. This assessment determines building needs; identifies risk areas where water leaks occur and areas and assets that need to be protected; and ensures that the BAS is reliable and not subject to failures. It also provides an opportunity to look for systems that can offer advancements in wireless and monitoring technology.

Factors to consider include sensor locations and access (critical space walls, pipe chases, floors, ceilings, mechanical penthouses); confined locations (drip pans under HVAC units); speed of detection and leak location accuracy; accommodations for different types of sensors to physical constraints such as hard-to-reach areas; ensuring cables and sensors are out of the way of damage; types of notification required (simple alarm or notification via automated system); the standard procedure for ongoing inspection of building plumbing and HVAC systems; connectivity with the BAS; ease of installation; and technical support required.

Wired vs. Wireless

Sensors can be wired or wireless. Wired sensors provide security, reliability, and speed and are cost-effective to maintain. However, they lack mobility and have a high initial cost and scalability difficulties. Wireless sensors transmit data via a dedicated wireless platform or Wi-Fi on existing network. They provide flexibility and can cover large monitoring areas while being cost effective. The disadvantages to wireless sensors are shorter battery life, slower speeds, and limited signal due to RF interferences.

Spot Detector Sensors

A spot detector sensor uses two gold-plated, corrosion-resistant probes to detect the presence of water. When water forms a bridge between the two probes, the sensor activates an alarm. Probes are adjustable to the desired height and connected to the BAS. These sensors are flexible: they are good for confined or contained areas, should function while immersed in water, and should not activate in high humidity areas. They can be designed to handle dirt and detect RO water if desired.

Sensing Detection Cable

A sensing detection cable detects water anywhere along its length. It is constructed of sensing wires and insulated wires with an abrasion-resistant, non-conductive polymer core. This helps prevent false alarms. The cable is plenum rated, fast-drying, and highly flexible, allowing for small bend radii. It should not be placed in areas where it can be damaged by foot traffic or tools rolling or dropping. In high humidity areas, sensitivity adjustment is essential to minimize false alarms.

Distance Read Controllers

These standalone controllers are paired with sensing cables in areas such as raised floors in computer rooms, pipe chases where leaks can go unseen, or ceiling plenums. The controllers can pinpoint where along the length of the sensing cable a leak is occurring. Advanced controllers are capable of BAS integration via BACnet and equipped with local LCD screens with mapping capabilities to display status, provide alarm notifications, and allow for sensitivity adjustments.

Acoustic Detection

This technology uses acoustic noise sensors and leak noise correlators attached to valves to identify leak locations. They help identify small leaks before they become major problems.

Fluorescent Leak Detection

This technology is used to detect and locate leaks in piping systems. Once the dye is injected into the system and allowed to circulate with the host fluid, technicians inspect for leak sites using UV lamps. Depending on the size of system, it can take 5-45 minutes to find leaks. They can be deployed easily and inexpensively. This requires regular and thorough manual monitoring.

Lineal Tape Detectors

This method uses capacitance measurement to detect water leaks. Water detector tape is wrapped around the equipment or source of the leak. A warning will sound when as few as two drops (adjustable) of water comes in contact with the tape. This method is relatively inexpensive; lineal tape along with the dye detection method can provide a short-term solution for leak detection.

Conclusion

There are several technologies available for water leak detection. Utilizing a single leak detection methodology is not advisable; instead, a hybrid leak detection system should be installed. As with any technology, it is critical that false positive or negative responses be discussed with specific vendors prior to system installation.

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