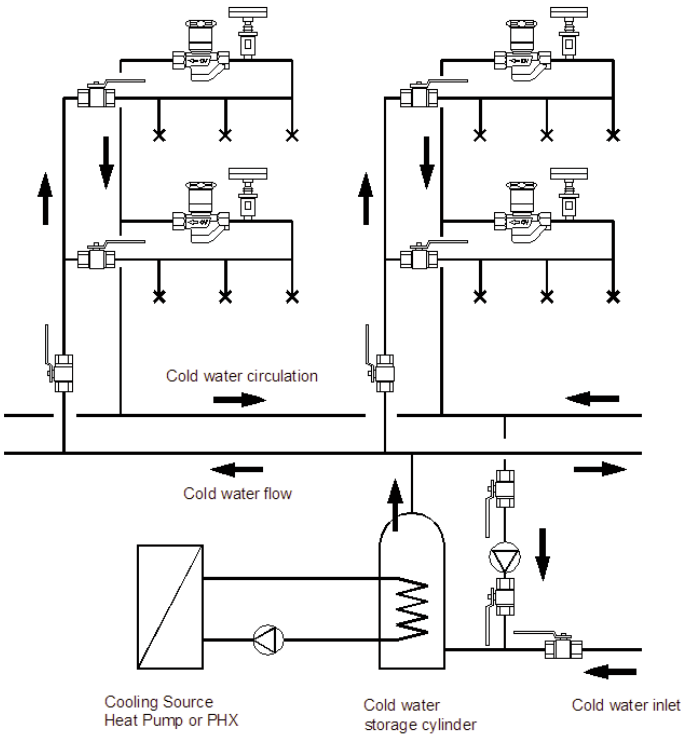
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Engineering Solutions for Energy Efficiency

Cold water thermal balancing





Wholesome or Potable cold water is one of the most important products for our nutrition and wellbeing and is used everyday in all walks of life. It is therefore very important that this water is free from bacteria and micro-organisms. Two micro-organisms that are of major significance are Legionella Pneumophila and Pseudonomas Aeruginosa which inhabit the biofilms on the surfaces of the pipes. For most healthy people, these bacteria have little effect, however, occupants in hospitals, healthcare premises, schools and public buildings are likely to be most susceptible.

The main factors that lead to an increase in the growth of these bacteria are stagnation, the nutrients within fresh water, the existence of bacterial bio-films and water temperature with both Legionella and Pseudonomas at their most active between the temperatures of 20°C and 50°C.

By far the factor with the largest effect is stagnation. When still, both the bio-film and the bacteria easily attach themselves onto the surface of the pipe and fittings. Once attached, increase in temperature and the availability of naturally occuring nutrients provide the ideal conditions for the bacteria to grow.

If water is allowed to be static within a building, heat is transferred to the water from the surrounding areas. This will be from the adjacent room or where pipe work is concealed within service ducts or ceiling voids, consequently the ambient temperature will be significantly higher than 20°C and therefore the water is effectively stored in the pipe work at the ideal temperatures for Legionella growth.

In a hot water system, there is the opportunity to elevate the temperatures to 70°C periodically to pasteurise the system. This is not possible in cold water systems, therefore it is essential to keep the cold water below 20°C.

To ensure the control of Legionella, it is essential that dead legs are kept to a minimum. In a traditional cold water system, it is not possible to minimise deadlegs and potentially stagnant areas, as when there is no draw-off, the entire system becomes a dead leg.

Therefore to exchange the water in the pipe work for water below 20°C, it becomes necessary to put into place a regular maintenance regime of flushing cold water through all outlets until the measured temperature is below 20°C at each. It must be recognised however that as soon as the flow stops the temperature issues and increases can quickly return.

This is where the balance between risk to the occupants and the effect on the environment together with the cost for the maintenance regime and the cost of water and waste needs to be considered.

To minimise this wastage and ensure that there is a flow within all parts of the system, a circulation system including circulation pump should be provided, similar to that used in hot water systems.

As with any circulation system, in order to ensure the cold water circulation system works efficiently and economically, it is essential for the circulation system to be balanced to ensure that return water is drawn from all areas of the building.

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It must be appreciated that as draw off occurs, the dynamics of the system change, with water taking the least line of resistance through the open outlets. If relying solely upon static balancing techniques, the only time that the system will be in balance is when there is no draw off.

As the reason for employing a circulation system is to keep water temperature within the pipe work below the problem temperature for Legionella protection, the desire should be to provide a means by which to monitor the temperatures within the pipe work and dynamically balance the flows of water by continually increasing or decreasing these flows to achieve the desired temperature in reaction to draw off from the system.

Temperature balancing valves are designed to meet this requirement. The valve monitors the temperature of the water as it passes across the internal sensing element and then adjusts the flow of water accordingly. If the temperature sensed at the valve is too high, in relation to the set point, the valve will open to provide more water to pass to the return. As the sensed water temperature reduces towards the set point, the valve will gradually throttle back to a minimum residual flow condition at the set point. It is essential that this minimum residual flow is maintained to ensure that deadlegs are not created.

The valves would be preset to a recommended flow temperature setting but this would be adjustable to suit particular water temperature and site requirements.

Whilst, in combination with a circulating pump, the above will provide the necessary constant circulation and therefore minimise dead legs, this is not a total solution to Cold Water temperature control on it's own.

Desired draw-off water temperature, incoming water temperature and circulation pick up must all be considered when designing the circulation system.

It is possible that at certain times of the year, the incoming mains water temperature can already be close to or even in excess of 20°C.

Also, depending upon the building usage, especially where there are large periods without draw-off, the cold water temperature, even when being circulated, can be above the 20°C.

Therefore in order to ensure that the water is kept below 20°C, a source of cooling should be made available. This could be in the form of a dedicated chiller or the use of existing chiller plant. For best efficiency, a buffer tank maintained at a temperature of 3°C below the desired outlet temperature, would allow for large variations in draw off or cooling demand.

The cold water supply network should be sized as normal with reference to demand units and diversity factors. The cold water return pipe work would be sized on the same basis as hot water circulation pipe work, taking into account the heat pick up of the return pipe work. The locations of the temperature balancing valves would be determined, based on a rationale of a maximum of 15 outlets within a group and a maximum length of group return pipe work of 10 metres from the last connection within the group to the thermal balancing valve. Adoption of this rationale should mean that the total flow rate required to satisfy the minimum flow requirement of the thermal balancing valves will be very similar to the flow rate calculated during pipe sizing.

Due to the very low flow rates required for return circulation and the use of a temperature balancing valve on a group of outlets, there will be no need for individual balancing devices on the return loop from each outlet within the group. In practice, the minuscule flow rates within the pipe work would lead to differences in the pipe pressure drops between the most favoured and least favoured outlets in the regions of Pascals only, which cannot be balanced within water systems.

No specific balancing would be required when using temperature balancing valves. Each valve needs only to be set to work by adjusting the temperature set point if the desired control temperature is different to the factory setting. It is then recommended to energise the cooling system and to circulate this for 48 hours to allow the valves and the system to settle. After this period, temperatures should be checked at the temperature gauges located adjacent to the temperature balancing valve.

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