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Continuous circulation means greater efficiency, comfort

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Because of Europe's heavy use of hydronic heating systems, research and development efforts naturally have been concentrated in this area, not only at the heat source but also at the control and distribution level. As a result, a number of control techniques have been developed that increase both fuel efficiency and heating comfort. These concepts are applicable to the American market, particularly control methods dealing with distribution systems.

Much of today's oil- and gas-fired hydronic equipment routinely achieves seasonal efficiency levels of 80% and better. Every additional percentage point to be gained by bringing flue gas temperatures into the condensing stage results in excessive equipment and maintenance costs. It's time to take a closer look at the distribution system as a whole, where there is an enormous potential for fuel reduction in commercial and residential buildings.

It is possible to save fuel in new and existing hydronic systems. These savings can be realized through existing off-the-shelf technologies at

extremely low cost. Also, a dramatic increase in heating comfort is an attractive byproduct of the fuel reduction achieved by tweaking the control concepts.

The most efficient method of operating a hydronic system is by running the circulator constantly and resetting the system water temperature to maintain the building temperature setpoint.

Continuous circulation results in fewer indoor temperature fluctuations and thus greater indoor comfort, as well as reduced fuel consumption on the order of 10% to 35% because overheating and underheating cycles are eliminated.

The heating curve will vary depending on the amount of radiation and insulation in the beginning.

Boiler temperature modulation in response to outside temperature change is a first step toward the continuous circulation concept. However, a true continuous circulation system cannot be obtained without the use of a three- or four-way mixing valve. Depending on the

application, three- or four-way valves with rotary or plug-and-seat design in sizes from 3/4-in. to 8-in. are available in threaded, flanged, weld-neck or sweat adapter connections. A typical four-way mixing valve installed in an existing intermittent circulation system will divide the circulation loop into radiation and boiler loops.

In the fully closed position, the valve will separate the two loops completely. In the fully open position, the valve will have no effect on the circulation loop at all. It is when the valve is in any intermediate position that the mixing action takes place. The valve will mix boiler flow and radiation return water, modulating the temperature of the water flowing through the radiation loop, either hotter or cooler, depending on the heating demand and outside temperature.

Mixing valves can be adjusted manually or automatically. Manual adjustment requires physically resetting the device every time the outside temperature changes. Doing this can be annoying to the homeowner and the full benefit of the valve can never be achieved. Therefore, a weather-responsive control system is recommended.

Over the years, many types and variations of weather-responsive controls have evolved. They determine the precise flow temperature for a given dwelling along an adjusted heating curve. This curve represents the relationship between

a certain outside temperature and the necessary corresponding flow temperature.

The heating curve will vary depending on the amount of radiation and insulation in the building. Therefore, the installer must make the initial heating curve adjustment.

These motor-driven proportional controllers modulate the mixing valve by sensing the outside temperature and the flow temperature of the radiant loop. Most controllers can be set for temperature setback periods, as well as for burner and pump switching. More complex commercial versions have built-in functions that take wind chill and solar and internal heat gain factors into consideration.

Heating optimization is an additional feature of the more sophisticated controllers. This logic feature calculates, by monitoring the outside and inside temperatures, the latest possible moment to bring the heating system's temperature back to the required level before the building is occupied. This maximizes the setback savings achieved when the building is empty. Such automatic reset controls offer a number of additional advantages:

- Elimination of boiler overfiring. The "draining" of boiler temperature during circulator startup is eliminated, thus allowing higher combustion efficiencies by downsizing the heat source and achieving longer firing cycles.
- Elimination of thermal shock caused by surges of cold return water to the boiler (with the use of a four-way valve). The return water is pre-tempered by the mixing valve, which increases the life expectancy of the boiler.

- Elimination of the uncomfortable dust-smoldering effect on fin-tube convectors and radiators because flow temperatures are now lower.
- Peak performance of thermostatic radiator valves is obtained because the optimum flow temperature for any of these valves lies within the medium range of 90°F to 140°F. Zone valves will also last longer because of the lower water temperatures.
- Elimination of circulator startups prolongs the life of the motor while decreasing electrical usage.

Can the mixing valve concept be integrated into an existing American circulating hot water system? Yes, it's an ideal marriage. All existing thermostats, operating zone valves or circulators will become high limit controls, taking solar gain and foreign heat sources (body heat, fireplaces, stoves, appliance heat, etc.) into consideration, thus eliminating possible temperature override in certain sections of the building.

Therefore, none of the existing controls need be removed. It is strictly a matter of adding a mixing valve, controller and sensors to the system and establishing a test room within the highest heat loss area of the building. The radiation in this test room will be operated as a "wild" circulation loop for proper temperature feedback (indoor temperature sensor) to the master controller.

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