Consideration for water treatment in homes with fire suppression systems-

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Introduction

Some residential fire suppression systems are designed to be part of the potable water system. They require the potable water system to produce a flow that will be adequate for the suppression system. Standalone potable water systems are typically designed for peak flows of 5-7 gallons per minute (gpm). The fire suppression system requirement adds as much as 19 gpm to this flow. These systems provide this flow either by increasing the capacity of the well pump or by adding atmospheric storage and a booster pump. In both of these cases, the pumps are usually controlled by a variable frequency drive (VFD). These drives control the speed of the pump in order to provide the wide range of flows required by the combined system.

Flow Problems and By-Passes

Flow rates for water treatment systems are set based on a dynamic pressure drop of 15 pounds per square inch (psi). A treatment system rated at 5 gpm creates a pressure loss of 15 psi at its rated flow. I have attached a table of some common flows and pressure losses for different types of systems.

There are treatment systems that are flow restricted. This restriction is required for them to deliver the guaranteed performance. This restriction is common for radon aeration systems. These systems will not allow more than a fixed maximum flow regardless of the pressure drop across the system.

Most treatment systems require a backwash (self-cleaning) cycle. This cycle requires an additional flow from the system. The amount of water required for the cleaning can vary from 2 to 7 gpm for a given system. This extra flow must be taken into consideration when designing the suppression system.

Fire system designs for NFPA 13D require flow rates of up to 26 gpm. These systems also require a minimum pressure to force the necessary flow through the system. It is not uncommon for this pressure to be 60 psi. Most residential water systems are designed to be operated at a maximum of 60-65 pounds. This means that any pressure drop from a treatment system beyond a few pounds will render the system ineffective.

We have seen many instances where the consumer is totally unaware that his system has been made inadequate by the simple addition of a cartridge filter. The filter is placed inline so all of the water for the house and the fire suppression system must pass through it. Many cartridge filters will not allow enough water to pass through them when they are new, let alone when they have accumulated enough sediment to cause flow problems for a good shower.

Uponor has tried to provide a solution for the problem by suggesting a pressure regulator be installed that will automatically by-pass untreated water around the treatment system in the event of an unacceptable pressure drop. This solution creates what is called a cross connection. A cross connection is any plumbing connection that will allow the mixing of treated and untreated water. This connection will go unnoticed leaving the homeowner with the likelihood of being exposed to health related contaminants. These types of by-passes and cross connections are in direct conflict with Maine Drinking Water Program rules for by-passes. The rule states that all by-passes must have a removable section of pipe that will leave an air gap between the by-pass connections, and that the removable piece of pipe cannot be attached to the plumbing during normal operation. The reason for the rule is to prevent consumers from being unknowingly subjected to operator error or mechanical failure in systems treating health related parameters.

Atmospheric Storage Tanks

Some of the Uponor fire suppression systems use atmospheric storage tanks to provide an adequate supply of water. These systems allow one to treat the water before entering the tank. This configuration is the most practical because a typical residential treatment system can handle the fill rate for the tanks.

These tanks do require air vents to allow air to flow in and out of the tanks. This air fills the changing volume over the top of the water as the level in the tank goes up and down. These storage tank systems, unless properly designed, create an added risk of biological contamination of the water through the air vent.

These tanks also provide an opportunity for elevated levels of iron and manganese to oxidize. The particles created by this oxidation will not only foul the tank but will foul the pump, pump controls, piping and sprinkler heads unless treated.

Cost Consideration of Added Treatment Requirements-

To treat the water for high flow systems without storage tanks would require treatment systems that have pressure losses of less than a few pounds. If the rated flow of a treatment system is, for example, 5 gpm and you need to provide 15 gpm, you will need 3 systems connected in parallel to provide the required flow. This flow will, however, create a 15 psi pressure loss. To

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have a treatment system with a 5 psi drop will require 9 of these systems.
As can be seen from the above, the cost of treatment without consideration of the added cost of the added flow requirements will be anything from 3 to 9 times. If the treatment cost for a home without fire suppression is $1,500 for a 5 gpm system, then, with fire suppression, it could cost between $4,500 (3 X $1,500) and $13,500 (9 X $1,500).

Other Technical Issues Not Being Considered

There are some issues that are not related to the treatment of the water which need to be considered. These include well capacities and storage tank level controls. Some of these systems assume that there is always enough capacity in the well to provide the required volume of water for the fire suppression system. Forty-eight hour pump tests are not performed on the wells to determine their sustainable recovery. Without these tests, there is no assurance that the well will support normal water use and have an adequate reserve capacity. This will be especially true as more wells in a development are added, putting more pressure on the aquifer. The pressure on the aquifer will also be increased by the addition of irrigation systems.
The storage tanks in these systems do not typically have controls to prevent the water level in the tank from being drawn down below the minimum required volume for the suppression system operation. Provisions for this should be included as part of the system.
The cost of pump tests, hydrogeological studies and levels controls need to be added to the cost of the systems on private wells.

Conclusion

All good intention can have undesirable consequences. It seems that this solution to fire suppression systems has dangerous consequences. It leaves the consumers unknowingly exposed to water related contaminants that can be just a fatal as a tragic fire. In some case with a low yielding well the consumer does not even have adequate fire protection. The best solution to fire suppression is still a standalone system with storage that is used only for the fire suppression system.

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Typical Flows for Some Treatment Systems-

System	Service flow	Backwash Flow	Pressure Loss at Service Flow	Notes
Small Filter	5	5	15	
Large Filter	7	7	15	
Small Softener	7	2	15	
Large Softener	12	3	15	
Radon Water System	6	NA	Flow Restricted	Cannot exceed restricted flow
Whole House RO	.5-2	NA	See Notes	Has its own storage