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Legionella Amplification in Carbon Filters

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Right People. **Right** Perspective. **Right** Now.

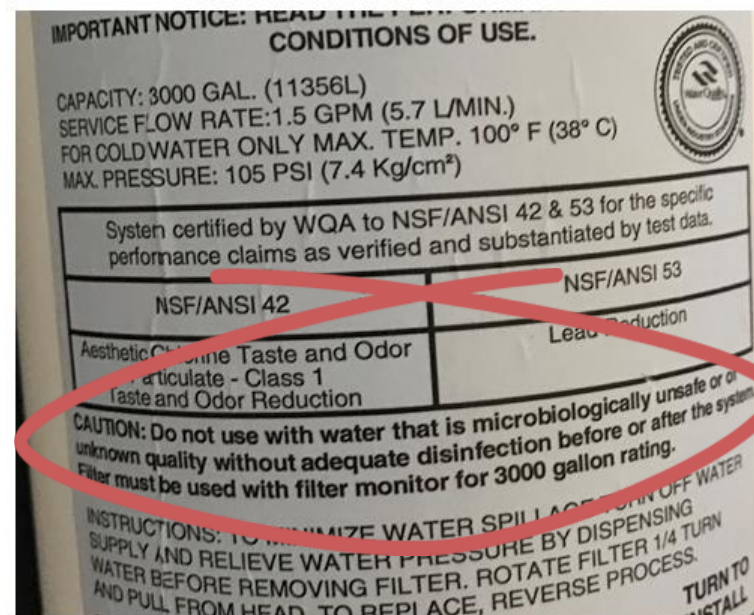
Good Tasting Water, At What Cost?

Carbon Filter Uses

- Municipalities sometimes recommend or require facilities to use filters to remove lead and other contaminants from drinking water.
- Carbon filters are also used to remove chlorine from water to improve taste and odor.
- Majority of filters used on drinking fountains and ice machines are carbon.

Requirements for Carbon Filters

- Must have a dedicated filter changing regiment.
- Water must be of relatively good quality.
- What defines “*microbiologically unsafe*”?
- Adequate disinfection “*after the system,*” how?
- Can Legionella can colonize filters long before the recommended change?



Unknown Consequences

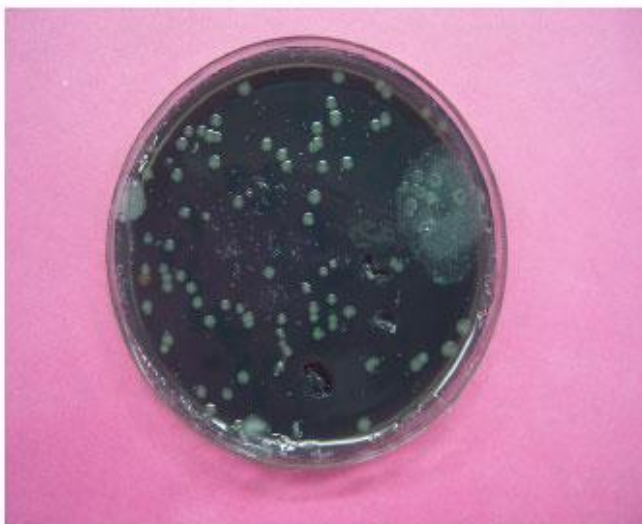
- Carbon removes chlorine, one of the controls that is most relied upon for *Legionella* control.
- How effective is a carbon filter at removing chlorine?

Device	Monochloramine (PPM)/ pH at the Water Line to the Device	Monochloramine (PPM)/ pH after Water Passed through Carbon Filter
Drinking Water Dispenser	2.20/7.82	0.11/8.12

Note: Monochloramine entering the building was 4.16 ppm. All samples were negative for *Legionella*

Unknown Consequences

- Drinking fountains and ice machines systems are generally designed in a manner that allows the water to become warm and stagnant after being filtered.
- Carbon filters supply a critical nutrient source.
- Carbon is one of the required nutrients for the media (buffered charcoal-yeast extract agar) that Laboratories use to grow *Legionella*.



*Picture Source: Interaction of Legionellae and Free-Living Amoebae Within Hospital Water Supplies by R.H. Doust, M.A. Mobarez, H. Bagheri and N. Khoramabadi

Filter Sampling

Number of Sites Sampled	Water Sample Results (cfu/ml)	Swab Results (cfu/swab)
Drinking Fountains (n=4)	2730, ND, Not Submitted, 3420	7600, 1860, ND, 3690
Ice Machines (n=3)	ND, ND, 3	Not Tested

- Samples were collected from filters that had been removed at the end of manufacturer's recommended cycle.
- *Legionella* control had been difficult for this facility, especially with ice machines and drinking fountains.
- The site changed filters at a frequency consistent with the manufacturer's recommendations.

Carbon Filter Experiment

Location on Filter	Colony Forming Unit (cfu/swab)
Carbon (n=5)	120, ND, 2460, ND, 3270
Mesh (n=3)	>6000, 5010, 570
Gasket (n=1)	>6000

- New Carbon Filters were installed in a cold-water bench-top test rig.



- All Filters tested positive for *Legionella*.
- All components of the filters tested positive for *Legionella*.
- Microbiological growth was observed on all components of the filter.



Ramifications

Limited Chlorine + Nutrients + Time = **Amplification**

- With the disinfectant removed the organism is allowed to grow on surfaces other than the filter.

After 1 Week



After 7 Weeks



Recommendations

- Water Quality:
 - Not “*microbiologically unsafe.*”
- Maintenance:
 - Increase the filter change rate.
- Modifications:
 - Drinking fountains and ice machines should have 0.2 μ m filter installed between the filter and devices.
 - A check valve or backflow preventer should be installed in the water line prior to the carbon filter.

Conclusions

- Carbon Filters pose a risk of amplifying *Legionella* and possibly other pathogenic bacteria. This is at an especially higher risk in building that have poor water quality supplied to it or has been degraded within the building's own systems.
- Besides occupant exposure, Legionella amplification on Carbon Filters may allow retrograde contamination of a water system, similar to what occurs in a Dead Leg water line.
- Assessment and monitoring of Carbon Filters is advised and their use should be considered in light of the risk.

Thank You!

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