

Penn State Harrisburg Small Public Water Systems Technology Assistance Center

Disinfection Byproduct Removal Using Point-Of-Use Carbon Filters

Sources of Disinfection Byproducts

Disinfection byproducts (DBPs) are a group of organic and inorganic compounds formed during water disinfection. Trihalomethanes (THMs), including chloroform, bromodichloromethane, chlorodibromomethane, and bromoform, and haloacetic acids (HAAs), including monochloroacetic acid, monobromoacetic acid, dichloroacetic acid, dibromoacetic acid, and trichloroacetic acid, are two groups of regulated organic DBPs in drinking water. Both THMs and HAAs occur in the finished water at levels between several to several hundreds of $\mu\text{g/L}$.

Health Effects

Exposures to THMs and HAAs may cause bladder, rectal and/or colon cancers. Other potential risks include spontaneous abortion, stillbirth, pre-term delivery, intrauterine growth, retardation, and low birth weight.

Drinking Water Standard

Under the Stage 1 Disinfectants and Disinfection Byproducts rule, THMs and HAAs are regulated with maximum contaminant levels set at 80 $\mu\text{g/l}$ and 60 $\mu\text{g/L}$, respectively.

POU Carbon Filters

Point-of-use (POU) carbon filters are small activated carbon cartridges which attach to one or several water taps in a building to reduce organic and inorganic contaminants in drinking

water. US EPA has approved centrally managed POU treatment devices as a means to achieve compliance with maximum contaminant levels established in the National Primary Drinking Water Regulations.

Objectives of the Study

The objective of this study was to investigate the effectiveness of various POU carbon filters for DBP removal in both laboratory and field studies. The results provide information in minimizing the health risks from DBP exposures. Although POU carbon filters are not allowed for compliance in many states, these results could help regulatory agencies and water professionals better understand the use of POU carbon filters in DBP control.

DBP Removal in POU Carbon Filters

Laboratory evaluation was conducted in a local surface water treatment plant. The plant effluent with approximately 30 $\mu\text{g/l}$ of THMs and 33 $\mu\text{g/l}$ of HAAs was used as the filter influent. Six POU carbon filters were purchased and installed on a test bench. Each carbon filter was run continuously to the recommended hydraulic capacity. The average removal efficiencies for THMs and HAAs were calculated for the entire run period, as shown in Table 1 (laboratory study). The results indicated that all six carbon filters can remove over 40% of DBPs. Four carbon filters (PUR, Brita, Culligan and Espring)

performed very well in THM removal (91% to 98%). Three carbon filters (PUR, Brita and Espring) performed well in HAA removal (80% to 89%).

A field study was also conducted in 20 individual households. Each house was equipped with one of four types of tap mounted POU carbon filters. The DBP removal in these carbon filters was similar to results obtained in the laboratory study, as shown in Table 1 (Field Study). For THM removal, the average removal efficiencies for all four POU carbon filters, PUR, Brita, Culligan and Waterpik, were higher than 90%. For HAA removal, the average removal efficiencies for PUR, Brita, Culligan and Waterpik were 94%, 85%, 86%, and 75%, respectively.

In both laboratory and field studies, the removal efficiencies for THMs in POU carbon filters are generally better than those for HAAs. This indicates that physical adsorption is the main mechanism for DBP removal in these POU carbon filters because carbon adsorption capacities for THMs are higher than those for HAAs.

Both laboratory and field study results indicated that POU carbon filters are effective in reducing exposures to DBPs from drinking water in a household. Because of the variation in carbon types, carbon quantity, flow rates, and hydraulic flow patterns, DBP removal in these carbon filters vary substantially. Influent DBP levels also affect the bed life of these POU carbon filters.

Table 1. DBP Removal Efficiencies (%) in Six POU Carbon Filters

Brand & Model	Capacity (gallon)	Laboratory Study		Field Study	
		THMs	HAAs	THMs	HAAs
Brita 42202	100	98	89	91	85
Culligan FM-15	200	91	65	97	86
Culligan undersink	500	41	42	Not tested	Not tested
Espring	500	98	85	Not tested	Not tested
PUR FM-4500L	100	97	80	100	94
Waterpik F-7	200	62	41	92	75

For more information

For further information and resources on Drinking Water Research, Water Operator Training and Financial and Managerial Training

Website: <http://www.hbg.psu.edu/etc> or <http://www.tacnet.info>

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