LEAD AND PESTICIDE REMOVAL BY CARBON BLOCK FILTER

Marjana Simonič

University of Maribor, Faculty of Chemistry and Chemical Engineering, Smetanova 17, 2000 Maribor, Slovenia, tel: +386 2 22 94 472,
Fax: +386 2 252 77 74, E-mail: marjana.simonic@uni-mb.si

ABSTRACT

The aim of the research was to determine the reduction of pesticide, lead, chlorine and bacteria in drinking water after the filtration using carbon block filter.
The effectiveness of filter was determined by general and physico-chemical analysis on drinking water samples before being treated with filter. We made some rapid test using drinking water test WS–425B. The results show that the total hardness in filtered water decreased at the start, while the concentration of K^+ increased tremendously. After about 10 L of water was used, the hardness of water increased to the value of untreated drinking water, while the concentration of K^+ decreased down to 20 mg/L. The concentrations of atrazine and lead in water samples were reduced after being treated with filter. Nitrate-ions were reduced and probably exchanged with chloride-ions from filter due to increased electrical conductivity.

*Keywords:*drinking water, carbon block filter, atrazine

INTRODUCTION

Very tight carbon block filters can remove cysts simply because of their restricted pore size. Multi-Pure blocks are absolute 0.5 micron filters, making cryptosporidium organisms about ten times too large to go through the pores. Thus the very dense carbon block filters could be effective against certain forms of microbiological contaminants although other types of very tight filtration might work as well. Coconut shell carbon is becoming popular not only because it is made from a renewable resource but also because it produces very good tasting water and is particularly good at trihalomethane removal. A new specialty carbon called catalytic carbon is now available that will remove hydrogen sulfide gas (which produces the "rotten egg" smell in some well water) and is very good at removing chloramines (the mixture of ammonia and chlorine used as a disinfectant by some water supplies) [1]. The adsorption behavior for the coconut coal is ascribed to its high inorganic matter content (up to 13.7% wt.)

MATERIALS and METHODS

Samples

Drinking water sample was taken for analysis. Drinking water was filtered through carbon block filter and samples were taken for analysis after 1, 10, 20, 30 and 40 L were filtered.

Analytical methods

The parameters for the drinking water were set according to the Slovenian regulation [2]. Coliform Bacteria were determined by the MPN method after APHA standard [3].

Table 1: Standard methods

Parameter	Unit	Standard method
pH	-	DIN 38 404 – C5 (1984)
Conductivity	µS/cm	EN (DIN) 27 888 (1993)
Turbidity	NTU	DIN 38 404 (1985)
Hardness	°dH	DIN 38 409 – H6 (1986)
Pb	µg/L	DIN 38406-E 22 ICP-MS
Atrazine	µg/L	modified spectrofotometric method
Potassium	mg/L	DIN 38406-E13, AES
Nitrate	mg/L	DIN 38 405 – D19 (1988)

Rapid test WS–425B was used for determining: *E.coli* bakteria, Pb, pesticide (atrazine / simazine), nitrate and nitrite.

Carbon block filter

The filtration process begins with water passing through a graded density 5-micron pre-filter that traps dirt, sand, and particles that affect the taste, odor, and overall appearance of your water. Then the water passes through the highly compacted solid carbon block where direct mechanical interception of particles as small as 0.5 micron occurs. The graded density prefilter acquires a positive molecular charge as water passes through it. Since most colloidal contaminants exhibit a negative charge in solution, the media fibers will electrokinetically attract charged colloidal particles which are smaller and removal by mechanical straining is not effective.

RESULTS

The results of water analyses is presented in Table 2 after 10 L of water was filtered.
It is seen that all parameters masured were below the detection limits, but also pure drinking was was of best quality.

Several times the analyses were repeated for treated samples (after 1, 10, 20, 30 and 40 L of water was filtered) determining pH, conductivity, turbidity and K- concentration. Results are presented in Table 3. As seen from Table 3 pH was stable, conductivity increased every time as well as turbidity til the last sample. Potasium concentration increased very much after 1 L was filtered. Also after 10 L was filtered the concentration was still very high, then it started to decrease. Lead was measured with more sufisitcated apparatus and it was found put that the concentration decreased from 3 to 1 ug/L. Some authors reported that 26 mg of lead per g of activated carbon could be adsorbed [4].

Table 2: Characteristics of the treated water

Parameters	Drinking water	After treatment
c_{NO3}	< 0,5 mg/L	< 0,5 mg/L
c_{NO2}	< 0,01 mg/L	< 0,01 mg/L
$c_{\mathrm{E.coli}}$	negative	negative
c_{Pb}	< 15 μg/L	< 15 μg/L
c_{atrazine}	< 3 μg/L	< 3 μg/L
c_{simazine}	< 4 μg/L	< 4 μg/L

Table 3: Analyses before and after filtration

Samples	pH	after	Conduct. (uS/cm)	after	Tb (NTU)	after	c_K (mg/L)	after
1	7,4	7,4	518	526	0,60	0,64	3,1	48
2	7,6	7,6	522	529	0,38	0,39	3,1	20
3	7,6	7,6	530	537	0,55	0,60	3,0	4
4	7,7	7,7	545	547	0,43	0,53	3,0	3,5
5	7,6	7,6	530	530	0,32	0,32	3,0	3

Bacteria were determined on agar-agar at room temperature, 24 h. Figure 2 presents both samples of drinking water before and after treatement.
As seen from Fig 2. The MPN-value (most probable number) is below 100, therefore there were no bacteria developing at room temperature.

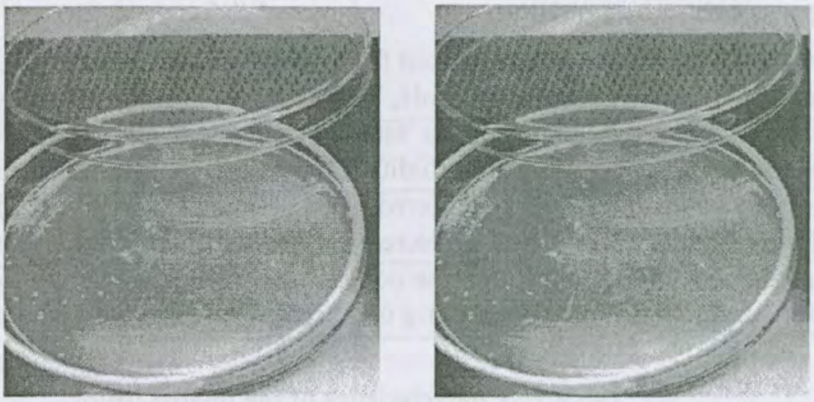

Figure 2: MPN in drinking water (left side) and filtered water (right side)

Analyses of atrazine showed that the concentration in drinking water decreased from 0,15 µg/L to 0,07 µg/L and in the second experiment from 0,15µg/L to 0,03 µg/L. Atrazine was adsorbed onto block carbon. It is in accordance with other authors who found out that coconut shell carbon is a good adsorbent for atrazine [5]. Probably some other pesticides would adsorbe even better due to the fact that higher adsorption coeficient were determined for certain pesticides as follows from Table 4.

Table 4: Freundlich constants for atrazine, desethylatrazine and metolachlor [5].

Compound	K_f	1/n	Qe (mg/g)	c (mg/L)
Atrazine	0,8	0,8	0,1	0,1
Metolachlor	115	0,4	86,6	0,5
Desethylatrazine	0,7	0,8	0,2	0,2

CONCLUSION

Carbon block filter provide efficient filtration performance. Atrazine, lead and bacteria were removed from drinking water. The effectiveness is connected with good maintainance of the filter. If properly mantained the filter could be effective for years in 4- member family housekeeping. The total hardness in water was lower at the start. After about 10 L of water was filtered, the hardness of water increased near value of safe drinking water. The concentration of K^+ in water was very high at the start of filtration. After around 20 L were filtered, K^+ concentration was reduced down to 4 mg/L. The concentrations of atrazine and lead in water samples were reduced after being treated with filter.

LIST OF REFERENCES

[1] Coconut shell drinking water treatment (2011). *Filtration + Separation, 48 2, p. 12*

[2] Official Gazette of the Republic of Slovenia. Regulation on drinking water, No 19, 2004.

[3] APHA (1990). Standard Methods for the Examination of Water and Wastewater, Drinking Water Microbiology.

[4] M. Sekara, V. Sakthia and S. Rengaraj (2004). Kinetics and equilibrium adsorption study of lead (II) onto activated carbon prepared from coconut shell, *Journal of Colloid and Interface Science*, 279/2, S307–S313.

[5] B. Tepuš (2007). Simultanous atrazine and nitrate removal by catalitical ozonation and ion exchange, Doctoral thesis, University of Maribor.