Reduction of sodium valproate compounds concentrations in water intended for human consumption by activated carbon

Reducerea concentrației de compuși de valproat de sodiu în apa destinată consumului uman prin cărbune activ

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Abstract. In our research project with the objective of reducing the pharmaceutical substance valproate sodium, it is aimed to reduce the concentrations of this pharmaceutical compound. Their water retention is carried out by several treatments and among these unconventional treatment methods such as: advanced oxidation, biological product with biomass, adsorption and catalytic oxidation suitable for this type of hulls.
Due to the fact that part of the drugs are dispensed in pharmacies without a prescription, they are used and would be part of it, but also their metabolites end up in insurface water. Similarly, the intensive use of antibiotics and growth hormones in animal husbandry and the resulting insufficient treatment of surfacewaters by these elements.
Pharmaceuticals are generally synthetic organic layers that are used for the purpose of improving animal and human health. Overuse of torah needles leads to their elimination andthe elimination of their metabolites through the urine. Similarly, dispensing without a prescription leads to the rare expiration of these substances which, when expired, mostly endup in the landfill.
Internationally, there are studies of the risk posed by pharmaceuticals, their metabolites fromwater often intended for human consumption, and research into various means of reducing their concentration in water intended for human consumption.
For the realization of the research project, studies will be reintegrated on laboratory facilities and pilot facilities of the water treatment laboratory of the Colentine laboratory complex, Faculty of Hydrotechnics. In this experimental research at colentina laboratory (romania) we 'to study the pharmaceutical substance valproate sodium with the treatment of adsorption by activated carbon at different concentrations (0.4, 0.8 and 1.6 mg/l) at two different flow rates (1.25 l/minand 2.5 l/min).

Key words: pharmaceutical substance, valproate sodium, pollution of surface, adsorption.

1. Introduce

Our research aims to reduce pharmaceutical concentrations in water intended for human consumption.

In this work, we used the pharmaceutical substance metoclopramide as a pollutant with different and low concentrations that can be found in the ecosystem (1.6, 0.8 and 0.4 mg/l).

Among all the adsorption processes that do not give chemical toxicity compared to other processes that pose a danger to the ecosystem when it does not comply with the exact treatment measures used.

In our experimental research, we use a granular activated carbon adsorption process, and this process is also cheaper compared to other processes with a very high adsorption percentage.

1. Working method used

Among all the adsorption processes that do not give chemical toxicity compared to other processes that cause danger to the ecosystem when it does not respect the exact treatment measures used.

In our experimental research we use a process of adsorption by granulated active

carbon which does not give human or animal toxicity and also this process is cheaper compared to other processes with a very high percentage of adsorption.

There are three steps to follow as follows:

• The first step is to wash the granulated activated carbon with tap water for 48 hours ina 1000-liter capacity water tank to release all the pollutants it contains.

• the second step takes three samples at 15min intervals (15min, 30min, 45min) of thesubstance sodium valproate.

Each solution is directly analyzed by TOC measurement.

1.1. Analyzer TOC

TOC is used to measure organic micropollutants in water (wastewater and hazardous waste in the aquatic environment) and gives the total amount of oxygen by chemical oxidation of organic matter in the sample under high heat condition (148C°). The advantage of COT can analyze several samples at the same time (more than 60 samples) is each result remains almost 10min compared to other products which need a few days (eg the BOD remains five days to see the result).

In our research project the products used as presented in Figure 1

It must be placed in a place with a temperature between 15C° and 20C° in order to preserve its chemical properties.

Figure 1 TOC Analyzer.

1.2. Treatment pilot

The O_3/CA pilot consists of two cylindrical reactors (R1=200mm, R2=100mm):

• the R1 reactor includes an ozone mixer which allows the injection of ozone into the waterto be treated

• the R2 reactor includes granulated activated carbon (GAC) and a water level regulator inorder to obtain the solution to the treated water.

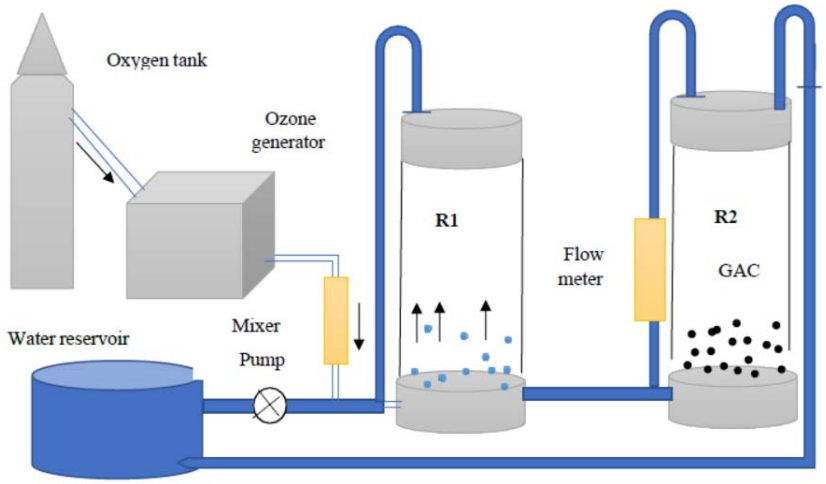

Figure 2 Diagram of the processing driver.

2. Main results obtained

2.1. Degradation of sodium valproate at a concentration of 1.6 mg/l

Figure 3 shows the percentage elimination with the active carbon adsorption process at a concentration of 1.6 mg/l.

We can see in this figure for the concentration 1.6 mg/l of sodium valproate in the flow rate (1.25 l/min) the elimination rates are very sufficient in the time 45min which gives percentages that exceed the half with values of 55.25%.

In the 30min contact time the flow rate of 1.25 l/min gives an elimination rate of 53.75 ٪ however in the 2.5 l/min flow rate it gives a low rate with a value of 41.5 ٪ but in the 15min time and in the flow rate 1.25 l/min the elimination rate is insufficient (49.62٪) compared tothe other flow rate which is low with a value of 33.5٪

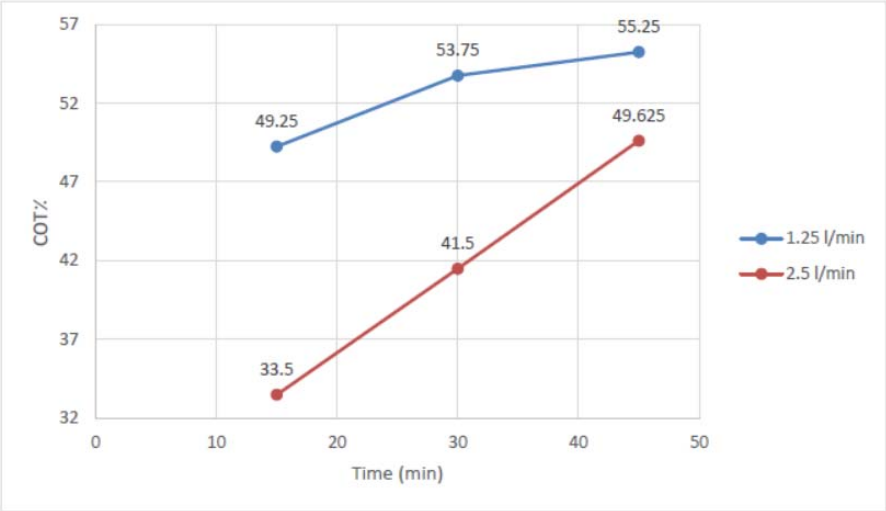

Figure 3 Percentage of adsorption by CA alone at a concentration of 1.6 mg/l.

2.2. Degradation of sodium valproate at a concentration of 0.8 mg/l

Figure 4 shows the percentage of elimination with the active carbon adsorption process at aconcentration of 0.8 mg/l.

We can see in this figure for the concentration 0.8 mg/l of sodium valproate with a flow rateof 1.25 l/min the elimination by the process of adsorption by active carbon is sufficient and the rate of elimination exceeds 50٪ at all contact times, on the other hand in the flow rate of 2.5 l/min it is not sufficient for other flow rates and its elimination rate does not exceed 50٪ inthe times of 15 and 30min with a percentage of 46.88 and 49.63٪, but in the time 45min it gives an interesting rate with a value of 50.31٪.

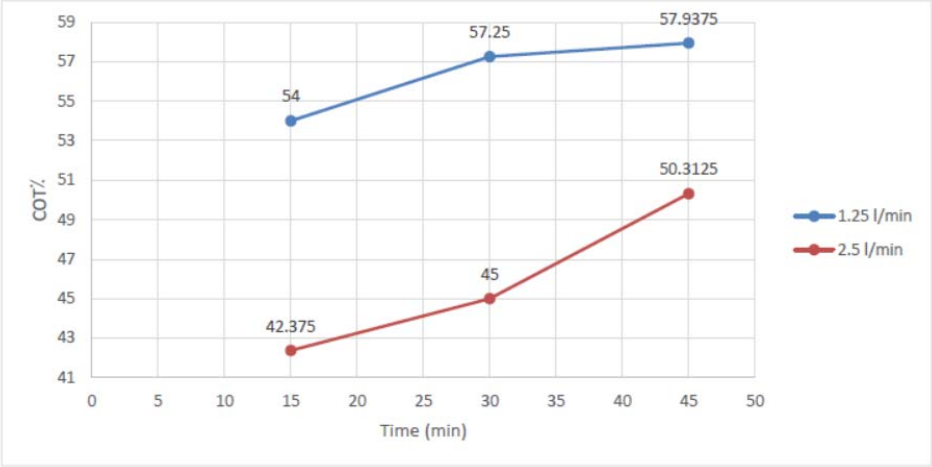

Figure 4 Percentage of adsorption by CA alone at a concentration of 0.8 mg/l.

2.3. Degradation of sodium valproate at a concentration of 0.4 mg/l

Figure 5 shows the percentage elimination with the active carbon adsorption process at a concentration of 0.4 mg/l.

We can see in this figure for the concentration 0.4 mg/l of sodium valproate with a flow rate of 1.25 l/min the elimination by the process of adsorption by active carbon is very sufficient because we obtain a rate of elimination with a value of 61 ٪ in the contact time 45min, on theother hand in the flow 2.5 l/min and at the same time it gives a percentage of elimination 51.5٪and the difference between the two flows varies 10٪

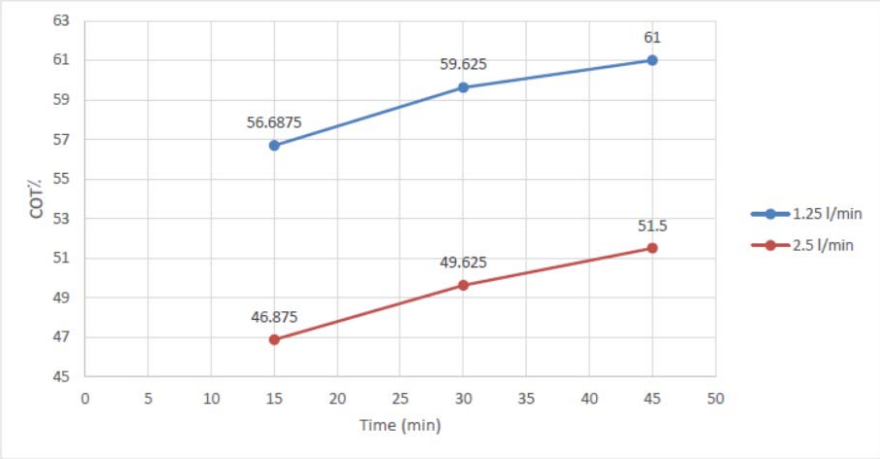

Figure 5 Percentage of adsorption by CA alone at a concentration of 0.4 mg/l.

5. Conclusion

The adsorption process using granular activated carbon which is applied to the valproate sodium substance gives interesting results with elimination percentages up to 61٪ at a concentration of 0.4 mg/l at a flow rate of 1.25 l/min and 51.5٪ at the same concentration at a flow rate of 2.5 l/min and this percentage increases with decreasing concentrations and also decreasing flow rates.

We conclude that the activated carbon adsorption process is particularly effective in yielding more hydroxyl radicals that attack these pharmaceutical pollutants.

References

[1] A. Bhatnagar, W. Hogland, M. Marques, M. Sillanpää, An overview of the modification methods of activated carbon for its water treatment applications, Chem. Eng. J. 219 (2013) 499–511, https://doi.org/10.1016/j.cej.2012.12.038.

[2] Kim, I., Tanaka, H., 2010. Use of ozone-based processes for the removal of pharmaceuticals detected in a wastewater treatment plant.Water Environ. Res. 82, 294e301.

[3] Carbajo, M., Rivas, F.J., Beltrán, F., Alvarez, P., Medina, F., 2006. Effects of different catalysts on the ozonation of pyruvic acid in water. Ozone-Sci. Eng. 28, 229e235.
[4] Fent, K., Weston, A.A., Caminada, D., 2006. Ecotoxicology of human pharmaceuticals. Aquat. Toxicol. 76, 122–159.
[5] Geissen, V., Mol, H., Klumpp, E., Umlauf, G., Nadal, M., van der Ploeg, M., van de Zee, S.E.A.T.M., Ritsema, C.J., 2015. Emerging pollutants in the environment: a challenge for water resource management. Int. Soil Water Conserv. Res. 3, 57–65.