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Aqua Circular On-line Conference

NATURE-BASED FILTERING MATERIAL FOR INOVATIVE WATER TREATMENT WITHIN CIRCULAR ECONOMY CONTEXT

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Research Objective

In general, the development of improved innovative technology and process represents a prerequisite condition within the context of the circular economy and can be applied also, in water management to assure the water quality considering natural materials-based process. This study presents some preliminary results of the innovative water treatment related to the removal of the suspended matters and organics from water using natural sand supported-polyelectrolytes. A reached amino group polycation (branched polyethyleneimine (PEI)) was one-step deposited through non-stoichiometric PEI/polyacrylic acid (PAA) interpolyelectrolyte precipitation method onto different sand fractions. The sand/PEI composites were tested for turbidity and the organics removal from simulated water to further develop an innovative direct flocculation-filtration system in water/wastewater treatment, without any reagents addition.

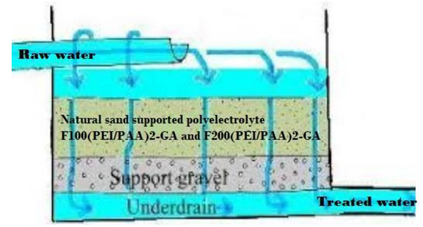
Materials and Method

Preliminary testes consists of sorption and coagulation tests to assess the sorption and respective, coagulation ability of the natural sand modified with polyelectrolytes. In this study, the presence of natural organic matter (NOM) in water was simulated using humic acid (HA), whose concentrations were measured with a UV-VIS spectrophotometer (Varian Carry 100) at 254 nm (A254). Also, NOM concentrations were expressed as turbidity and Chemical Oxygen Demand (COD) parameter.

The adsorption of humic acid (HA) on natural sand-supported polyelectrolytes F100/(PEI/PAA)2-GA and F100/PEI-GA was studied by batch method. 100 mL solutions of HA were kept in contact with sand-supported polyelectolytes, under continuously stirring at 25°C for 120 min, in the dark. The pH was adjusted using 10% H_2SO_4 or 5% NaOH solution. At different time intervals, samples were collected and the extent of adsorption of the HA on the zeolite surface was evaluated as HA removal efficiency.

Also, the classical Jar-test method was used to test the conventional capacity of coagulation, which consisted of 120 seconds fast stirring, 15 minutes slow stirring and 30 minutes of settling.

Before and after natural sand based composite use, under the conditions of washing and non-washing, scanning electron microscopy (SEM) using Inspect S PANalytical model coupled with the energy dispersive X-ray analysis detector (EDX) was used to characterize the morphostructural properties and to achieve the elemental analysis.



Results and Discussion

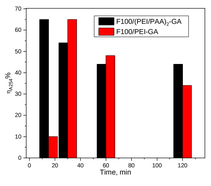


Figure 1. Humic acid removal degree *vs* sorption time using F100/(PEI/PAA)2-GA and F100/PEI-GA

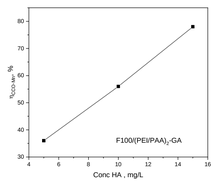


Figure 3. Chemical oxygen demand removal degree *vs* sorption time using F100/(PEI/PAA)2-GA

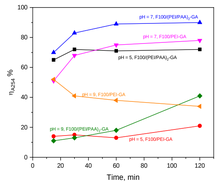


Figure 4. Humic acid removal degree *vs* sorption time using F100/(PEI/PAA)2-GA and F100/PEI-GA at pH of 5;7;9

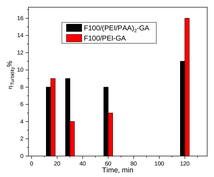


Figure 2. Turbidity removal degree *vs* sorption time using F100/(PEI/PAA)2-GA and F100/PEI-GA

Table 1. Example of Jar-test results using *F100/PEI/PAA)2-GA and F200/PEI/PAA)2-GA*

	Parameters	*Initial*	*I**	*II***
Jar-Test	*Sample volume, ml*	200	200	200
	Mixing time (fast), 150 rot/min, sec	120	120	120
	Mixing time (slow), 45rot/min, minutes	15	15	15
	Dose of F100(PEI/PAA)2-GA and F200(PEI/PAA)2-GA, g/L	**0**	**1**	**1**
	Settling, minutes	30	30	30
	Turbidity , NTU	8.68	6.21	6.51
	ηNTU, %	0	28	25
	A254 ,nm	0.2672	0.1134	0.1348
	η A254, %	0	58	50
	CCO-Mn, mg O2/L	12	8	9
	η CCO-Mn, %	0	38	28

*F100(PEI/PAA)2-GA
**F200(PEI/PAA)2-GA

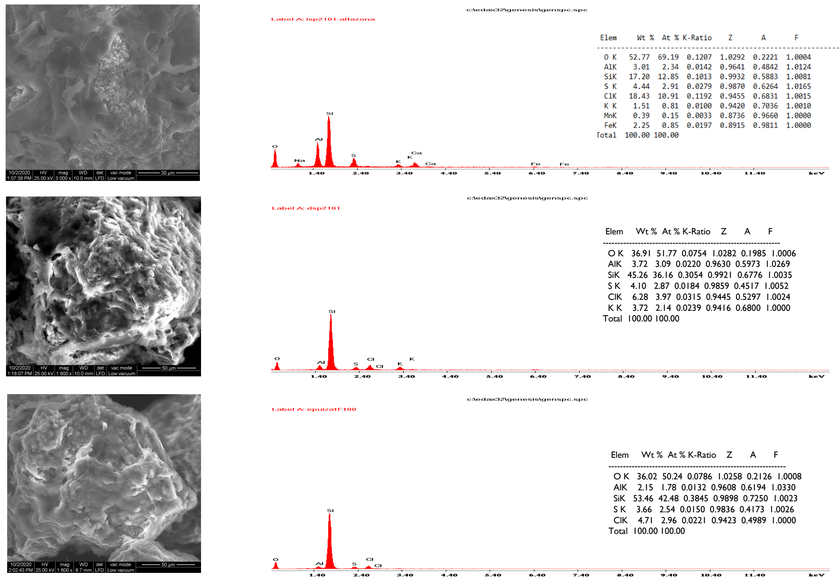
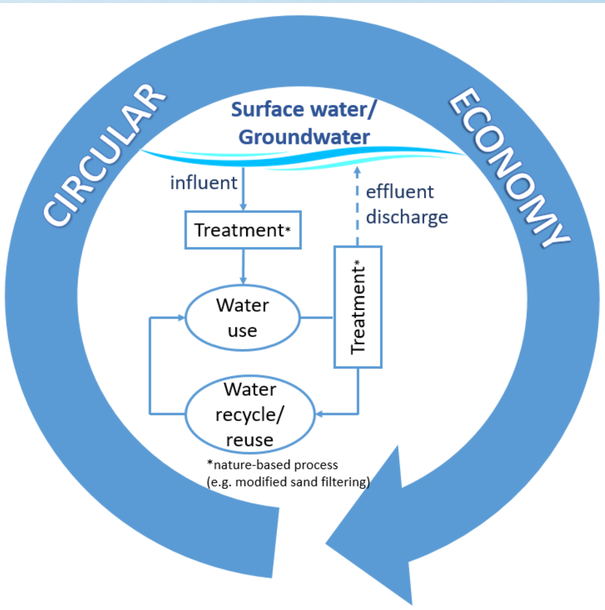


Figure 5. SEM / EDX results for F100(PEI/PAA)2-GA / natural sand (d=100μm)



Conclusions

The circular economy offers a new way of looking at water resources management, promoting sustainable and resource-efficient policies and practices, including the innovative processes and technology for water reuse/recycle. The composite materials based on natural sand modified with polyelectrolytes tested in this study exhibited great potential to further research in innovative development of simple filtering process that assure a contact flocculation, coagulation and filtration directly onto filter material without any reagent adding.

Acknowledgement

This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI-UEFISCDI, project number 26PCCDI/01.03.2018, "Integrated and sustainable processes for environmental clean-up, wastewater reuse and waste valorization" (SUSTENVPRO), within PNCDI III.