

Introduction

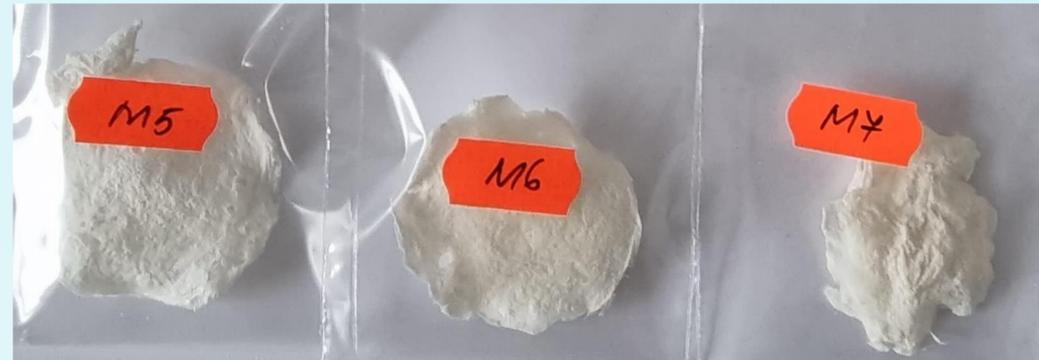
Synthetic products gain interest in everyday life to keep up with economic development. However, to develop appropriate materials that may satisfy this requirement, researchers' attention has been shifted toward sustainable raw materials [1]. Therefore, this study focuses on using renewable raw materials to create novel CMs (composite membranes) with tailored properties for water purification [2-3]. Thereby, we propose a method for modifying chitosan scaffolds upon coating with organo-silane moieties produced by sol-gel to yield improved-stability membranes. This method creates a one-phase solution when metal alkoxides and water react with an acid or base [4-5].

Discussions

To highlight the final properties of the developed CM were improved, several characterization techniques were employed. A swelling study was performed at four pH values (10 to 13) to make sure the chitosan membranes can withstand the basic conditions, as the secondary step of coating with sol-gel has to be carried out at alkaline pH. FTIR spectra for the CMs displayed the characteristic bands for chitosan and silane network, while TGA results indicated that the CMs acquired higher thermal stability. SEM images confirmed that the chitosan membranes were coated with a thin organo-silane layer produced by sol-gel. BET results highlighted the increase in the specific surface area and pore surface area after organo-silane coating of chitosan scaffolds. Thus, a potentially higher capacity for pollutant retention is expected.

Methodology

For the preparation of the CMs coated with organo-silane structures produced by sol-gel, commercial chitosan (CC), TEOS (tetraethylortosilicate), and MPTMS (mercaptopropyl trimethoxysilane) were used. For chitosan dissolution, acetic acid was used. The chitosan membrane was coagulated in a sodium hydroxide solution and lyophilized, and afterwards immersed into the mixture of silanes; the sol-gel reaction was performed under basic catalysis.



Results

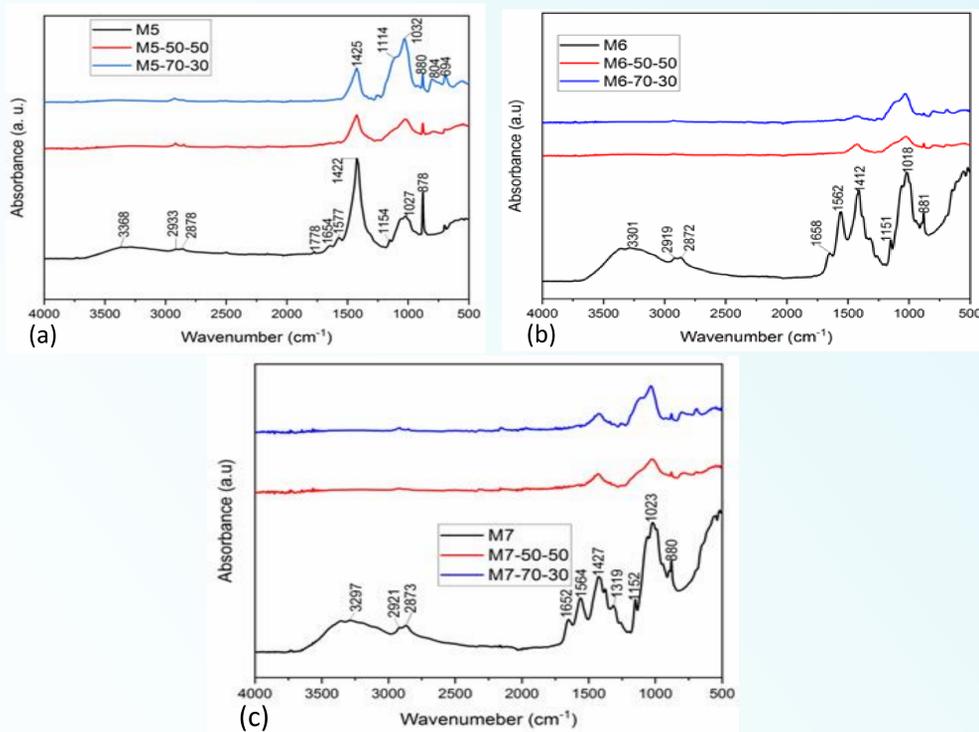


Fig. 1. FTIR spectra for reference CMs (M5, M6, and M7) and after being coated with organosilane structures produced by sol-gel at two different MAPTES/TEOS ratios (50/50 and 70/30, respectively)

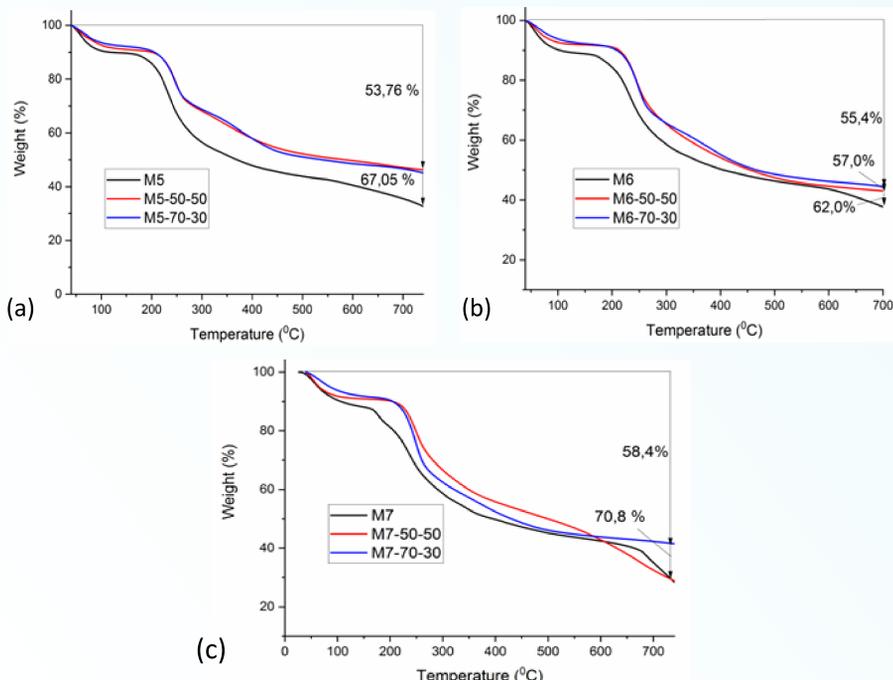


Fig. 3. TGA curves for reference CMs (M5, M6, and M7) and after being coated with organosilane structures produced by sol-gel at two different MAPTES/TEOS ratios (50/50 and 70/30, respectively)

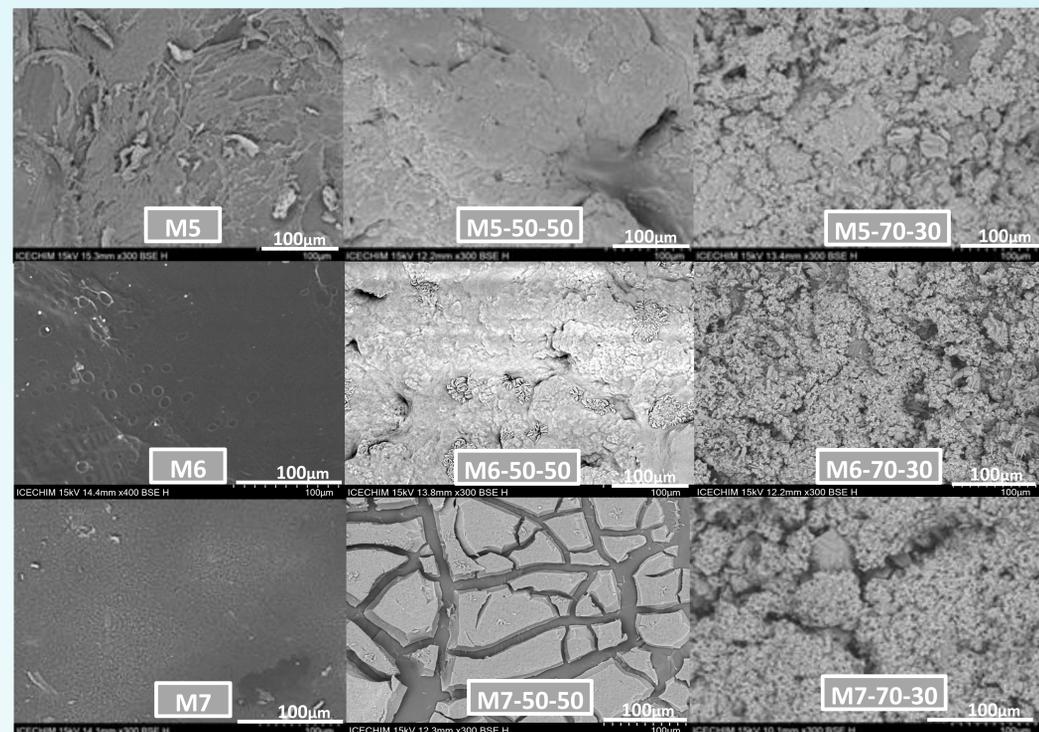


Fig. 2. SEM images for reference CMs (M5, M6, and M7) and after being coated with organosilane structures produced by sol-gel at two different MAPTES/TEOS ratios (50/50 and 70/30, respectively)

Table 1. Swelling degrees for the membranes at different values of pH (10 to 13)

Time	SD (%) M5				SD (%) M6				SD (%) M7			
	pH10	pH11	pH12	pH13	pH10	pH11	pH12	pH13	pH10	pH11	pH12	pH13
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	142.44	262.35	195.74	244.85	263.99	245.95	301.78	287.85	194.40	163.64	133.11	164.29
30	254.20	260.00	185.11	226.06	303.05	288.73	301.48	287.01	178.02	229.72	141.98	197.62
60	269.75	261.76	198.40	183.64	248.48	277.17	265.58	229.10	185.78	204.20	139.93	170.00
120	265.13	191.76	212.23	176.97	292.52	268.50	283.38	310.73	162.50	203.50	140.61	145.71
180	245.38	204.12	225.00	233.33	317.17	275.43	275.37	300.85	147.84	208.74	123.55	172.38
240	230.67	215.29	155.85	224.85	255.40	238.15	235.61	234.18	182.76	210.84	95.56	143.33
480	231.51	195.88	203.72	256.36	262.60	265.03	271.81	270.34	144.83	177.62	96.93	138.10

Table 2. BET results for CMs and their reference (M5 and M6)

Sample	BET Surface Area (m ² g ⁻¹)	Pore surface area (BJH) (m ² g ⁻¹)	Pores diameter (BJH) (nm)	Pore volume(BJH) (măsurat la P/P0 = 0.99)(cm ³ g ⁻¹)
M5	1.02	2.09	5.439	0.0046
M5-50-50	38.42	34.61	4.543	0.0515
M6	1.46	2.48	4.543	0.0069
M6-50-50	28.67	24.46	4.543	0.0377

Conclusions

To sum up, new CMs based on chitosan coated with an

Acknowledgements

The authors thank UEFISCDI and the European Commission for funding the ctr. 57/2024 "WATER-BIOFIL" within the WATER4ALL 2022 JOINT TRANSNATIONAL CALL and the Ministry of Research, Innovation and Digitalization under the institutional grant PN 23.06.01.01. AOUAMAT