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WATER RESEARCH

Supplementary material

Applying multi-criteria analysis for preliminary assessment of the properties of alginate immobilized *Myriophyllum spicatum* in lake water

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Table S1. Hydrological data and intended use of studied lakes

No.	Lake	Watercourse	Volume (10^6 m^3)	Depth (m)	Elevation (m)	Intended use	Aquatic area*
1	Bovan	Moravica river	59	50	262	water supply, flood defense	Morava
2	Vlasina	Vlasina river	165	22	1213	water supply, energy supply	Morava
3	Prvonek	Banjska river	20	65	618	water supply	Morava
4	Garaši	Bukulja river	14	26	411	fishing	Morava
5	Ćelije	Rasina river	51.5	45	284	water supply, flood defense	Morava
6	Vrutci	Đetinja river	54	/	628	water supply	Morava
7	Sava	Sava river	/	4.5	73	recreation, water supply	Sava
8	Gruža	Gruža river	64	27	267	water supply	Morava
9	Srebrno	Danube river	/	8	70	recreation	Danube

*On the teritory of the Republic of Serbia (Anonymous 2001; Dević et al., 2014; Mićković et al., 2014; Denić et al., 2015)

Table S2. ICP Performance Characteristics

Element	LOD* (μg L^{-1})	LOQ** (μg L^{-1})	Recovery range %	RSDr*** %	Measurement uncertainity %
Al	1.5	5	95	4.55	9
As	1.5	5	104	2.80	6
Cd	0.15	0.5	98	5.84	12
Co	1.5	5	97	3.37	7
Cr	1.5	5	95	6.13	12
Cu	1.5	5	98	3.35	7
Mn	0.9	3	97	6.16	12
Ni	1.5	5	95	3.85	8
Pb	1.5	5	98	2.72	6
Sb	1.5	5	93	5.79	12
Zn	0.6	2	98	2.45	5
Mo	1.5	5	95	4.73	9

*Limit of detection (LOD); ** Limit of quantification (LOQ); *** Relative standard deviation

Table S3. Limit values (LV) for pollutants in surface waters according national regulations and imperative values (I) of some principal parameters of water quality according EU EPA

	Regulation on limit values of pollutants in surface and ground waters and sediments and deadlines for their achievement [#]					**Parameters of water quality: interpretation and standards, EPA** [¶]	
	Class I	Class II	Class III	Class IV	Class V	Surface Water Regulations [1989]	Drinking Water Directive[98/83/EC]
			[*]**LV** (μg/L)			**I**[‡] (mg/L)	**I**[‡] (μg/L)
Al						/	200
As	<5 (or nl[**])	10	50	100	>100	0.05–0.1 mg/L	10
Ba	/	/	/	/	/	0.10–1.0 mg/L	nr[†]
B	300 (or nl)	1000	1000	2500	>2500	2.0 mg/L	1000
Cd	/	/	/	/	/	0.005 mg/L	5
Cr	25 (or nl)	50	100	250	>250	0.05 mg/L	50
Cu	5 /[§]H=10 22/H=50 40/H=100 112/H=300	5 /H=10 22/H=50 40/H=100 112/H=300	500	1000	>1000	0.05–0.1 mg/L	2000
Fe	200	500	1000	2000	>2000	0.2-2.0 mg/L	200
Hg	/	/	/	/	/	0.001 mg/L	1
Mn	50	100	300	1000	>1000	0.05–0.1 mg/L	50
Ni	/	/	/	/	/	/	20
Pb	/	/	/	/	/	0.05 mg/L	10
Zn	30 /H=10 200/H=50 300/H=100 300/H=500	300 /H=10 700/H=50 1000/H=100 2000/H=500	2000	5000	>5000	3.0–5.0 mg/L	/
pH	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	<6.5 / >8.5	5.5 – 9.0	≥6.5 and ≤ 9.5

[*]LV–Limit values; /– Not regulated; [**]nl – Natural level; [§]H – Hardness (mg/L $CaCO_3$) (Official Gazette of RS, 2014).
[‡]**I**–Imperative values; [†]nr – No reference (EU EPA, 2001).

[#]–According to the national regulations surface waters are classified in five classes (class I>class II>class III>class IV>class V), Table S1. Water within classes I–IV may be used for drinking water supply (after the treatment by appropriate methods for water purification), bathing and recreation, irrigation, industrial use (process and cooling water), whereas water ranked as class V cannot be used for any purpose (Official Gazette of RS, 24/2014).

[¶]–It should be noted that Directive 75/440 EEC includes the quality only of surface water that serves as a source of water for human consumption (drinking water). The Directive actually deals with water intended for distribution after the appropriate treatment processes, so-called "raw water". The base for this directive is so-called "Environmental Quality Objective" (EQO) approach, which sets out [EQSs] standards for different types of water in which pollutants can be found, and their concentrations are more or less strictly limited (EU EPA, 2001).

Table S4. The contents of elements (μg/L) and pH in water samples before and after biosorption, and weight coefficient (W)

No.	Lake	I/F	Al	Ba	Fe	Mg	Sr	Ca	B	K	Mn	Na	As	pH
1	Bovan	Ci	8.00	42.00	8.00	8210.00	169.00	45440.00	31.00	1960.00	8.00	7870.00	0.00	7.65
		Cf	5.00	10.00	5.00	7190.00	82.00	47810.00	35.00	2440.00	14.00	9490.00	0.00	6.51
2	Vlasina	Ci	14.00	6.00	8.00	2000.00	21.00	8170.00	13.00	760.00	8.00	2200.00	0.00	6.20
		Cf	11.00	8.00	6.00	1740.00	13.00	17080.00	24.00	1270.00	9.00	4330.00	0.00	6.85
3	Prvonek	Ci	35.00	17.00	8.00	3980.00	97.00	16840.00	15.00	1540.00	9.00	4120.00	0.00	6.49
		Cf	8.00	4.00	5.00	3410.00	34.00	24460.00	19.00	1940.00	12.00	6000.00	0.00	6.87
4	Garaši	Ci	120.00	10.00	11.00	3120.00	44.00	12290.00	19.00	1500.00	0.00	5910.00	0.00	6.62
		Cf	12.00	11.00	5.00	2750.00	19.00	19540.00	22.00	1790.00	0.00	7470.00	0.00	7.06
5	Ćelije	Ci	14.00	22.00	6.00	18360.00	106.00	20780.00	33.00	1950.00	8.00	6030.00	0.00	6.73
		Cf	8.00	9.00	4.50	14240.00	52.00	35010.00	37.00	2240.00	14.00	8340.00	0.00	7.02
6	Vrutci	Ci	15.00	8.00	7.00	23810.00	44.00	27910.00	39.00	640.00	7.00	1960.00	0.00	7.48
		Cf	7.00	8.00	4.50	18170.00	42.00	37680.00	40.00	1090.00	10.00	4060.00	0.00	7.30
7	Sava	Ci	117.00	19.00	0.00	9910.00	92.00	26840.00	35.00	1380.00	8.00	8340.00	0.00	7.43
		Cf	42.00	9.00	0.00	8070.00	47.00	34850.00	36.00	1700.00	12.00	10130.00	0.00	7.33
8	Gruža	Ci	25.00	33.00	0.00	12050.00	149.00	28320.00	34.00	3140.00	7.00	8840.00	0.00	7.44
		Cf	9.00	9.00	0.00	9540.00	59.00	35230.00	37.00	3410.00	13.00	10460.00	0.00	7.32
9	Srebrno	Ci	8.00	26.00	0.00	21810.00	170.00	29910.00	50.00	2830.00	8.00	16220.00	7.00	7.51
		Cf	5.00	6.00	0.00	16940.00	71.00	38750.00	51.00	3310.00	14.00	17740.00	6.00	7.35
W			**0.15**	**0.08**	**0.09**	**0.07**	**0.07**	**0.04**	**0.04**	**0.05**	**0.05**	**0.06**	**0.31**	

Ci - initial concentration, Cf - final concentration, I/F - initial/final, W-weight coefficient

Table S5. Sorption characteristics of MsAlg applied in lake water samples

No.	Lake	Initial pH	Biosorption	Leakage	TH
1	Bovan	7.65	21.68	-71.18	7.98
2	Vlasina	6.20	5.47	-164.56	1.56
3	Prvonek	6.49	12.66	-141.28	3.17
4	Garaši	6.62	9.81	-128.22	2.37
5	Ćelije	6.73	85.24	-231.72	7.02
6	Vrutci	7.48	116.21	-173.39	9.23
7	Sava	7.43	39.54	-143.04	5.88
8	Gruža	7.44	52.53	-125.09	6.57
9	Srebrno	7.51	100.89	-149.58	9.04

Figure S1

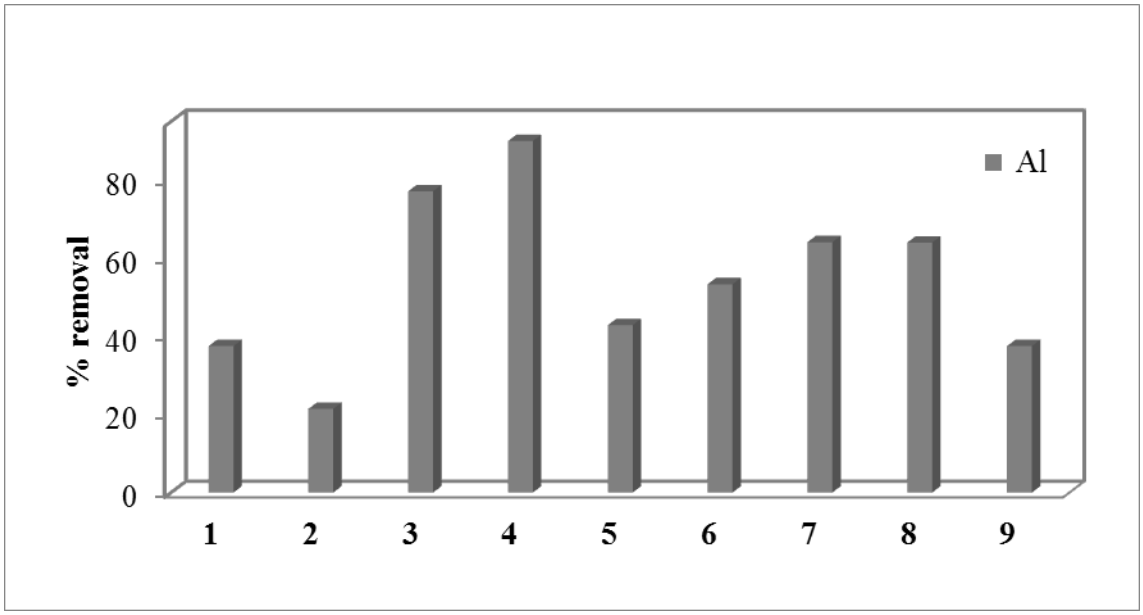

Figure S1. Removal efficiency of aliminium (%) by MsAlg from water samples of lakes: 1–Bovan 2–Vlasina 3–Prvonek 4–Garaši 5–Ćelije 6–Vrutci 7–Sava 8–Gruža 9–Srebrno

Figure S2

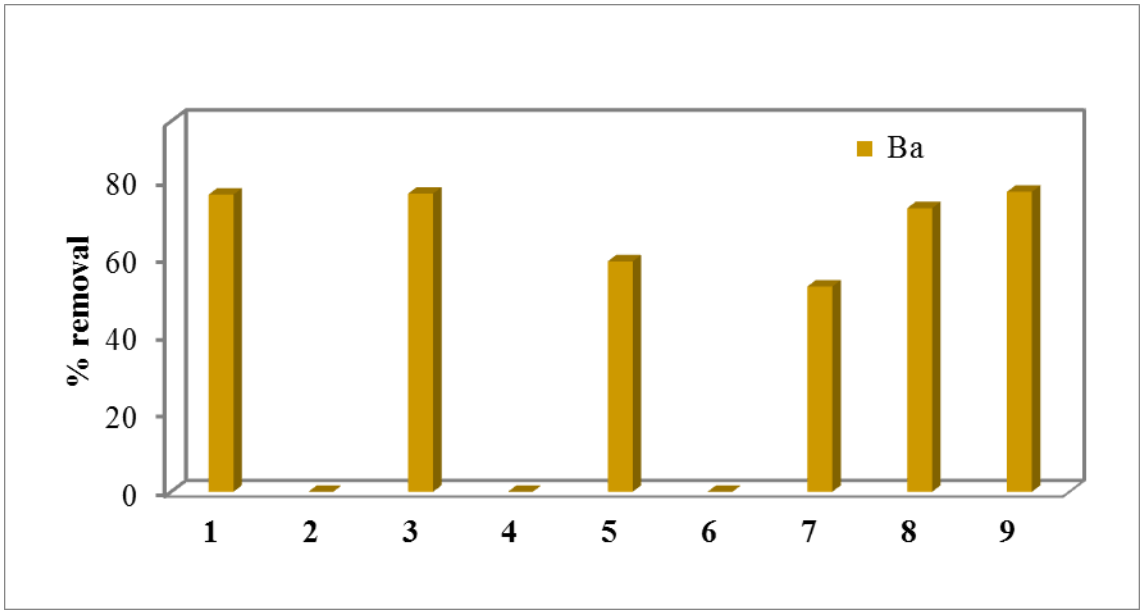

Figure S2. Removal efficiency of barium (%) by MsAlg from water samples of lakes: 1–Bovan 2–Vlasina 3–Prvonek 4–Garaši 5–Ćelije 6–Vrutci 7–Sava 8–Gruža 9–Srebrno

Figure S3

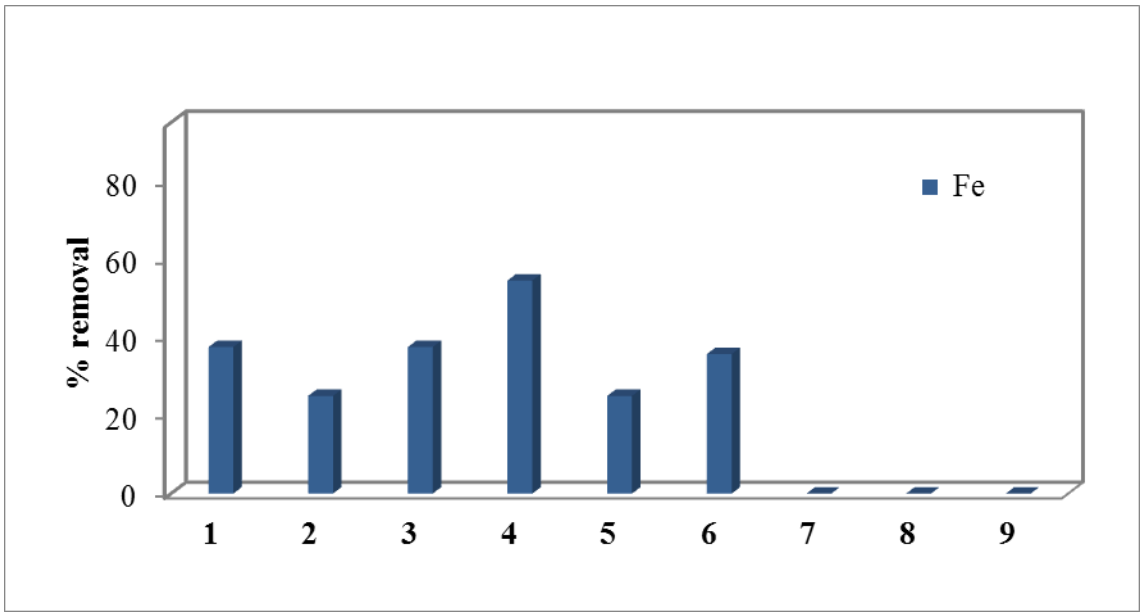

Figure S3. Removal efficiency of iron (%) by MsAlg from water samples of lakes: 1–Bovan 2–Vlasina 3–Prvonek 4–Garaši 5–Ćelije 6–Vrutci 7–Sava 8–Gruža 9–Srebrno

Figure S4

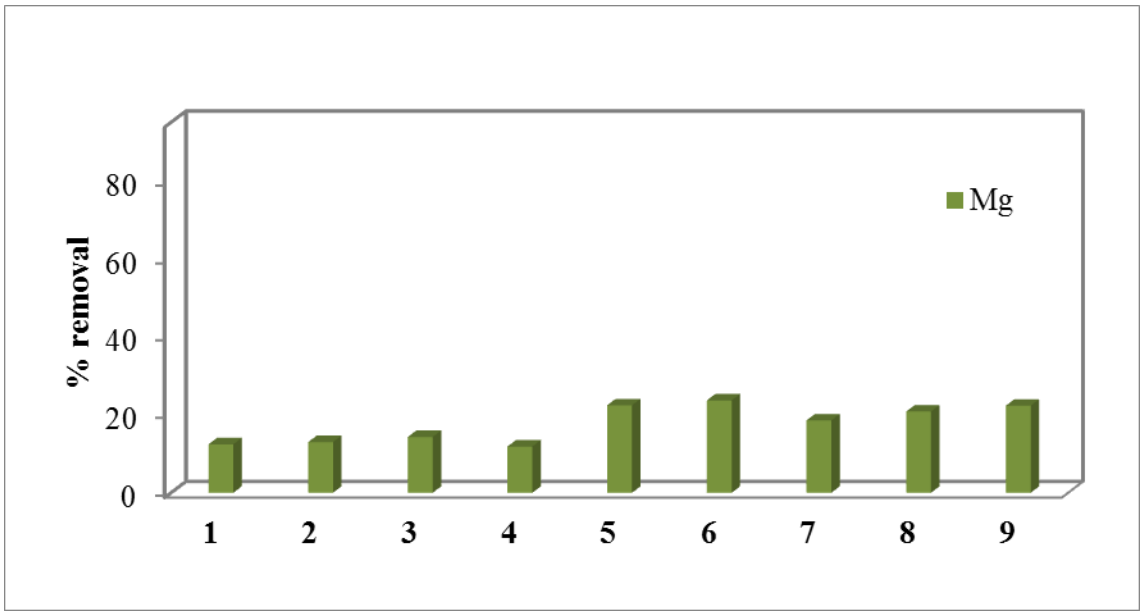

Figure S4. Removal efficiency of magnesium (%) by MsAlg from water samples of lakes: 1–Bovan 2–Vlasina 3–Prvonek 4–Garaši 5–Ćelije 6–Vrutci 7–Sava 8–Gruža 9–Srebrno

Figure S5

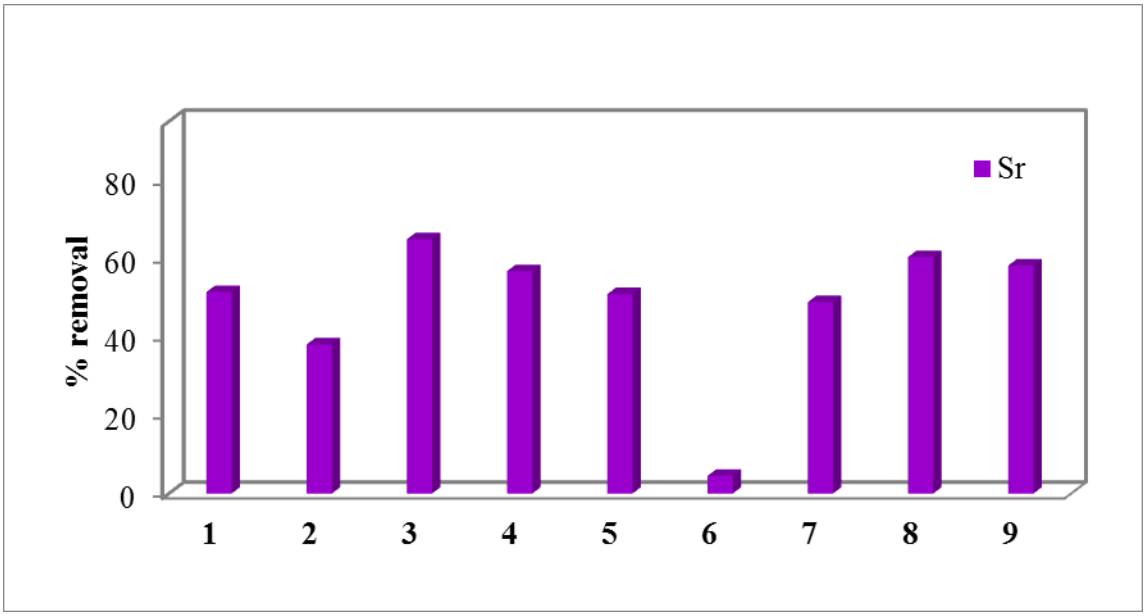

Figure S5. Removal efficiency of strontium (%) by MsAlg from water samples of lakes: 1–Bovan 2–Vlasina 3–Prvonek 4–Garaši 5–Ćelije 6–Vrutci 7–Sava 8–Gruža 9–Srebrno

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