

Iron and manganese in sediments of constructed wetlands with horizontal subsurface flow treating municipal sewage



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Objectives

To evaluate concentrations of iron and manganese in sediments in filtration beds of constructed wetlands

To evaluate the amount of sediments in filtration beds

To evaluate the amount of iron and manganese in the filtration beds

Methods

7 constructed wetlands with length of operation between 2 and 16 years (all sub-surface flow systems)

Sampling pattern:

**3 cores in inflow, middle and outflow zones (total of 9)
each core divided into 2 layers (0-20 cm, 20-60 cm)**

Studied constructed wetlands (horizontal sub-surface flow)

Čejkovice Libnič Břehov Slavošovice Mořina Příbraz Sp. Poříčí

Start	2006	2006	2003	2001	2000	1999	1992
Length of operation	2	2	5	7	8	9	16
PE	500	200	100	150	700	300	700
Filtration material	CR	CR	G	G	CR	G	G
Plants	PH	PH	PG+PH	PG	PG+PH	PG+PH	PG

CR = crushed rock, G = gravel, PH = *Phalaris arundinacea*, PG = *Phragmites australis*





CW Čejkovice



CW Libníč



CW Břehov



CW Slavošovice



CW Mořina



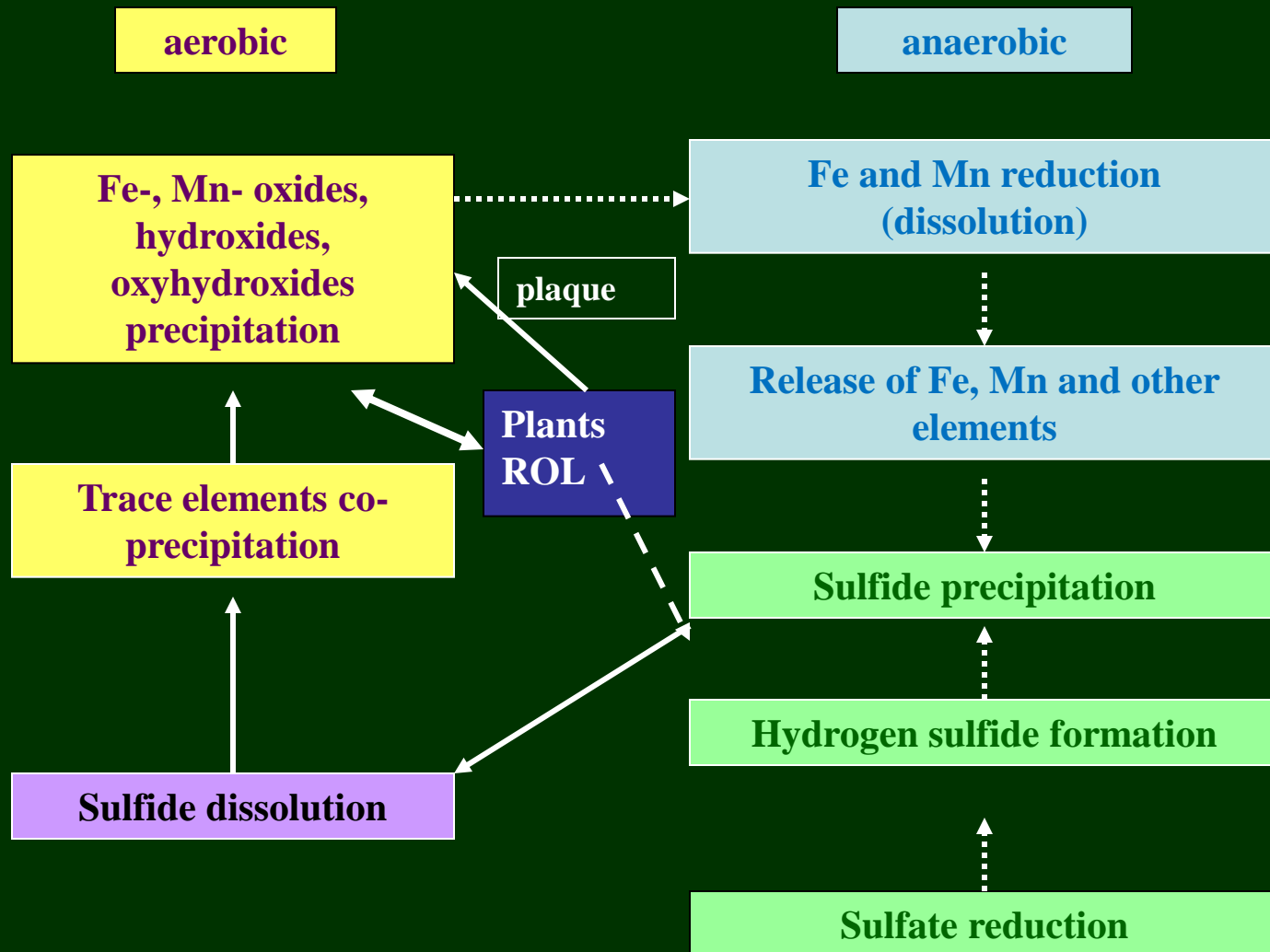
CW Příbraz



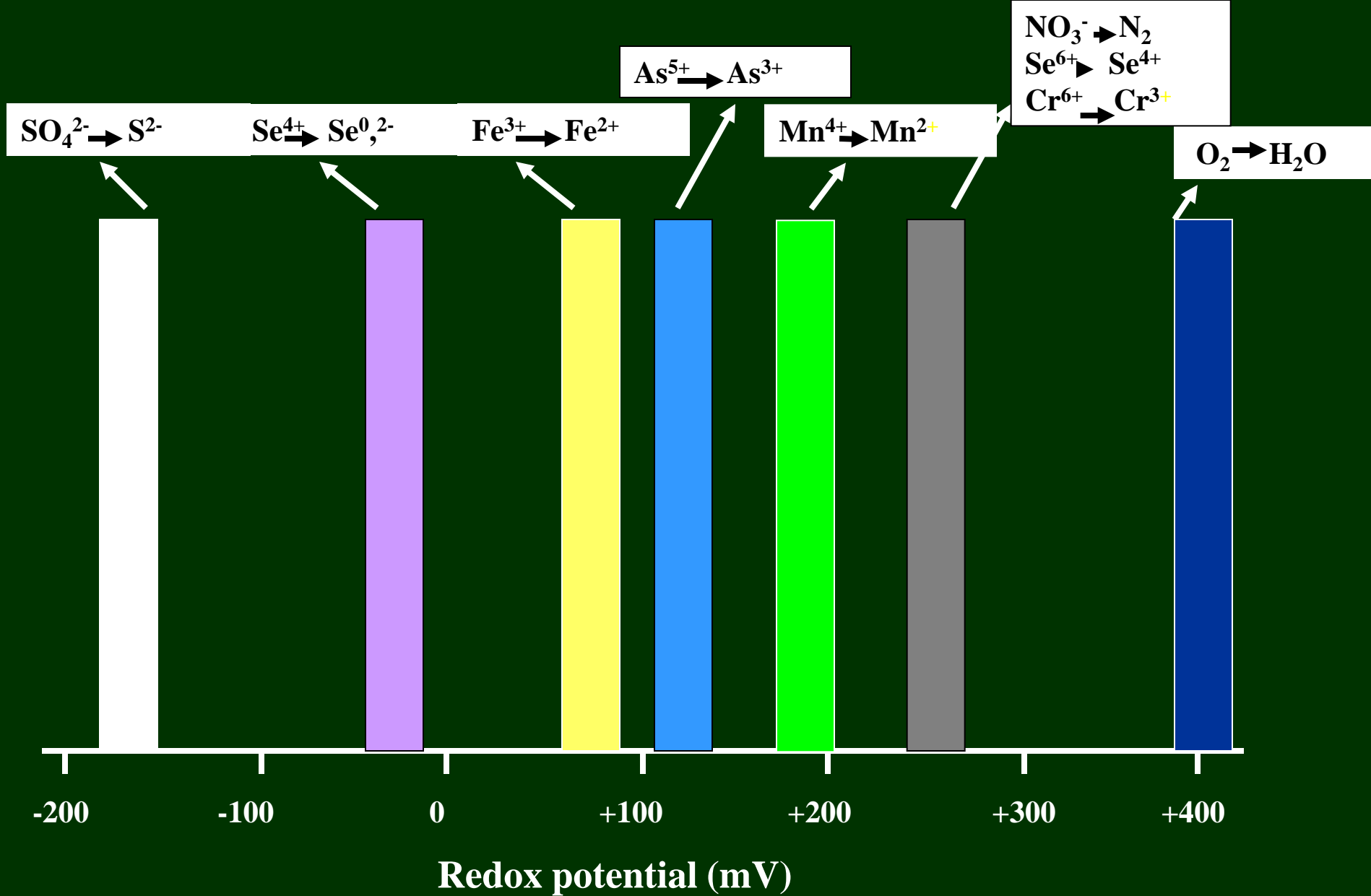
CW Spálené Poříčí



Fe/Mn transformations under various redox conditions in the soil/substrate



Release of metallophores, chelatins



Gambrell et al., 1998

Manganese and iron concentration in sediments of surveyed constructed wetlands.

Different letters indicate significant difference at $\alpha = 0.05$ between the means

	Years	Mn (mg/kg)		Fe (mg/kg)	
Čejkovice	2	507^a	161	18 028^a	1 127
Libníč	2	625^a	303	17 585^a	3 917
Břehov	5	221^b	65	19 694^{ac}	5 312
Slavošovice	7	253^b	164	21 567^c	3 399
Mořina	8	213^b	35	11 773^b	1 553
Příbraz	9	266^b	78	16 412^a	3 373
Spálené Poříčí	16	127^c	116	8 659^b	6 872

Mean sediment amount in various parts of filtration beds during the sampling in 2008 (g/ dm³ DM)

	Layer	Libnič	Čejkovice	Břehov	Slavošovice	Mořina	Příbraz	Sp.Poříčí
Inflow	top	7.5	11.4	38.2	24.2	44.8	53.2	126.7
	bottom	10.3	18.5	42.8	66.4	51.7	41.5	127.9
Middle	top	4.0	13.5	38.7	10.4	39.0	25.0	156.0
	bottom	5.7	7.2	38.7	59.9	22.9	48.6	132.6
Outflow	top	4.5	1.5	50.7	6.3	53.6	24.2	99.9
	bottom	6.3	1.3	34.7	41.6	21.6	40.8	163.6

Length of operation



Inflow – Outflow



Top-Bottom



Sediment as percentge of filtration material (% dry matter)

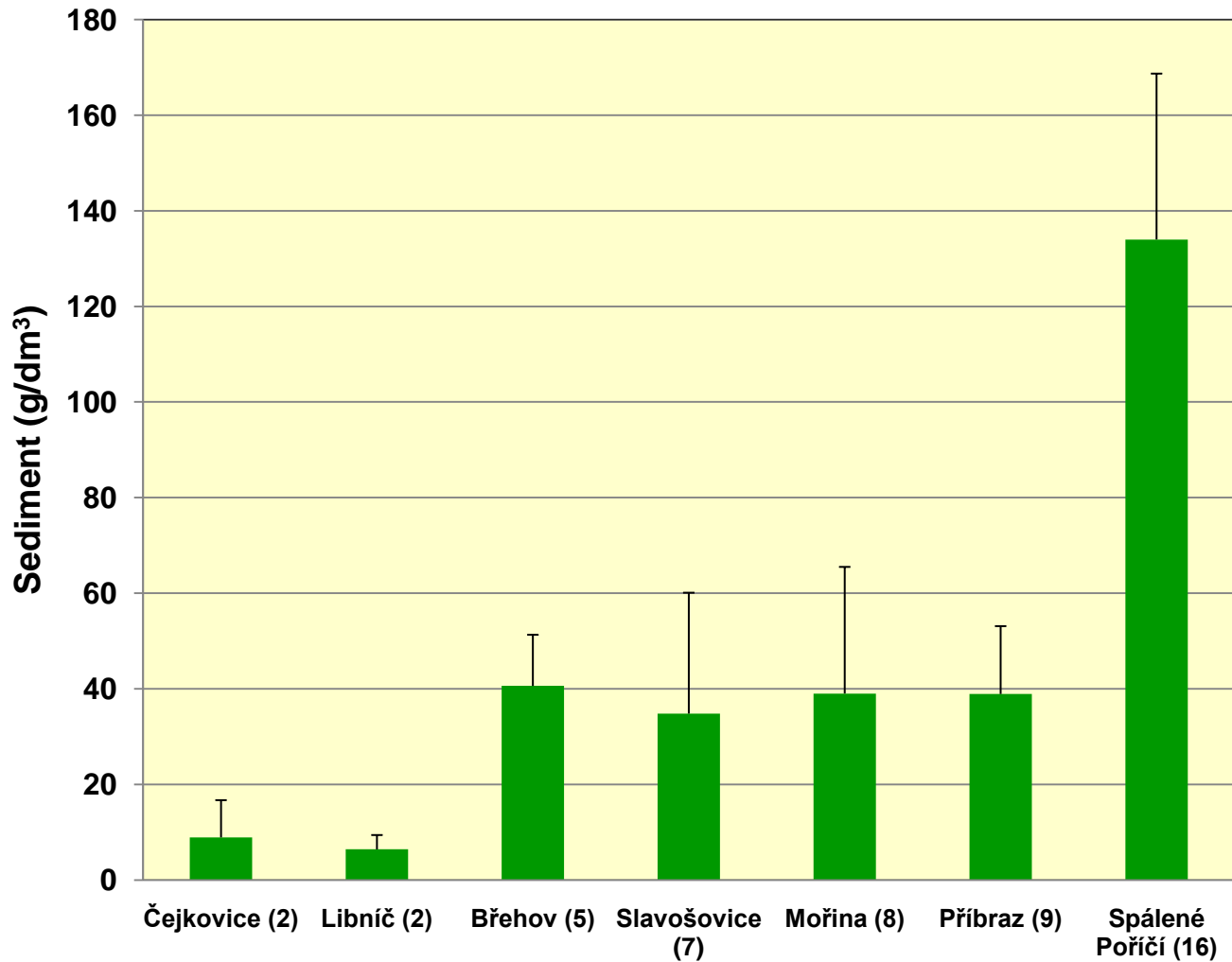
	Layer	Libníč	Čejkovice	Břehov	Slavošovice	Mořina	Příbraz	Sp.Poříčí
Inflow	top	0.5	1.0	4.4	1.7	4.0	5.9	14.8
	bottom	0.6	1.2	2.7	4.2	3.3	2.9	7.8
Middle	top	0.3	1.0	3.9	0.7	3.4	2.0	15.3
	bottom	0.4	0.5	2.5	3.8	1.5	3.4	7.7
Outflow	top	0.3	0.1	4.3	0.4	4.7	2.4	7.8
	bottom	0.4	0.1	2.1	2.7	1.4	2.8	9.9

Mean **0.42** **0.65** **3.31** **2.25** **3.05** **3.23** **10.6**

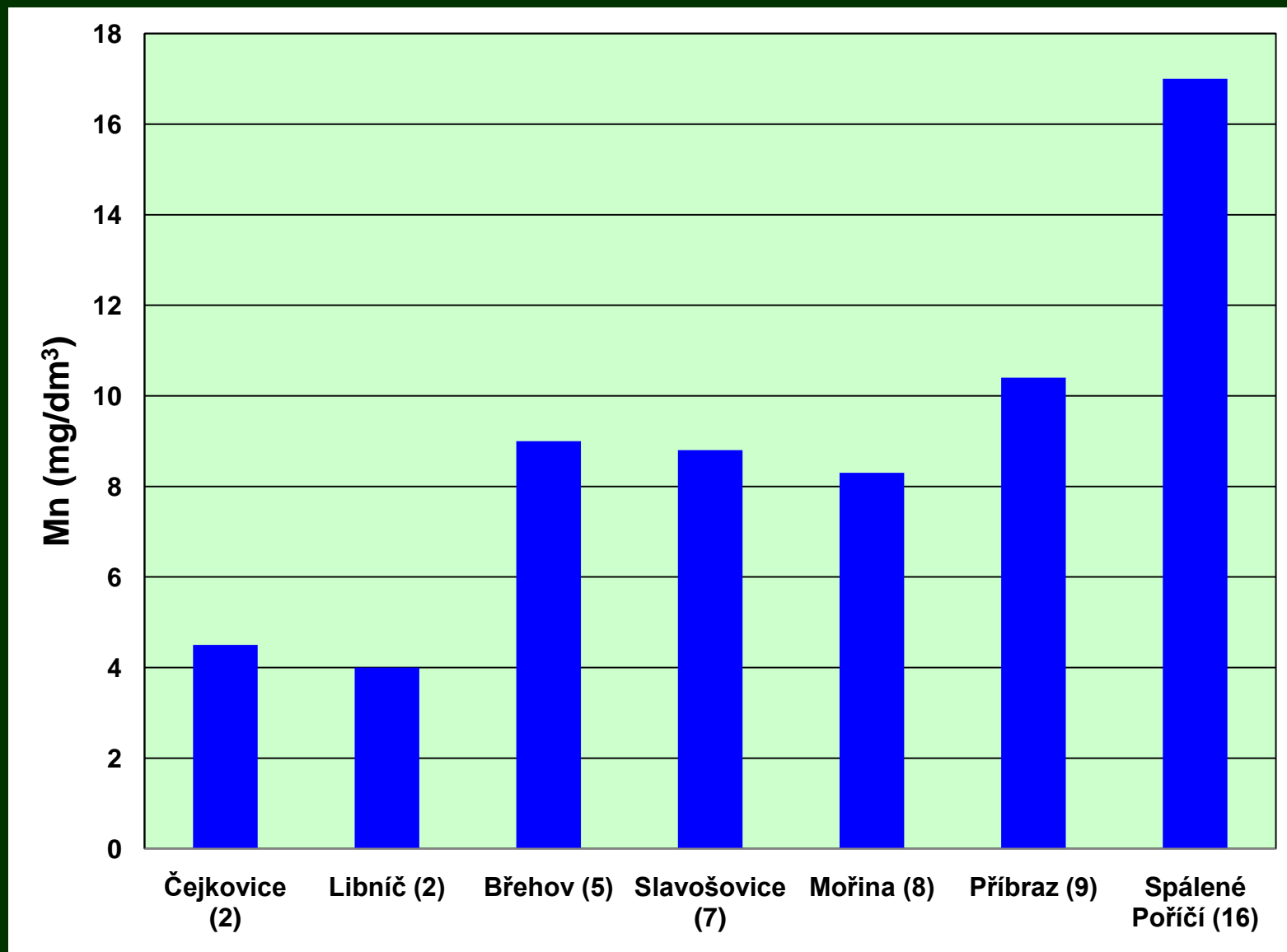
Inflow **0.55** **1.1** **3.55** **2.95** **3.65** **4.4** **11.3**

Outflow **0.35** **0.1** **3.2** **1.55** **3.05** **2.6** **8.85**

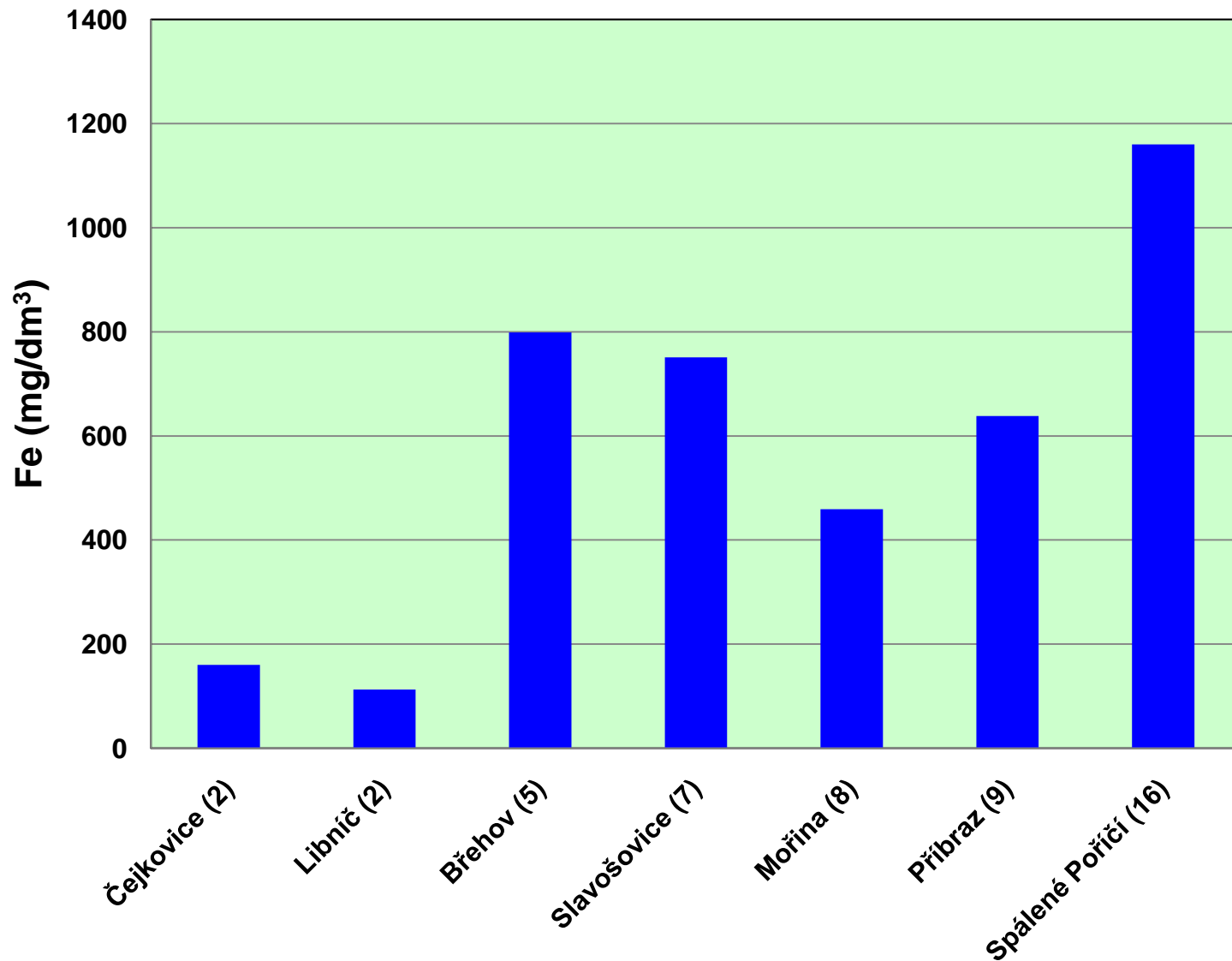
Sediment dry matter in the filtration beds



Magnesium amount per volume unit of the filtration bed



Iron amount per volume unit of the filtration bed



Conclusions

The amount of sediment increased with the length of operation

Sediments formed 0.4 – 10.6 % dry matter of the filtration bed material

Iron and manganese concentrations in the sediments generally decreased with the length of operation

However, the amount of Fe and Mn sequestered in the sediments increased over the length of operation

Thank you for your attention

