Titre: Title:	Comparison of organic materials for the passive treatment of synthetic neutral mine drainage contaminated by nickel: Short- and medium-term batch experiments
Auteurs: Authors:	Dominique Richard, Alfonso Mucci, Carmen Mihaela Neculita, & Gérald J. Zagury
Date:	2020
Type:	Article de revue / Article
Référence: Citation:	Richard, D., Mucci, A., Neculita, C. M., & Zagury, G. J. (2020). Comparison of organic materials for the passive treatment of synthetic neutral mine drainage contaminated by nickel: Short- and medium-term batch experiments. Applied Geochemistry, 123, 104772 (11 pages). https://doi.org/10.1016/j.apgeochem.2020.104772

Comparison of organic materials for the passive treatment of synthetic neutral mine drainage contaminated by nickel: Short- and medium-term batch experiments

Dominique Richard[1], Alfonso Mucci[2], Carmen Mihaela Neculita[3], Gérald J. Zagury[1*]

[1] Research Institute on Mines and Environment (RIME), Department of Civil, Geological, and Mining Engineering, Polytechnique Montréal, Montreal (QC), Canada, H3C 3A7

[2] GEOTOP and Department of Earth and Planetary Sciences, McGill University, Montreal (QC), Canada, H3A 2A7

[3] RIME, Université du Quebec en Abitibi-Temiscamingue (UQAT), Rouyn-Noranda (QC), Canada, J9X 5E4

*corresponding author
Email: gerald.zagury@polymtl.ca, Tel: +1 514 320 4711 ext: 4980, Fax: +1 514 340-4477

Electronic Supplementary Material

Table S1 Number and distribution of reactors during short-term and medium-term batch experiments.

Short-term experiment						Medium-term experiment		
	Natural pH of the substrate	pH 6	pH 7	pH 8			Experimental duplicate reactors	Sacrificial triplicate reactor[2]
Number of Algae reactors	2	2	2	2		Number of Wood ash reactors	2	1
Number of Sawdust reactors	2	2	2	2		Number of Compost reactors	2	1
Number of Wood ash reactors	2	2	2	0[1]		Number of HD-peat reactors	2	1
Number of Compost reactors	2	2	0[1]	2		Number of LT-peat reactors	2	1
Number of HD-peat reactors	2	2	2	2				
Total number of reactors	**36**					**Total number of reactors**	**12**	

[1]The natural pH of compost and wood ash was 7 and 8, respectively, and thus, no pH 7 and pH 8 experiments were conducted for these substrates. [2]These reactors were sampled at t = 21 days to measure the parameters used in geochemical modeling.

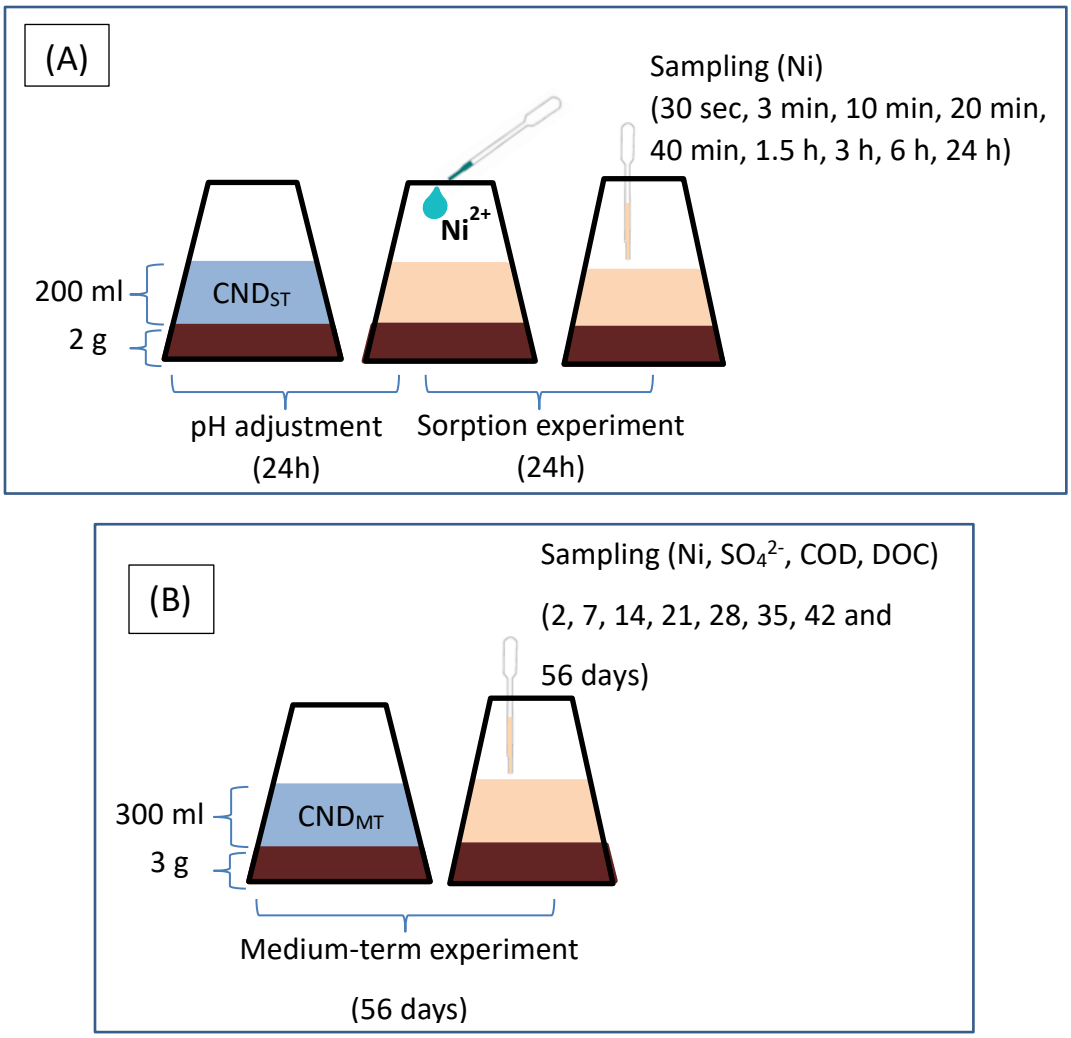

Fig. S1 Experimental conditions during (A) short-term and (B) medium-term batch experiments (experimental duplicate reactors).

Table S2 Composition of filtered solutions following 21 days of equilibration in medium-term batch reactors used as input to VMINTEQ geochemical equilibrium model. Eleven elements (Al, Be, Bi, Cd, Sn, Fe, Pb, Se, Ti, Br, NO_2) were not included in the models because they were below their respective detection limits (10 µg/L, 2 µg/L, 1 µg/L, 0.2 µg/L, 2 µg/L, 60 µg/L, 0.5 µg/L, 3 µg/L, 10 µg/L, 0.1 mg/L, 0.2 mg/L) in all reactor solutions.

Parameter	Unit	DL	Wood-ash	Compost	HD-peat	LT-peat
pH	-	-	8.08	7.24	7.60	7.58
Eh	mV	-	560	560	560	560
Alkalinity	mg/L CaCO3	4	64	10	32	34
DOC	mg/L	3	8.6	23	42	33
Temperature	°C	-	22	22	22	22
ICP-MS						
Ca	mg/L	5.0	250	250	250	320
Mg	mg/L	0.1	74	68	67	50
Na	mg/L	0.5	89	83	90	77
K	mg/L	0.5	51	63	6.0	7.4
Ni	µg/L	2.0	450	320	75	300
Zn	µg/L	7.0	<DL	18	<DL	<DL
Mn	µg/L	1.0	130	170	220	320
Co	µg/L	1.0	97	150	53	210
Cu	µg/L	1.0	<DL	3.8	<DL	<DL
Mo	µg/L	1.0	25	7.3	<DL	<DL
Cr	µg/L	5.0	5.3	<DL	<DL	<DL
As	µg/L	1.0	16	15	<DL	2.6
B	µg/L	50	550	180	60	<DL
Ba	µg/L	2.0	52	6	145	25
Sb	µg/L	1.0	2.2	1.9	<DL	<DL
Ion chromatography						
SO_4^{2-}	mg/L	0.2	983	946	976	950
NO_3^-	mg/L	0.2	<DL	25.5	<DL	<DL
Cl^-	mg/L	0.5	95	104	93	89
PO_4^{3-}	mg/L	0.1	0.1	1.6	<DL	<DL
F^-	mg/L	0.1	<DL	<DL	330	460

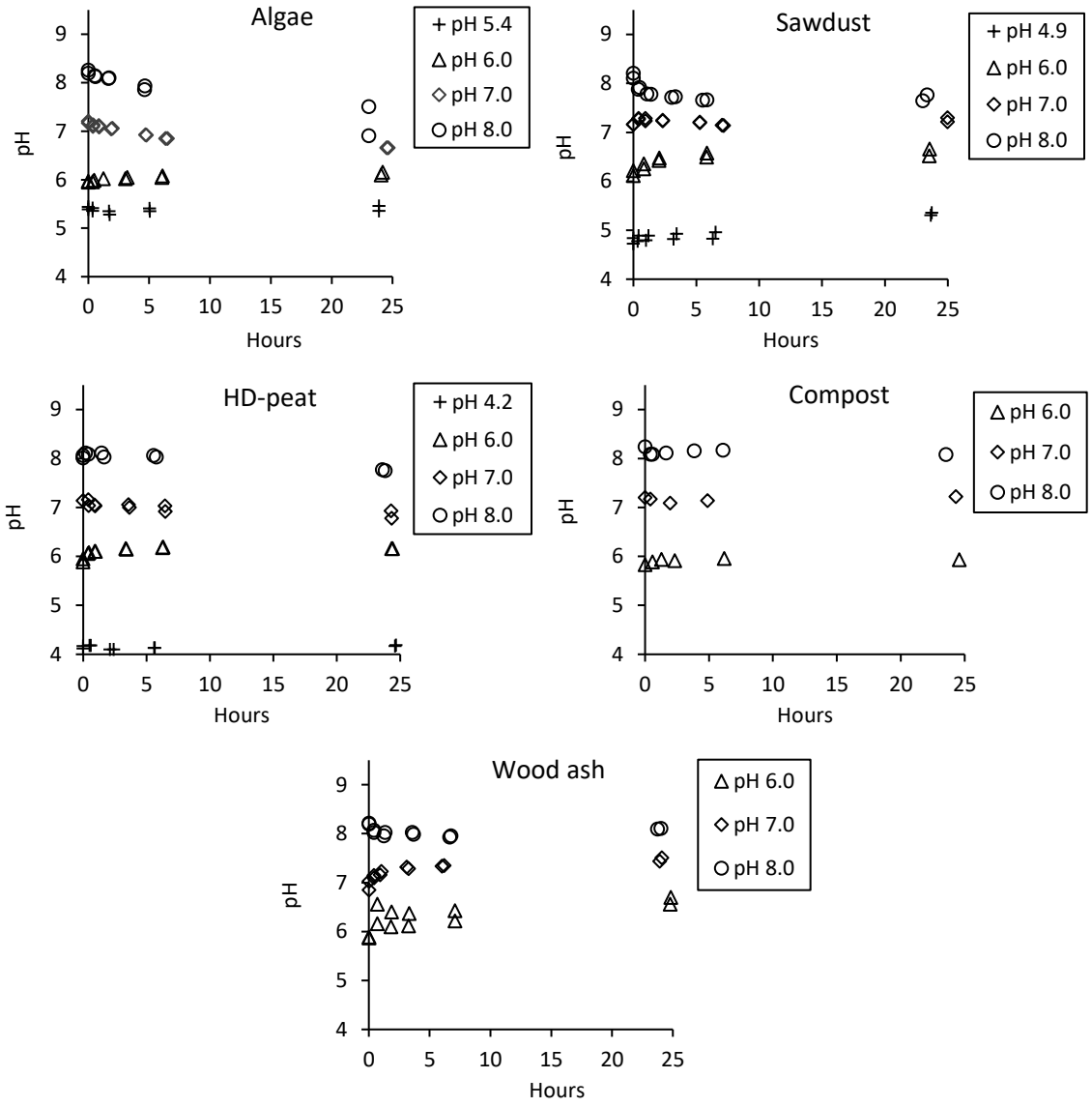

Fig. S2 Temporal evolution of solution pH during short-term batch experiments for the five materials tested

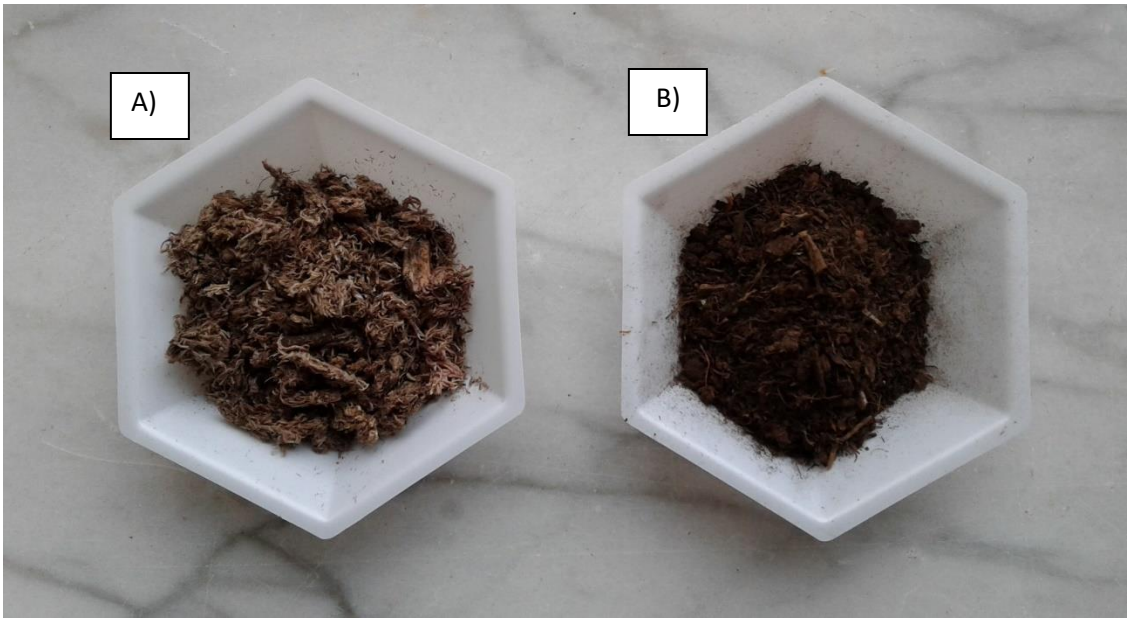

Fig. S3 A) Surface sphagnum peat moss (LT-peat), manually crumbled B) Horticultural sphagnum peat moss (HD-peat) purchased from a local retailer (Home Depot, Montreal), sieved to less than 5 mm.

Table S3 VMINTEQ equilibrium model results for solutions in batch reactors at t=21 days

	Charge imbalance (%)	Ionic strength (M)	Solids	Oversaturated species (SI)[1]
Wood ash	1.23	0.0324	Calcium carbonates	Calcite (0.39), Aragonite (0.24), Dolomite (disordered) (0.021), Dolomite (ordered) (0.58)
			Nickel carbonate	$NiCO_3$(s) (0.10)
			Cobalt oxide	Co_3O_4(s) (10.5)
			Manganese oxides	Birnessite (1.72), Bixbyite (4.76), Hausmannite (3.71), Manganite (2.37), Nsutite (2.31), Pyrolusite (3.50)
			Barium sulfate	Barite (0.79)
			Manganese phosphate	$MnHPO_4$(s) (0.35)
			Calcium phosphate	Hydroxyapatite (6.50)
Compost	0.29	0.0315	Cobalt oxide	Co_3O_4(s) (4.45)
			Manganese oxide	Pyrolusite (0.26)
			Manganese Phosphate	$MnHPO_4$(s) (1.58)
			Calcium phosphate	Hydroxyapatite (6.45)
HD-peat-calcite	4.79	0.0309	Cobalt oxide	Co_3O_4(s) (5.91)
			Manganese oxides	Birnessite (0.010), Bixbyite (2.300), Hausmannite (0.50), Manganite (1.14), Nsutite (0.60), Pyrolusite (1.78)
			Barium sulfate	Barite(1.24)
LT-peat-calcite	2.15	0.0313	Cobalt oxide	Co_3O_4(s) (7.60)
			Manganese oxides	Birnessite (0.12), Bixbyite (2.561), Hausmannite (0.91), Manganite (1.27), Nsutite (0.71), Pyrolusite (1.89),
			Barium sulfate	Barite (0.45)

[1]SI = -log (IAP/$K°_{sp}$), where IAP is the ion activity product of the ionic constituents of the solid and $K°_{sp}$ is the thermodynamic solubility of the solid at the experimental temperature and 1 atm total pressure.