Supplementary information for:

Solvent bar micro-extraction of heavy metals from natural water samples using 3-hydroxy-2-naphthoate-based ionic liquids

Philip Pirkwieser[1,2], José A. López-López[2], Wolfgang Kandioller[1], Bernhard K. Keppler[1], Carlos Moreno[2] and Franz Jirsa[1,3]*

[1] Institute of Inorganic Chemistry, Faculty of Chemistry, University of Vienna, Waehringer Strasse 42, 1090 Vienna, Austria
[2] Department of Analytical Chemistry, Faculty of Marine and Environmental Sciences, Instituto de Investigación Marina (INMAR), University of Cádiz, PC 11510, Puerto Real, Spain
[3] Department of Zoology, University of Johannesburg, PO Box 524, Auckland Park, 2006, Johannesburg, South Africa
* Correspondence: franz.jirsa@univie.ac.at

Table of contents

Table S1: Summarized results for the optimization of extraction efficacy. Considered were all metals that showed an extraction efficacy >40% after the time dependent experiments for each setup respectively.

		Extraction efficacy ± SD (%)																				
		Cu									Ag			Cd			Pb					
		$[P_{66614}][HNA]$			$[P_{1888}][HNA]$			$[N_{1888}][HNA]$			$[P_{66614}][HNA]$			$[P_{66614}][HNA]$			$[P_{66614}][HNA]$			$[P_{1888}][HNA]$			$[N_{1888}][HNA]$		
Dodecan-1-ol (wt%)	90	n/a			45.6	±	1.3	29.5	±	1.6	n/a			n/a			n/a			28.1	±	1.7	12.9	±	0.8
	75	<5			70.4	±	4.7	40.0	±	7.0	35.2	±	2.9	5.5	±	0.9	<5			40.8	±	2.8	37.7	±	8.3
	60	n/a			83.7	±	2.5	80.3	±	1.4	n/a			n/a			n/a			47.6	±	0.8	47.3	±	6.8
	50	<5			87.4	±	0.8	90.1	±	1.7	73.8	±	2.5	4.4	±	0.4	20.9	±	6.7	50.4	±	2.1	69.1	±	2.7
	25	30.6	±	2.8	n/a			n/a			74.8	±	2.6	9.1	±	3.0	54.3	±	3.0	n/a			n/a		
	0	55.5	±	3.7	n/a			n/a			80.2	±	1.2	27.9	±	3.2	70.1	±	3.4	n/a			n/a		
pH	2	<5			<5			<5			76.9	±	0.9	<5			<5			<5			<5		
	4	33.8	±	2.1	<5			<5			83.2	±	1.0	11.4	±	1.6	55.8	±	2.8	16.8	±	1.9	<5		
	6	54.0	±	3.4	37.6	±	3.6	56.1	±	1.0	82.4	±	1.3	18.9	±	1.2	64.7	±	3.5	15.5	±	2.4	32.5	±	3.3
	8	55.5	±	3.7	87.4	±	0.8	90.1	±	1.7	80.2	±	1.2	27.9	±	3.2	70.1	±	3.4	50.4	±	2.1	69.1	±	2.7
Stirring rate (rpm)	0	17.3	±	0.6	15.5	±	4.7	28.2	±	2.9	39.5	±	0.7	15.4	±	0.3	11.6	±	1.4	19.1	±	2.2	16.1	±	1.2
	100	42.4	±	1.1	59.4	±	0.8	61.0	±	0.9	53.3	±	1.8	23.2	±	0.4	48.6	±	1.6	32.6	±	1.3	35.0	±	1.7
	300	56.8	±	1.0	75.1	±	0.1	85.6	±	1.8	73.5	±	0.4	29.4	±	0.4	56.4	±	2.0	44.9	±	2.0	73.3	±	3.1
	600	55.5	±	3.7	87.4	±	0.8	90.1	±	1.7	80.2	±	1.2	27.9	±	3.2	70.1	±	3.4	50.4	±	2.1	69.1	±	2.7
	800	63.1	±	0.0	74.1	±	4.3	87.8	±	3.5	81.4	±	1.4	27.2	±	0.2	70.7	±	3.6	57.5	±	3.0	68.0	±	4.4
Fiber length (cm)	10	45.7	±	0.2	72.3	±	3.8	75.7	±	0.8	70.9	±	1.1	14.5	±	2.5	62.2	±	1.6	29.9	±	1.7	54.7	±	2.1
	15	55.5	±	3.7	87.4	±	0.8	90.1	±	1.7	80.2	±	1.2	27.9	±	3.2	70.1	±	3.4	50.4	±	2.1	69.1	±	2.7
	20	57.4	±	0.9	88.7	±	1.4	82.7	±	1.5	81.8	±	0.6	27.1	±	2.8	65.3	±	2.0	39.5	±	3.2	61.3	±	0.9
NaCl ($g\ L^{-1}$)	0	55.5	±	3.7	87.4	±	0.8	90.1	±	1.7	80.2	±	1.2	27.9	±	3.2	70.1	±	3.4	50.4	±	2.1	69.1	±	2.7
	5	54.2	±	2.3	77.9	±	3.7	50.1	±	1.9	72.3	±	0.8	41.4	±	1.2	64.5	±	2.9	31.6	±	1.9	19.3	±	2.3
	10	59.1	±	1.1	79.7	±	3.7	53.3	±	1.5	74.2	±	0.7	66.5	±	2.6	73.1	±	3.2	39.7	±	2.6	18.4	±	1.4
	15	53.7	±	1.5	60.7	±	3.7	56.3	±	2.0	60.3	±	2.6	72.3	±	0.9	38.6	±	1.6	21.6	±	2.8	26.4	±	0.6
	30	53.8	±	2.3	77.2	±	1.5	47.2	±	1.4	63.9	±	1.2	78.0	±	1.6	29.9	±	4.2	<5			8.8	±	0.6
	60	46.6	±	2.2	36.4	±	2.0	40.6	±	2.0	55.2	±	1.8	86.5	±	1.9	22.1	±	3.1	<5			9.9	±	1.5

n/a= not applicable.

Table S2: Summarized results for leaching during extraction. WWTP = wastewater treatment plant, DOC = dissolved organic carbon.

		Leaching ± SD (mg L^{-1} DOC)		
		$[P_{66614}][HNA]$	$[P_{1888}][HNA]$	$[N_{1888}][HNA]$
Dodecan-1-ol (wt%)	90	n/a	14.9 ± 1.4	6.2 ± 0.9
	75	11.6 ± 0.6	19.3 ± 0.9	9.0 ± 0.2
	60	n/a	21.1 ± 1.1	15.6 ± 0.8
	50	13.9 ± 0.1	20.6 ± 0.2	19.4 ± 0.6
	25	12.8 ± 0.1	n/a	n/a
	0	11.3 ± 0.7	n/a	n/a
pH	2	2.9 ± 0.2	12.6 ± 0.3	8.0 ± 0.3
	4	7.6 ± 0.5	16.6 ± 0.9	13.2 ± 0.2
	6	10.1 ± 0.5	18.2 ± 0.6	15.1 ± 0.9
	8	11.3 ± 0.7	20.6 ± 0.2	19.4 ± 0.6
Stirring rate (rpm)	0	7.9 ± 0.3	16.2 ± 0.9	13.3 ± 0.5
	100	10.9 ± 0.6	22.8 ± 1.2	18.3 ± 1.0
	300	11.4 ± 0.4	21.7 ± 1.8	18.7 ± 0.3
	600	11.3 ± 0.7	20.6 ± 0.2	19.4 ± 0.6
	800	11.7 ± 0.4	24.8 ± 2.2	19.9 ± 0.6
Fiber length (cm)	10	7.0 ± 0.9	17.5 ± 1.2	14.9 ± 0.2
	15	11.3 ± 0.7	20.6 ± 0.2	19.4 ± 0.6
	20	19.5 ± 1.8	24.5 ± 0.9	21.0 ± 0.5
NaCl (g L^{-1})	0	11.3 ± 0.7	20.6 ± 0.2	19.4 ± 0.6
	5	13.9 ± 0.3	19.2 ± 0.9	12.3 ± 0.5
	10	16.1 ± 0.5	21.6 ± 0.9	14.5 ± 0.1
	15	13.9 ± 0.2	16.7 ± 0.7	14.7 ± 0.1
	30	10.2 ± 0.1	23.4 ± 1.9	11.2 ± 0.2
	60	12.6 ± 0.4	24.4 ± 2.1	14.7 ± 0.2
Drinking water		16.2 ± 1.3	24.5 ± 2.0	19.4 ± 0.5
WWTP effluent		3.8 ± 0.3	25.4 ± 0.4	19.3 ± 0.2
Sea water		12.2 ± 0.3	29.7 ± 0.1	26.1 ± 2.7
Hypersaline water		11.3 ± 0.9	27.0 ± 0.0	24.6 ± 0.5

n/a= not applicable.

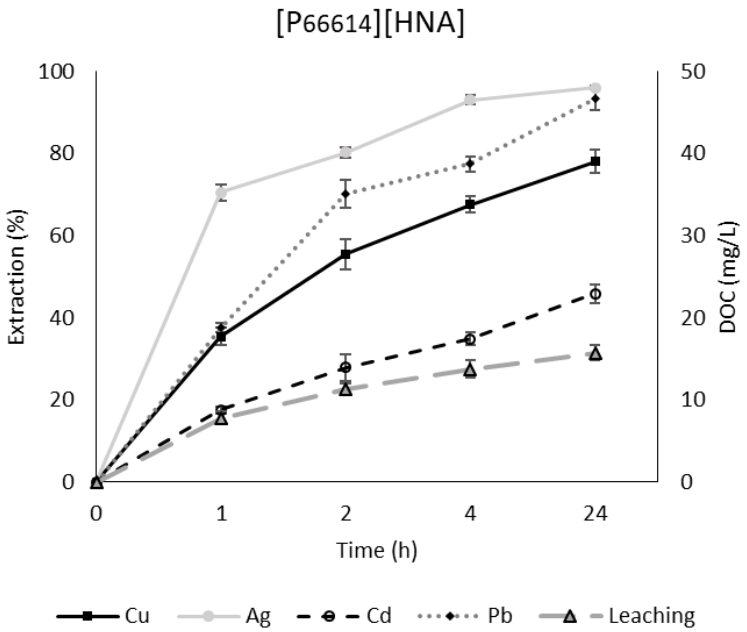

Figure S1: Time dependency of extraction and leaching using pure $[P_{66614}][HNA]$, pH = 8.0 (n=3, error bars = ± SD).