HJ

Water quality—Determination of four organic tin compounds including tributyltin Liquid chromatography/inductively coupled plasma mass spectrometry

4

4

-

A B

2019 12 31

2020 6 30

4 -

1000 ml 1.0 ml 20.0 µl

0.004 µg/L 0.005 µg/L 0.016 µg/L 0.020 µg/L

20.0 µl 3 µg/L 6 µg/L 12 µg/L 24 µg/L

A

HJ 91.1

HJ 442

HJ 493

HJ/T 91

HJ/T 164

CH_3CN

CH_3COOH

$C_6H_{15}N$

CH_3OH

CH_3COCH_3

CH_2Cl_2

NaCl

400 2 h

ρ HCl =1.19 g/ml

1+1

50.0 ml 4.8 100 ml

1+19

50.0 ml 4.8 1000 ml

1+99

1.0 ml 4.8 100 ml

Na_2SO_4

400 4 h

ρ=1000 mg/L

13.05 mg 0.01 mg $C_8H_{18}Cl_2Sn$ 11.22 mg

$C_{12}H_{27}ClSn$ 12.60 mg $C_{12}H_{10}Cl_2Sn$ 11.01 mg

$C_{18}H_{15}ClSn$ 4.4 4.5 10.00 ml

1000 mg -18 1

ρ=10.0 mg/L

1.00 ml 4.13

4.1 100 ml -18 20 d

65.0 ml 4.1 12.0 ml 4.2 0.05 ml 4.3 100 ml

100 ml

0.22 μm

99.99 %

80% 20% V/V 99.99%

A

250 mm 4.6 mm C_{18}

KD

2 L

2.0 ml

HJ 91.1 HJ/T 91 HJ/T 164 HJ 442 HJ 493

2.5 L 4.9 pH 2

4 24 h 7 d

24 h

pH 2 1000 ml

5.5 30 g 4.7 60 ml 4.6

5 min 60 ml 4.6

4.12

4.7

5.4 0.5 ml 1 ml 4.1

0.5 ml 4.1 2 4.15 1.0 ml

4.16 5.6

4.9 pH 2 1.0 ml

4.16 5.6 1.0 ml 4.1

5.6

6.2

V *V* *V* =65 23 12 0.05%
18 30
0.8 ml/min

ICP-MS 1

	1600 W
	9.0 mm
/	15.0 L·min^{-1}
	0.00 L·min^{-1}
	0.55 L·min^{-1}
	0.25 L·min^{-1}
	1.0 mm
	0.4 mm
	1200 s
	^{116}Sn ^{118}Sn ^{120}Sn

4.14
4.15 10.0 μg/L 20.0 μg/L 50.0 μg/L 100 μg/L 150 μg/L 200 μg/L
5.6

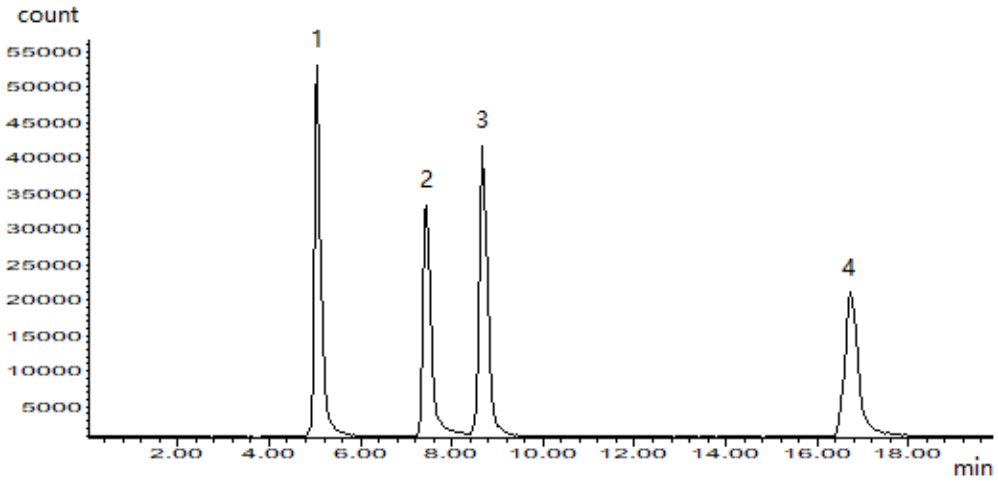
4.14
4.11 10.0 μg/L 20.0 μg/L 50.0 μg/L 100 μg/L 150 μg/L 200 μg/L
5.6

7.1

20.0 l

20.0 l 7.3

4 1



1 2 3 4

1

$$\rho_i = \frac{\rho_i' \times V}{V_0} \qquad 1$$

ρ_i μg/L

ρ_i' μg/L

V ml

V_0 ml

2

$$\rho_i = \rho_i' \times D \times 2 \qquad 2$$

ρ_i μg/L

ρ_i' μg/L

D

6 4 0.100 μg/L 0.020 μg/L 0.020 μg/L 6 1.6% 5.1% 2.4% 9.9% 2.5% 9.8% 2.0% 3.5% 3.1% 7.8% 4.6% 13% 0.007 μg/L 0.010 μg/L 0.003 μg/L 0.004 μg/L 0.003 μg/L 0.005 μg/L 0.008 μg/L 0.011 μg/L 0.003 μg/L 0.005 μg/L 0.003 μg/L 0.008 μg/L

6 4 100 μg/L 200 μg/L 6 0.8% 5.5% 0.9% 4.6% 3.2% 12% 1.3% 9.4% 4 μg/L 8 μg/L 10 μg/L 15 μg/L 10 μg/L 37 μg/L 15 μg/L 47 μg/L

B

6 4 0.100 μg/L 0.020 μg/L 0.020 μg/L 74.6% 90.3% 68.5% 93.0% 69.0% 109% 77.5% 4.8% 86.1% 5.0% 78.8% 12.4% 85.9% 8.4% 77.3% 7.2% 90.3% 24.2%

6 4 100 μg/L 200 μg/L

80.4% 106% 80.5% 102%

86.4% 5.6% 93.7% 13.2% 86.4% 16.6% 94.3% 7.0%

B

20 20 /

r 0.990 20 20 /

20%

20 20 /

20%

20 20 /

60% 120%

4.10 24 h

A.1

		μg/L	μg/L
1		0.004	0.016
2		0.005	0.020
3		0.004	0.016
4		0.004	0.016

A.2

		μg/L	μg/L
1		4	16
2		6	24
3		3	12
4		3	12

B.1

			μg/L	%	%	r μg/L	R μg/L
1			0.100	2.4 5.1	3.1	0.010	0.011
			0.020	3.4 9.9	7.8	0.003	0.005
			0.020	4.8 8.5	4.6	0.003	0.003
2			0.100	2.4 4.9	2.9	0.009	0.010
			0.020	2.9 9.9	4.9	0.004	0.004
			0.020	7.5 9.8	13	0.005	0.008
3			0.100	1.6 3.7	3.5	0.007	0.011
			0.020	2.4 8.8	5.9	0.003	0.004
			0.020	2.5 9.4	8.7	0.004	0.006
4			0.100	1.9 3.7	2.0	0.007	0.008
			0.020	3.6 8.6	3.1	0.003	0.003
			0.020	3.9 7.9	9.3	0.003	0.005

B.2

			μg/L	μg/L	%	$\overline{P}(\%)$	$S_{\overline{P}}$ %	$\overline{P} \pm 2S_{\overline{P}}(\%)$
1			ND	0.100	74.6 80.6	77.5	2.4	77.5 4.8
			ND	0.020	68.5 86.0	78.8	6.2	78.8 12.4
			ND	0.020	73.5 82.0	77.3	3.6	77.3 7.2
2			ND	0.100	83.1 90.3	86.1	2.5	86.1 5.0
			ND	0.020	78.5 90.0	85.9	4.2	85.9 8.4
			ND	0.020	71.5 109	90.3	12	90.3 24
3			ND	0.100	82.3 90.3	86.0	3.0	86.0 6.0
			ND	0.020	79.5 93.0	83.7	5.0	83.7 10.0
			ND	0.020	76.5 97.0	88.2	7.6	88.2 15.2
4			ND	0.100	77.9 82.2	80.2	1.6	80.2 3.2
			ND	0.020	79.5 86.5	84.8	2.7	84.8 5.4
			ND	0.020	69.0 89.0	80.6	7.5	80.6 15.0

B.3

			μg/L	%	%	μg/L	μg/L
1			100	1.6 4.7	12	8	37
			200	1.5 3.9	9.4	13	47
2			100	1.0 2.1	7.6	4	20
			200	0.9 2.8	3.7	10	21
3			100	0.8 3.9	7.1	6	19
			200	1.7 4.4	4.4	15	26
4			100	1.5 5.5	3.2	7	10
			200	1.4 4.6	1.3	15	15

B.4

			μg/L	μg/L	%	$\overline{P}(\%)$	$S_{\overline{P}}$ %	$\overline{P} \pm 2S_{\overline{P}}(\%)$
1			ND	100	80.4 106	92.3	11	92.3 22
			ND	200	80.5 102	86.4	8.3	86.4 16.6
2			ND	100	86.5 103	92.8	7.3	92.8 14.6
			ND	200	90.0 100	94.3	3.5	94.3 7.0
3			ND	100	86.4 106	93.7	6.6	93.7 13.2
			ND	200	85.0 95.5	88.5	3.9	88.5 7.8
4			ND	100	81.5 89.7	86.4	2.8	86.4 5.6
			ND	200	89.0 92.5	91.3	1.2	91.3 2.4