**Investigations of the Chemical Distribution of Heavy Metals in Street Dust and its Impact on Risk Assessment for Human Health, case study of Radom (Poland)**

Marzena Trojanowska and Ryszard Świetlik

Kazimierz Pulaski University of Technology and Humanities in Radom, Department of Environmental Protection, Chrobrego 27, 26-600 Radom, Poland

Corresponding author. E-mail address: m.trojanowska@uthrad.pl (M. Trojanowska)

**Supplementary Material**

Table S1. Steps of the modified Tessier sequential extraction procedure.

Table S2. Metal recovery from the sequential extraction analysis.

Table S3. Reference doses (*RfD*) of toxic metals used in this study (Ferreira-Baptista and De Miguel 2005; Chen et al. 2014; RAIS 2019).

Table S4. Chemical fractionation of Cr, Cu, Fe, Mn, Ni, Pb and Zn in urban street dusts of Radom.

Table S1. Steps of the modified Tessier sequential extraction procedure.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step | Fraction | | Reagent | Conditionsa,b | |
| Shaking time | Temperature |
| 1 | F(1) | water soluble | 10 mL H2O | 24 h | 25°C ± 2°C |
| 2 | F(2) | weak acid soluble | 8 mL 1 M NaOAc, pH 5 (HOAc) | 5 h | 25°C ± 2°C |
| 3 | F(3) | reducible | 20 mL 0.04 M NH2OH·HCl/25% HOAc | 6 h | 96°C ± 2°C |
| 4 | F(4) | oxidizable | 5 mL 30% H2O2 (pH 2) + 3 mL 0.02 M HNO3,  3 mL 30% H2O2 (pH 2),  5 mL 3.2 M NH4OAc in 20% HNO3 | 2 h  3 h  30 min | 85°C ± 2 °C  85°C ± 2°C  25°C ± 2°C |
| 5 | F(5) | residual | 5 mL 65% HNO3 + 1 mL 30% H2O2 | microwave-assisted, analogously as pseudo-total content determination | |
| a 1.00 g of sample was used  b All extracted solutions were separated by centrifugation at 10,000 rpm for 30 min and filtered through a membrane filter Millipore 0.45 µm | | | | | |

Table S2. Metal recovery from the sequential extraction analysis.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample | Cr | | | Cu | | | Fe | | | Mn | | |
| ΣF(1÷5) | C*tot*.a | Recovery | ΣF(1÷5) | C*tot*.a | Recovery | ΣF(1÷5) | C*tot*.a | Recovery | ΣF(1÷5) | C*tot*.a | Recovery |
| (mg kg-1) | (mg kg-1) | [%] | (mg kg-1) | (mg kg-1) | [%] | (g kg-1) | (g kg-1) | [%] | (mg kg-1) | (mg kg-1) | [%] |
| P-1 | 56.4 | 55.1 | 102 | 279 | 271 | 103 | 20.9 | 22.8 | 91.7 | 598 | 610 | 98.0 |
| P-2 | 66.5 | 66.7 | 99.7 | 170 | 164 | 104 | 17.1 | 17.6 | 97.2 | 472 | 475 | 99.4 |
| P-3 | 47.4 | 45.2 | 105 | 210 | 208 | 101 | 18.6 | 19.7 | 94.4 | 618 | 638 | 96.9 |
| P-4 | 49.1 | 47.4 | 104 | 296 | 313 | 94.6 | 21.0 | 21.8 | 96.3 | 529 | 536 | 98.7 |
| Mean recovery |  |  | 103 |  |  | 101 |  |  | 94.9 |  |  | 98.2 |
| Sample | Ni | | | Pb | | | Zn | | |  |  |  |
| ΣF(1÷5) | C*tot*.a | Recovery | ΣF(1÷5) | C*tot*.a | Recovery | ΣF(1÷5) | C*tot*.a | Recovery |  |  |  |
| (mg kg-1) | (mg kg-1) | [%] | (mg kg-1) | (mg kg-1) | [%] | (mg kg-1) | (mg kg-1) | [%] |  |  |  |
| P-1 | 43.0 | 44.8 | 96.0 | 70.0 | 75.5 | 92.7 | 653 | 627 | 104 |  |  |  |
| P-2 | 74.9 | 76.7 | 97.7 | 106 | 113 | 93.8 | 516 | 484 | 107 |  |  |  |
| P-3 | 36.5 | 36.0 | 101 | 78.8 | 72.2 | 109 | 599 | 635 | 94.3 |  |  |  |
| P-4 | 40.2 | 41.8 | 96.2 | 91.8 | 93.2 | 98.5 | 677 | 726 | 93.3 |  |  |  |
| Mean recovery |  |  | 97.7 |  |  | 98.5 |  |  | 99.7 |  |  |  |

a C*tot*. – pseudo-total metal concentration

Table S3. Reference doses (RfD) of toxic metals used in this study (Ferreira-Baptista and De Miguel 2005; Chen et al. 2014; RAIS 2019).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
| RfDoral (mg kg-1d-1) | 3.00E-03 | 4.00E-02 | 7.00E-01 | 4.60E-02 | 2.00E-02 | 3.50E-03 | 3.00E-01 |
| RfDinhal (mg kg-1d-1) | 2.86E-05 | 4.02E-02 | 2.20E-04 | 1.40E-05 | 2.06E-02 | 3.52E-03 | 3.00E-01 |
| RfDderm (mg kg-1d-1) | 6.00E-05 | 1.20E-02 | 7.00E-02 | 1.84E-03 | 5.40E-03 | 5.25E-04 | 6.00E-02 |

Table S4. Chemical fractionation of Cr, Cu, Fe, Mn, Ni, Pb and Zn in urban street dusts of Radom.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | F(1)-Me | | F(2)-Me | | F(3)-Me | | F(4)-Me | | F(5)-Me | |
|  | (mg kg-1) | (%) | (mg kg-1) | (%) | (mg kg-1) | (%) | (mg kg-1) | (%) | (mg kg-1) | (%) |
| Cr |  |  |  |  |  |  |  |  |  |  |
| Min | < LOD | - | 1.23 | 3.6 | 14.9 | 31.4 | 2.78 | 5.9 | 25.8 | 34.7 |
| Max | < LOD | - | 3.19 | 6.3 | 31.8 | 47.8 | 8.91 | 13.4 | 29.7 | 59.1 |
| Mean ± SD | < LOD | - | 2.5 ± 1.8 | 4.6 | 21.5 ± 7.5 | 39.1 | 5.2 ± 2.7 | 9.5 | 25.7 ± 1.7 | 46.8 |
| Cu |  |  |  |  |  |  |  |  |  |  |
| Min | 0.28 | 0.2 | 11.5 | 6.8 | 27.4 | 16.1 | 103 | 49.2 | 25.5 | 15.0 |
| Max | 1.36 | 0.5 | 30.1 | 10.8 | 92.0 | 31.1 | 153 | 54.8 | 47.2 | 15.9 |
| Mean ±SD | 0.86 ± 0.55 | 0.4 | 18.6 ± 8.2 | 7.8 | 58 ± 27 | 24.2 | 126 ± 25 | 52.6 | 35.9 ± 8.9 | 15.0 |
| Fe |  |  |  |  |  |  |  |  |  |  |
| Min | 1.09 | 0.01 | 4.11 | 0.02 | 5.27 a | 25.0 | 372 | 2.0 | 12.1 a | 68.5 |
| Max | 4.76 | 0.02 | 10.13 | 0.03 | 6.57 a | 31.4 | 719 | 3.5 | 15.3 a | 72.6 |
| Mean ±SD | 2.56 ± 1.73 | 0.01 | 6.7 ± 2.5 | 0.03 | 5.39 ± 0.82a | 27.5 | 537 ± 146 | 2.8 | 13.6 ± 1.3 a | 69.7 |
| Mn |  |  |  |  |  |  |  |  |  |  |
| Min | < LOD | - | 72.4 | 15.4 | 299 | 48.4 | 8.33 | 1.8 | 150 | 28.6 |
| Max | 6.12 | 1.02 | 125 | 20.2 | 311 | 52.0 | 13.4 | 2.2 | 181 | 31.8 |
| Mean ± SD | 3.70 ± 1.91 | 0.67 | 93.3 ± 23.2 | 16.8 | 282 ± 31 | 50.8 | 10.7 ± 2.1 | 1.9 | 165 ± 14 | 29.8 |
| Ni |  |  |  |  |  |  |  |  |  |  |
| Min | < LOD | - | 1.41 | 2.7 | 11.0 | 30.1 | 2.07 | 5.7 | 22.0 | 38.6 |
| Max | < LOD | - | 2.02 | 4.9 | 32.3 | 43.1 | 11.9 | 15.9 | 28.8 | 60.3 |
| Mean ± SD | < LOD | - | 1.75 ± 0.28 | 3.6 | 18 ± 10 | 36.6 | 5.3 ± 4.5 | 10.8 | 24.1 ± 3.1 | 49.0 |
| Pb |  |  |  |  |  |  |  |  |  |  |
| Min | < LOD | - | 0.90 | 1.2 | 46.5 | 59.5 | 7.57 | 9.6 | 9.03 | 12.9 |
| Max | < LOD | - | 6.47 | 7.1 | 64.4 | 66.5 | 18.3 | 19.4 | 20.7 | 21.6 |
| Mean ± SD | < LOD | - | 4.4 ± 2.5 | 5.1 | 54.4 ± 8.0 | 62.8 | 12.8 ± 4.5 | 14.8 | 15.0 ± 4.8 | 17.3 |
| Zn |  |  |  |  |  |  |  |  |  |  |
| Min | 4.73 | 0.73 | 145 | 26.6 | 270 | 48.9 | 13.1 | 2.2 | 63.2 | 10.5 |
| Max | 13.2 | 1.9 | 205 | 32.8 | 355 | 56.1 | 49.9 | 7.8 | 128 | 18.6 |
| Mean ± SD | 8.3 ± 4.0 | 1.3 | 168 ± 29 | 27.5 | 319 ± 37 | 52.1 | 29 ± 18 | 4.8 | 87 ± 30 | 14.3 |

a g kg-1

**Reference**

RAIS (The Risk Assessment Information System). 2019. U.S. Department of Energy, Office of Environmental Management, Oak Ridge Operations Office. Available at https://rais.ornl.gov/cgi-bin/tools/TOX\_search?select¼chem.