**ADDITIONAL MATERIALS**

**The efficiency and economic aspects of phytoremediation technology using *Phalaris arundinacea L.* and *Brassica napus L.* combined with compost and nano SIO2 fertilization for the removal of PAH from soil**

Correspondence to:

Dariusz Włóka

Institute of Environmental Engineering,

Faculty of Infrastructure and Environment,

Częstochowa University of Technology,

Brzeźnicka street 60a, 42-200 Czestochowa, Poland

dariusz.wloka@gmail.com

1. Polycyclic aromatic hydrocarbons (PAHs) changes In soils, during phytoremediation.

Data presented in tables S1 to S16 includes average values of 16 PAHs. Those values were analyzed during the realization of studied phytoremediation process. Each table represents the single type of treatment and contains values from 6 studied cycles.

**Tab. S1. The 16 PAHs content in soils collected from *P. arundinacea* plots, not treated with any additives. Depth of sampling: 0-15 cm. Results shown as means ± SD=6-14%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 180.14 | 156.03 | 91.61 | 74.15 | 41.61 | 27.64 |
| Acenaphtylene  | 504.01 | 443.11 | 366.55 | 219.30 | 120.42 | 79.62 |
| Acenatphtene  | 69.53 | 78.33 | 57.14 | 41.97 | 44.64 | 10.55 |
| Fluorene  | 278.34 | 237.61 | 184.41 | 120.26 | 55.41 | 17.64 |
| Phenanthrene  | 420.67 | 473.11 | 343.81 | 234.18 | 127,40 | 89.62 |
| Anthracene  | 389.79 | 375.21 | 254.14 | 195.54 | 124.41 | 137.63 |
| Fluoranthene  | 4164.17 | 3958.91 | 3547.14 | 2040.97 | 1841.41 | 1649.62 |
| Pyrene  | 1542.19 | 1382.73 | 1210.07 | 754.52 | 693.14 | 590.64 |
| Benzo(a)anthracene  | 1408.94 | 1407.61 | 1471.64 | 743.14 | 512.67 | 484.67 |
| Chrysene  | 213.86 | 168.11 | 177.14 | 93.18 | 107.67 | 93.58 |
| Benzo(b)fluoranthene  | 1417.66 | 1322.61 | 1214.71 | 709.77 | 699.41 | 709.77 |
| Benzo(k)fluoranthene  | 1159.13 | 1056.61 | 1121.14 | 1097.65 | 905.64 | 890.06 |
| Benzo(a)pyrene  | 1755.87 | 1200.25 | 1287.41 | 1075.65 | 987.41 | 974.64 |
| Dibenzo(a,h)anthracene | 339.36 | 310.72 | 347.64 | 321.97 | 347.64 | 299.40 |
| Benzo(g,h,i)perylene  | 1348.39 | 1209.31 | 1184.41 | 1071.67 | 967.15 | 945.64 |
| Indeno(1,2,3-c,d)pyrene | 2109.32 | 2024.711 | 2115.04 | 1977.05 | 1905.05 | 1877.55 |

**Tab. S2. The 16 PAHs content in soils collected from *P. arundinacea* plots, treated with SiO2. Depth of sampling: 0-15 cm. Results shown as means ± SD=5-15%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 154.49 | 99.42 | 42.18 | 14.05 | 24.51 | 2.76 |
| Acenaphtylene  | 428.23 | 378.89 | 291.28 | 121.46 | 94.18 | 27.11 |
| Acenatphtene  | 111.27 | 84.15 | 56.37 | 22.18 | 5.94 | 6.34 |
| Fluorene  | 299.79 | 259.81 | 207.06 | 153.87 | 79.51 | 31.14 |
| Phenanthrene  | 463.87 | 449.34 | 386.29 | 284.33 | 177.63 | 87.51 |
| Anthracene  | 311.17 | 271.16 | 294.17 | 205.05 | 189.81 | 99.67 |
| Fluoranthene  | 3855.28 | 3618.26 | 3514.31 | 3315.27 | 3191.44 | 2094.05 |
| Pyrene  | 1412.37 | 1512.18 | 1432.08 | 1284.11 | 1252.21 | 744.95 |
| Benzo(a)anthracene  | 1843.18 | 1741.19 | 1709.01 | 1729.57 | 1769.62 | 899.37 |
| Chrysene  | 355.08 | 341.05 | 308.43 | 271.41 | 212.24 | 102.41 |
| Benzo(b)fluoranthene  | 1541.37 | 1411.97 | 1459.61 | 1382.27 | 1286.36 | 1089.39 |
| Benzo(k)fluoranthene  | 1438.58 | 1521.67 | 1389.28 | 1359.35 | 1289.11 | 997.12 |
| Benzo(a)pyrene  | 1614.37 | 1681.51 | 1574.41 | 1497.91 | 1511.16 | 1125.52 |
| Dibenzo(a,h)anthracene | 877.25 | 891.51 | 798.44 | 722.06 | 615.81 | 488.14 |
| Benzo(g,h,i)perylene  | 1587.09 | 1438.81 | 1399.11 | 1374.25 | 1290.07 | 894.30 |
| Indeno(1,2,3-c,d)pyrene | 2247.99 | 2274.95 | 2186.67 | 2054.81 | 1891.83 | 1581.17 |

**Tab. S3. The 16 PAHs content in soils collected from *P. arundinacea* plots, treated compost. Depth of sampling: 0-15 cm. Results shown as means ± SD=9-14%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 141.99 | 99.14 | 21.05 | 72.62 | 31.21 | 15.05 |
| Acenaphtylene  | 732.65 | 257.34 | 186.42 | 207.52 | 121.26 | 51.64 |
| Acenatphtene  | 71.29 | 39.12 | 15.25 | 0.54 | 4.68 | 2.12 |
| Fluorene  | 545.62 | 257.64 | 227.62 | 211.17 | 141.19 | 32.07 |
| Phenanthrene  | 1135.54 | 497.52 | 501.67 | 455.03 | 241.05 | 89.32 |
| Anthracene  | 596.61 | 314.91 | 300.53 | 271.12 | 144.63 | 97.15 |
| Fluoranthene  | 5181.48 | 4411.28 | 4590.57 | 4108.11 | 3504.76 | 2914.26 |
| Pyrene  | 1560.22 | 1099.76 | 946.67 | 724.97 | 427.05 | 217.93 |
| Benzo(a)anthracene  | 2188.02 | 1665.87 | 1651.97 | 1322.02 | 994.21 | 311.53 |
| Chrysene  | 345.80 | 285.66 | 311.41 | 251.11 | 199.36 | 81.14 |
| Benzo(b)fluoranthene  | 2525.74 | 1952.67 | 2008.87 | 1597.25 | 1321.17 | 614.97 |
| Benzo(k)fluoranthene  | 1746.39 | 1211.47 | 1399.08 | 1197.44 | 917.75 | 428.78 |
| Benzo(a)pyrene  | 2870.35 | 2146.93 | 2310.87 | 2005.37 | 1701.07 | 909.01 |
| Dibenzo(a,h)anthracene | 379.46 | 246.69 | 300.75 | 199.17 | 154.18 | 44.15 |
| Benzo(g,h,i)perylene  | 2242.51 | 1844.49 | 2143.38 | 1840.05 | 1617.25 | 947.36 |
| Indeno(1,2,3-c,d)pyrene | 3726.14 | 3151.81 | 3198.55 | 3087.64 | 2921.05 | 2122.95 |

**Tab. S4. The 16 PAHs content in soils collected from *P. arundinacea* plots, treated with compost and SiO2. Depth of sampling: 0-15 cm. Results shown as means ± SD=4-14%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 129.09 | 71.25 | 63.80 | 12.28 | 5.77 | 9.36 |
| Acenaphtylene  | 308.32 | 141.91 | 125.56 | 41.91 | 27.63 | 15.10 |
| Acenatphtene  | 54.65 | 31.18 | 15.73 | 2.06 | 4.91 | 0.99 |
| Fluorene  | 479.35 | 235.43 | 153.69 | 91.42 | 57.12 | 12.71 |
| Phenanthrene  | 1008.09 | 507.54 | 461.47 | 246.31 | 142.23 | 54.97 |
| Anthracene  | 645.27 | 271.07 | 285.12 | 81.36 | 25.97 | 8.59 |
| Fluoranthene  | 4281.05 | 3177.96 | 2914.27 | 1215.91 | 717.37 | 214.20 |
| Pyrene  | 1466.05 | 621.17 | 521.51 | 155.67 | 101.20 | 5.11 |
| Benzo(a)anthracene  | 2220.06 | 1480.19 | 1290.25 | 595.95 | 499.36 | 141.39 |
| Chrysene  | 448.09 | 212.08 | 328.71 | 163.70 | 169.32 | 57.25 |
| Benzo(b)fluoranthene  | 2463.15 | 1537.41 | 1417.39 | 842.12 | 812.67 | 241.64 |
| Benzo(k)fluoranthene  | 1556.19 | 741.28 | 689.42 | 421.47 | 391.18 | 15.69 |
| Benzo(a)pyrene  | 2857.90 | 1841.55 | 1746.62 | 1097.05 | 997.64 | 111.97 |
| Dibenzo(a,h)anthracene | 350.87 | 203.11 | 214.98 | 185.39 | 168.59 | 52.31 |
| Benzo(g,h,i)perylene  | 2157.96 | 1532.72 | 1588.16 | 959.52 | 892.46 | 271.35 |
| Indeno(1,2,3-c,d)pyrene | 3513.63 | 3108.24 | 3064.66 | 2329.61 | 1666.42 | 239.75 |

**Tab. S5. The 16 PAHs content in soils collected from *P. arundinacea* plots, not treated with any additive. Depth of sampling: 15-30 cm. Results shown as means ± SD=8-16%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 236.96 | 274.53 | 137.49 | 51.61 | 15.61 | 21.64 |
| Acenaphtylene  | 710.97 | 762.29 | 594.25 | 386.80 | 141.34 | 57.63 |
| Acenatphtene  | 65.57 | 46.54 | 21.16 | 5.14 | 11.41 | 2.95 |
| Fluorene  | 395.31 | 424.23 | 297.62 | 111.67 | 49.62 | 33.07 |
| Phenanthrene  | 912.97 | 941.83 | 612.62 | 401.36 | 397.16 | 217.62 |
| Anthracene  | 671.48 | 689.54 | 375.65 | 279.06 | 149.64 | 99.05 |
| Fluoranthene  | 6223.68 | 6266.58 | 5716.41 | 5007.63 | 4227.69 | 3911.05 |
| Pyrene  | 2146.82 | 2208.08 | 1991.07 | 1755.64 | 1511.18 | 1183.94 |
| Benzo(a)anthracene  | 2177.07 | 2198.63 | 1905.26 | 1794.62 | 1534.77 | 1541.19 |
| Chrysene  | 380.20 | 408.29 | 271.65 | 218.06 | 218.06 | 199.72 |
| Benzo(b)fluoranthene  | 2792.13 | 2838.66 | 2467.28 | 2314.42 | 1468.00 | 1317.06 |
| Benzo(k)fluoranthene  | 1788.23 | 1830.56 | 1599.16 | 1508.09 | 1449.67 | 1307.09 |
| Benzo(a)pyrene  | 3232.42 | 3519.17 | 3011.87 | 2971.55 | 2811.70 | 2519.69 |
| Dibenzo(a,h)anthracene | 712.42 | 714.68 | 644.10 | 579.62 | 517.06 | 466.48 |
| Benzo(g,h,i)perylene  | 2360.39 | 2433.41 | 2301.05 | 2194.67 | 2097.06 | 1997.41 |
| Indeno(1,2,3-c,d)pyrene | 3683.02 | 3659.06 | 3467.51 | 3272.48 | 2951.14 | 2771.67 |

**Tab. S6. The 16 PAHs content in soils collected from *P. arundinacea* plots, treated with SiO2. Depth of sampling: 15-30 cm. Results shown as means ± SD=7-16%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 345.15 | 211.17 | 179.36 | 108.21 | 61.28 | 15.27 |
| Acenaphtylene  | 744.81 | 599.28 | 511.18 | 426.37 | 354.41 | 282.14 |
| Acenatphtene  | 495.25 | 451.18 | 385.14 | 312.20 | 254.19 | 220.15 |
| Fluorene  | 749.38 | 752.69 | 698.46 | 583.49 | 512.08 | 427.18 |
| Phenanthrene  | 1418.37 | 1328.29 | 1536.21 | 1411.27 | 1491.24 | 1211.71 |
| Anthracene  | 1497.35 | 1317.52 | 1279.12 | 1227.37 | 1244.69 | 1094.62 |
| Fluoranthene  | 3824.18 | 3914.63 | 3851.28 | 3792.36 | 3680.01 | 3508.51 |
| Pyrene  | 2415.31 | 2394.15 | 2384.41 | 2299.15 | 2317.26 | 2245.12 |
| Benzo(a)anthracene  | 2528.44 | 2671.85 | 2487.28 | 2419.07 | 2461.37 | 2349.31 |
| Chrysene  | 619.37 | 736.31 | 684.05 | 599.05 | 497.37 | 351.41 |
| Benzo(b)fluoranthene  | 2414.68 | 2596.07 | 2456.39 | 2341.29 | 2419.31 | 2324.05 |
| Benzo(k)fluoranthene  | 2015.69 | 1965.97 | 1999.89 | 1891.20 | 1767.49 | 1612.27 |
| Benzo(a)pyrene  | 2318.14 | 2459.14 | 2341.62 | 2284.04 | 2419.12 | 2352.97 |
| Dibenzo(a,h)anthracene | 624.05 | 822.34 | 711.62 | 649.27 | 597.92 | 611.41 |
| Benzo(g,h,i)perylene  | 1795.05 | 1894.15 | 1784.73 | 1648.04 | 1684.66 | 1613.37 |
| Indeno(1,2,3-c,d)pyrene | 2610.54 | 2583.31 | 2681.14 | 2559.18 | 2509.37 | 2498.21 |

**Tab. S7. The 16 PAHs content in soils collected from *P. arundinacea* plots, treated with compost. Depth of sampling: 15-30 cm. Results shown as means ± SD=5-12%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 234.72 | 159.57 | 57.15 | 44.12 | 32.79 | 39.05 |
| Acenaphtylene  | 501.68 | 324.15 | 248.53 | 211.97 | 142.33 | 77.20 |
| Acenatphtene  | 33.52 | 38.32 | 15.17 | 21.06 | 10.28 | 5.07 |
| Fluorene  | 466.59 | 304.63 | 262.27 | 271.69 | 216.50 | 124.63 |
| Phenanthrene  | 755.10 | 411.26 | 402.90 | 392.40 | 341.71 | 197.32 |
| Anthracene  | 591.09 | 371.37 | 391.05 | 351.35 | 297.36 | 88.61 |
| Fluoranthene  | 3798.33 | 3246.28 | 3107.33 | 3028.82 | 2874.17 | 1950.55 |
| Pyrene  | 1928.80 | 1541.63 | 1594.77 | 1496.77 | 1308.87 | 1154.71 |
| Benzo(a)anthracene  | 1861.80 | 1719.69 | 1659.17 | 1617.19 | 1512.22 | 1008.06 |
| Chrysene  | 396.34 | 321.47 | 307.27 | 311.09 | 289.97 | 94.15 |
| Benzo(b)fluoranthene  | 1926.05 | 1764.55 | 1699.59 | 1625.04 | 1493.06 | 992.95 |
| Benzo(k)fluoranthene  | 1337.98 | 1214.47 | 1200.76 | 1173.67 | 1084.44 | 710.23 |
| Benzo(a)pyrene  | 2105.26 | 1846.87 | 1797.57 | 1829.37 | 1754.26 | 1554.14 |
| Dibenzo(a,h)anthracene | 388.73 | 324.87 | 296.37 | 301.08 | 283.23 | 199.37 |
| Benzo(g,h,i)perylene  | 2632.36 | 2497.31 | 2391.55 | 2395.27 | 2251.57 | 1953.47 |
| Indeno(1,2,3-c,d)pyrene | 3190.75 | 2968.41 | 3010.07 | 2970.52 | 2822.07 | 2563.08 |

**Tab. S8. The 16 PAHs content in soils collected from *P. arundinacea* plots, treated with compost and SiO2. Depth of sampling: 15-30 cm. Results shown as means ± SD=4-15%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 297.21 | 214.19 | 191.05 | 59.41 | 22.08 | 12.16 |
| Acenaphtylene  | 619.39 | 552.76 | 495.06 | 371.37 | 158.15 | 49.81 |
| Acenatphtene  | 357.28 | 314.08 | 251.22 | 185.25 | 149.39 | 26.67 |
| Fluorene  | 766.37 | 788.69 | 714.16 | 421.44 | 57.61 | 14.39 |
| Phenanthrene  | 1210.41 | 1087.59 | 971.26 | 794.25 | 210.08 | 157.64 |
| Anthracene  | 1055.35 | 901.34 | 915.57 | 741.56 | 215.72 | 179.39 |
| Fluoranthene  | 4002.97 | 3914.25 | 2517.89 | 2297.47 | 1891.77 | 1439.39 |
| Pyrene  | 1845.71 | 1799.21 | 1007.60 | 915.52 | 431.22 | 297.56 |
| Benzo(a)anthracene  | 2419.37 | 2308.08 | 1266.06 | 1108.70 | 725.49 | 315.06 |
| Chrysene  | 551.69 | 478.72 | 251.66 | 212.67 | 200.14 | 51.94 |
| Benzo(b)fluoranthene  | 2517.94 | 2657.21 | 2315.68 | 2153.39 | 1280.14 | 549.52 |
| Benzo(k)fluoranthene  | 1899.28 | 1905.70 | 1541.97 | 1413.38 | 1008.17 | 611.58 |
| Benzo(a)pyrene  | 2412.36 | 2318.67 | 2144.89 | 2100.58 | 1549.69 | 956.67 |
| Dibenzo(a,h)anthracene | 518.70 | 644.14 | 518.68 | 527.66 | 415.28 | 214.69 |
| Benzo(g,h,i)perylene  | 1941.26 | 1868.78 | 1661.23 | 1500.97 | 1115.89 | 594.05 |
| Indeno(1,2,3-c,d)pyrene | 2847.91 | 2961.05 | 2817.54 | 2611.59 | 2091.00 | 1201.46 |

**Tab. S9. The 16 PAHs content in soils collected from *B. napus L* plots, not treated with any additive. Depth of sampling: 0-15 cm. Results shown as means ± SD=4-11%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 183.72 | 137.27 | 74.58 | 26.34 | 39.54 | 15.79 |
| Acenaphtylene  | 491.07 | 462.92 | 399.11 | 230.30 | 211.17 | 154.50 |
| Acenatphtene  | 64.16 | 69.02 | 24.65 | 5.17 | 7.97 | 11.17 |
| Fluorene  | 248.49 | 226.86 | 176.61 | 142.16 | 127.08 | 77.51 |
| Phenanthrene  | 536.16 | 462.35 | 311.05 | 283.18 | 200.79 | 111.75 |
| Anthracene  | 407.89 | 365.48 | 256.70 | 211.33 | 200.09 | 162.19 |
| Fluoranthene  | 3705.84 | 3187.61 | 3107.52 | 2987.65 | 2608.41 | 1821.29 |
| Pyrene  | 1587.40 | 1445.70 | 1409.64 | 1391.15 | 1214.12 | 990.92 |
| Benzo(a)anthracene  | 1369.29 | 1279.02 | 1197.64 | 1089.25 | 897.79 | 642.84 |
| Chrysene  | 190.83 | 193.83 | 177.26 | 184.69 | 159.58 | 113.43 |
| Benzo(b)fluoranthene  | 1483.68 | 1470.40 | 1409.64 | 1400.05 | 1328.55 | 1297.28 |
| Benzo(k)fluoranthene  | 1030.07 | 1044.49 | 1007.41 | 999.34 | 845.46 | 781.02 |
| Benzo(a)pyrene  | 1655.94 | 1493.15 | 1419.64 | 1456.60 | 1391.84 | 1232.55 |
| Dibenzo(a,h)anthracene | 358.13 | 322.49 | 311.47 | 299.64 | 226.95 | 195.57 |
| Benzo(g,h,i)perylene  | 1219.11 | 1108.82 | 1113.87 | 1098.39 | 946.95 | 859.64 |
| Indeno(1,2,3-c,d)pyrene | 2089.20 | 2071.66 | 2187.50 | 2199.07 | 2038.31 | 1944.65 |

**Tab. S10. The 16 PAHs content in soils collected from *B. napus L* plots, treated with SiO2. Depth of sampling: 0-15 cm. Results shown as means ± SD=4-10%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 211.51 | 189.27 | 107.24 | 55.17 | 27.21 | 5.05 |
| Acenaphtylene  | 451.69 | 411.63 | 384.16 | 241.23 | 266.18 | 199.14 |
| Acenatphtene  | 51.20 | 120.37 | 29.67 | 5.17 | 9.27 | 29.34 |
| Fluorene  | 239.37 | 199.85 | 127.21 | 91.27 | 54.94 | 27.24 |
| Phenanthrene  | 618.89 | 597.19 | 513.37 | 410.24 | 376.31 | 321.05 |
| Anthracene  | 912.58 | 819.33 | 733.15 | 612.88 | 652.04 | 597.14 |
| Fluoranthene  | 3705.84 | 3589.17 | 3414.09 | 3317.22 | 3486.03 | 3289.14 |
| Pyrene  | 2171.12 | 2079.26 | 1915.66 | 1824.46 | 1712.61 | 1628.27 |
| Benzo(a)anthracene  | 1863.33 | 1937.25 | 1674.01 | 1527.33 | 1655.01 | 1511.71 |
| Chrysene  | 127.51 | 228.63 | 142.69 | 159.28 | 87.41 | 71.25 |
| Benzo(b)fluoranthene  | 1452.66 | 1397.61 | 1284.61 | 1208.20 | 1108.25 | 1097.21 |
| Benzo(k)fluoranthene  | 881.16 | 800.24 | 859.37 | 714.61 | 659.27 | 599.41 |
| Benzo(a)pyrene  | 1759.38 | 1673.34 | 1612.58 | 1597.24 | 1614.25 | 1572.53 |
| Dibenzo(a,h)anthracene | 591.22 | 552.28 | 499.69 | 459.61 | 411.27 | 400.28 |
| Benzo(g,h,i)perylene  | 1008.07 | 1091.27 | 907.52 | 927.24 | 879.25 | 941.22 |
| Indeno(1,2,3-c,d)pyrene | 2109.02 | 2184.69 | 2049.08 | 2136.02 | 2004.66 | 1951.54 |

**Tab. S11. The 16 PAHs content in soils collected from *B. napus L* plots, treated with compost. Depth of sampling: 0-15 cm. Results shown as means ± SD=6-14%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 102.73 | 77.53 | 48.65 | 12.07 | 12.96 | 4.12 |
| Acenaphtylene  | 597.95 | 347.25 | 293.11 | 135.08 | 71.41 | 44.29 |
| Acenatphtene  | 76.99 | 43.65 | 12.10 | 14.64 | 1.67 | 9.37 |
| Fluorene  | 468.48 | 197.57 | 208.46 | 120.37 | 111.21 | 27.34 |
| Phenanthrene  | 752.65 | 359.97 | 344.04 | 277.20 | 114.97 | 73.92 |
| Anthracene  | 559.05 | 397.15 | 258.71 | 189.34 | 100.67 | 47.68 |
| Fluoranthene  | 4203.94 | 2997.57 | 3147.05 | 2097.16 | 1887.61 | 1327.07 |
| Pyrene  | 1507.23 | 1049.67 | 907.55 | 791.07 | 647.22 | 414.28 |
| Benzo(a)anthracene  | 1553.79 | 1414.11 | 1317.63 | 756.06 | 689.91 | 483.41 |
| Chrysene  | 368.78 | 151.47 | 186.86 | 154.09 | 127.36 | 95.57 |
| Benzo(b)fluoranthene  | 1794.39 | 1533.71 | 1451.97 | 921.89 | 884.62 | 669.27 |
| Benzo(k)fluoranthene  | 1408.48 | 979.55 | 988.55 | 738.89 | 621.88 | 541.67 |
| Benzo(a)pyrene  | 2012.20 | 1549.15 | 1497.28 | 1324.24 | 1214.50 | 1005.38 |
| Dibenzo(a,h)anthracene | 419.75 | 245.97 | 236.00 | 211.95 | 194.63 | 134.06 |
| Benzo(g,h,i)perylene  | 1621.16 | 1276.47 | 1124.19 | 988.08 | 847.52 | 591.22 |
| Indeno(1,2,3-c,d)pyrene | 2993.31 | 2533.93 | 2505.15 | 2481.89 | 2213.37 | 2122.48 |

**Tab. S12. The 16 PAHs content in soils collected from *B. napus L* plots, treated with compost and SiO2. Depth of sampling: 0-15 cm. Results shown as means ± SD=9-15%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 109.27 | 72.57 | 48.79 | 48.79 | 21.08 | 2.05 |
| Acenaphtylene  | 708.18 | 521.05 | 498.88 | 371.58 | 271.63 | 84.26 |
| Acenatphtene  | 33.50 | 24.42 | 15.71 | 153.77 | 97.82 | 14.67 |
| Fluorene  | 477.84 | 311.05 | 234.78 | 234.78 | 199.37 | 88.12 |
| Phenanthrene  | 1131.66 | 871.65 | 852.44 | 566.45 | 471.06 | 143.67 |
| Anthracene  | 698.29 | 515.00 | 559.37 | 310.85 | 324.28 | 173.38 |
| Fluoranthene  | 4503.65 | 4152.58 | 4052.39 | 3215.81 | 3158.02 | 1081.62 |
| Pyrene  | 1501.61 | 1341.19 | 1308.46 | 792.05 | 671.06 | 318.28 |
| Benzo(a)anthracene  | 2240.94 | 1957.59 | 1892.14 | 1145.58 | 1293.25 | 753.28 |
| Chrysene  | 454.22 | 299.34 | 349.31 | 222.07 | 199.47 | 100.59 |
| Benzo(b)fluoranthene  | 2508.40 | 2241.97 | 2108.97 | 1325.16 | 1217.10 | 517.68 |
| Benzo(k)fluoranthene  | 1668.82 | 1249.34 | 1284.67 | 751.48 | 712.51 | 271.69 |
| Benzo(a)pyrene  | 2705.35 | 2215.67 | 2101.88 | 1298.99 | 1311.05 | 715.66 |
| Dibenzo(a,h)anthracene | 585.28 | 421.69 | 544.28 | 298.05 | 288.05 | 151.28 |
| Benzo(g,h,i)perylene  | 2207.46 | 2008.18 | 2119.52 | 1541.67 | 1756.24 | 1150.74 |
| Indeno(1,2,3-c,d)pyrene | 3625.99 | 3210.94 | 3107.91 | 2877.14 | 2779.18 | 1848.59 |

**Tab. S13. The 16 PAHs content in soils collected from *B. napus L* plots, not treated with any additive. Depth of sampling: 15-30 cm. Results shown as means ± SD=5-17%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 234.26 | 175.21 | 105.86 | 74.49 | 55.06 | 66.14 |
| Acenaphtylene  | 693.84 | 541.41 | 349.08 | 195.31 | 115.64 | 80.05 |
| Acenatphtene  | 65.57 | 52.14 | 12.97 | 19.97 | 22.65 | 11.08 |
| Fluorene  | 416.94 | 429.63 | 310.50 | 188.47 | 94.06 | 50.97 |
| Phenanthrene  | 916.51 | 847.56 | 712.52 | 488.55 | 311.26 | 249.75 |
| Anthracene  | 690.13 | 712.25 | 600.77 | 384.75 | 254.09 | 211.29 |
| Fluoranthene  | 6019.70 | 6036.46 | 5795.18 | 4284.64 | 4319.57 | 3967.61 |
| Pyrene  | 2138.57 | 2133.33 | 1951.30 | 1229.67 | 1203.57 | 1008.76 |
| Benzo(a)anthracene  | 2098.01 | 2115.36 | 1984.54 | 1562.61 | 1412.64 | 1243.63 |
| Chrysene  | 377.35 | 403.91 | 341.23 | 248.60 | 313.89 | 193.07 |
| Benzo(b)fluoranthene  | 2714.71 | 2761.12 | 2412.99 | 2088.57 | 2146.33 | 1999.31 |
| Benzo(k)fluoranthene  | 1766.60 | 1495.16 | 1357.13 | 1021.49 | 997.41 | 840.62 |
| Benzo(a)pyrene  | 3156.21 | 3234.97 | 3108.59 | 2518.25 | 2607.59 | 2597.64 |
| Dibenzo(a,h)anthracene | 747.83 | 790.82 | 595.95 | 448.25 | 464.73 | 399.18 |
| Benzo(g,h,i)perylene  | 2298.20 | 2180.20 | 2249.66 | 2018.20 | 2238.50 | 2197.57 |
| Indeno(1,2,3-c,d)pyrene | 3745.66 | 3641.86 | 3653.34 | 3405.81 | 3491.23 | 3294.71 |

**Tab. S14. The 16 PAHs content in soils collected from *B. napus L* plots, treated with SiO2. Depth of sampling: 15-30 cm. Results shown as means ± SD=5-19%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 491.67 | 421.71 | 351.28 | 184.29 | 99.17 | 43.82 |
| Acenaphtylene  | 822.49 | 705.17 | 514.21 | 349.38 | 351.43 | 81.06 |
| Acenatphtene  | 437.15 | 351.241 | 299.41 | 143.55 | 88.12 | 12.49 |
| Fluorene  | 1371.25 | 1486.34 | 1215.97 | 1189.19 | 1121.42 | 952.28 |
| Phenanthrene  | 1344.09 | 1477.61 | 1207.41 | 900.42 | 859.38 | 772.17 |
| Anthracene  | 715.28 | 608.81 | 611.42 | 321.05 | 299.43 | 249.31 |
| Fluoranthene  | 4219.37 | 4159.39 | 3967.25 | 3511.39 | 3438.46 | 3219.77 |
| Pyrene  | 2489.34 | 2399.28 | 2211.07 | 1716.05 | 1697.75 | 1529.33 |
| Benzo(a)anthracene  | 2211.05 | 2304.08 | 2194.28 | 1849.37 | 1806.31 | 1799.17 |
| Chrysene  | 493.37 | 512.41 | 412.02 | 229.12 | 199.49 | 141.26 |
| Benzo(b)fluoranthene  | 2597.25 | 2495.16 | 2399.59 | 2054.67 | 2159.27 | 2108.12 |
| Benzo(k)fluoranthene  | 1974.54 | 1891.17 | 1856.39 | 1693.46 | 1562.06 | 1449.69 |
| Benzo(a)pyrene  | 2699.07 | 2649.23 | 2573.31 | 2444.87 | 2460.09 | 2311.52 |
| Dibenzo(a,h)anthracene | 971.29 | 1082.05 | 912.24 | 859.82 | 866.171 | 808.56 |
| Benzo(g,h,i)perylene  | 1937.34 | 1992.27 | 1859.97 | 1712.97 | 1812.44 | 1696.08 |
| Indeno(1,2,3-c,d)pyrene | 3197.25 | 3239.33 | 3085.44 | 2898.83 | 2894.64 | 2712.41 |

**Tab. S15. The 16 PAHs content in soils collected from *B. napus L* plots, treated with compost. Depth of sampling: 15-30 cm. Results shown as means ± SD 6-19%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene | 205.58 | 105.64 | 51.15 | 74.49 | 55.06 | 11.08 |
| Acenaphtylene | 537.08 | 351.84 | 291.33 | 195.31 | 115.64 | 80.05 |
| Acenatphtene | 36.25 | 22.00 | 12.97 | 19.97 | 22.65 | 11.08 |
| Fluorene | 487.81 | 317.69 | 274.42 | 188.47 | 94.06 | 50.97 |
| Phenanthrene | 1429.57 | 1108.01 | 911.52 | 488.55 | 311.26 | 249.75 |
| Anthracene | 959.40 | 712.25 | 600.77 | 384.75 | 254.09 | 211.29 |
| Fluoranthene | 6178.28 | 5746.37 | 5518.56 | 4284.64 | 4319.57 | 3451.08 |
| Pyrene | 2116.18 | 1728.85 | 1711.05 | 1229.67 | 1203.57 | 846.62 |
| Benzo(a)anthracene | 3162.61 | 2754.17 | 2846.34 | 2517.52 | 2043.31 | 1341.81 |
| Chrysene | 401.08 | 311.69 | 341.23 | 248.60 | 211.05 | 193.07 |
| Benzo(b)fluoranthene | 3566.75 | 3081.27 | 2971.05 | 2811.50 | 2246.32 | 1999.31 |
| Benzo(k)fluoranthene | 2271.47 | 1774.68 | 1799.21 | 1527.97 | 1248.98 | 840.62 |
| Benzo(a)pyrene | 4141.10 | 3737.99 | 3812.57 | 3617.81 | 3513.38 | 2761.99 |
| Dibenzo(a,h)anthracene | 619.11 | 790.82 | 754.09 | 699.31 | 517.08 | 399.18 |
| Benzo(g,h,i)perylene | 3020.11 | 2971.70 | 2827.64 | 2600.71 | 2671.52 | 2312.20 |
| Indeno(1,2,3-c,d)pyrene | 4828.54 | 4642.21 | 4690.24 | 4552.08 | 4548.16 | 4211.71 |

**Tab. S16. The 16 PAHs content in soils collected from *B. napus L* plots, treated with compost and SiO2. Depth of sampling: 15-30 cm. Results shown as means ± SD=9-14%, n=3.**

|  |
| --- |
| Month of process |
| Compound | 1 | 6 | 12 | 18 | 24 | 30 |
| Naphthalene  | 209.09 | 184.21 | 84.12 | 55.67 | 12.08 | 5.64 |
| Acenaphtylene  | 561.53 | 415.05 | 308.80 | 288.15 | 171.25 | 50.14 |
| Acenatphtene  | 27.91 | 35.86 | 15.08 | 5.44 | 1.25 | 0.64 |
| Fluorene  | 696.83 | 499.34 | 352.14 | 299.47 | 171.50 | 55.97 |
| Phenanthrene  | 903.70 | 813.25 | 741.62 | 612.28 | 501.05 | 211.41 |
| Anthracene  | 611.54 | 541.13 | 515.05 | 449.71 | 339.86 | 159.37 |
| Fluoranthene  | 4828.18 | 4913.36 | 4514.25 | 3289.34 | 2658.30 | 953.67 |
| Pyrene  | 1992.19 | 2082.08 | 1942.64 | 1671.05 | 1543.28 | 515.14 |
| Benzo(a)anthracene  | 2379.77 | 2079.94 | 2114.62 | 1972.25 | 1599.37 | 871.66 |
| Chrysene  | 509.86 | 508.31 | 499.28 | 487.25 | 421.08 | 307.27 |
| Benzo(b)fluoranthene  | 2495.31 | 2509.02 | 2244.69 | 1977.64 | 1775.62 | 1311.48 |
| Benzo(k)fluoranthene  | 1663.51 | 1627.28 | 1512.37 | 1544.35 | 1338.14 | 931.63 |
| Benzo(a)pyrene  | 2741.47 | 2511.57 | 2451.52 | 1987.07 | 1810.05 | 1152.64 |
| Dibenzo(a,h)anthracene | 526.67 | 510.81 | 521.67 | 472.64 | 424.28 | 347.57 |
| Benzo(g,h,i)perylene  | 1925.04 | 1816.34 | 1722.32 | 1624.24 | 1434.68 | 1255.87 |
| Indeno(1,2,3-c,d)pyrene | 3237.05 | 3103.51 | 2941.18 | 2745.26 | 2213.54 | 1841.68 |

1. Factors used during the evaluation of phytoremediation economic potential.

Data demonstrated in table S17 consist a full list of factors used during the evaluation of economic aspect of proposed soil remediation method. Those values were based on actual market prices for the region of Central Europe – Poland, with regard to the individual year of conducted research.

**Tab. S17. The list of factors, used during the evaluation of economic analysis of proposed remediation method. All listed prices applies to Polish market (years 2013-2016).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of cost** | **Description** | **Main unit** | **Annual unit** |
| **Raw materials** | Seeds of *P. arundinacea* | 96.00 ± 2.42 EU kg-1 | 288.00 ± 7.26 EU ha-1 |
| Seeds of *B. napus* | 0.74 ± 0.01 EU kg-1 | 222.00 ± 3.00 EU ha -1 |
| Compost | 0.01 ± 0.001 EU kg-1 | 57.51 ± 2.12 EU ha -1 |
| Nano SiO2 | 25.35 ± 0.98 EU kg-1 | 63.37 ± 2.45 EU ha-1 |
| **Operation costs** | Fuel and amortization 2013 | 3.04 ± 0.01 EU km-1 | 21.19 ± 0.06 EU ha-1 |
| Fuel and amortization 2014 | 3.09 ± 0.02 EU km-1 | 21.51 ± 0.08 EU ha-1 |
| Fuel and amortization 2015 | 3.59 ± 0.01 EU km -1 | 24.96 ± 0.03 EU ha-1 |
| Fuel and amortization 2016 | 3.85 ± 0.01 EU km -1 | 26.80 ± 0.05 EU ha-1 |
| **Work costs** | Average cost in 2013 | 5.49 ± 0.17 EU h-1 | 527.04 ± 5.49 EU ha-1 |
| Average cost in 2014 | 5.94 ± 0.16 EU h-1 | 570.24 ± 5.94 EU ha-1 |
| Average cost in 2015 | 6.15 ± 0.16 EU h-1 | 590.04 ± 6.15 EU ha-1 |
| Average cost in 2016 | 6.37 ± 0.13 EU h-1 | * 1. ± 6.37 EU ha-1
 |