**Supplemental data**

**Table A1**. Fraction analysis of Pb, Zn, Cd in soils after 90 - incubation day with FA, FAA and FBA (mg/Kg)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **F1: Exchangeable** | **F2: Fe- and Mn- oxide occlude** | **F3: Carbonate bound** | | **F4: Organically complexed** | **F5: Residual** |
| **Pb** | | | | | |
| Control | 466±34a | 1962±83a | 957±31a | - | | 85.7±9.6a |
| FA1 | 373±17b | 1646±684bc | 967±76a | - | | 73±10ab |
| FA3 | 285±37c | 1712±56b | 1778±54b | - | | 68.5±3.3b |
| FA5 | 273±3.56c | 1580±22cd | 1889±66c | - | | 77.1±5.1ab |
| FAA3 | 162±21d | 1527±48d | 1869±32bc | - | | 53.8±1.5c |
| FBA3 | 142± 1.74d | 1450 ± 48cd | 2072 ± 120d | - | | 61.5 ± 7.7c |
|  | **Zn** | | | | | |
| Control | 507±38a | 952±50a | 1135±50a | | 5.25±2.94a | 369±22a |
| FA1 | 352±26b | 795±40b | 1168±51a | | 3.02±3.86a | 330±15b |
| FA3 | 262±25c | 885±26c | 1296±52b | | 1.17±0.25a | 325±6.1b |
| FA5 | 248±6.9c | 863±23c | 1299±39b | | 1.07±0.15a | 379±37a |
| FAA3 | 156±16d | 909±27ac | 1678±33c | | 114±15b | 276±4.9c |
| FBA3 | 127 ± 6.1d | 812 ± 18b | 1802 ± 65d | | 10.3 ± 3.3b | 253 ±12c |
|  | **Cd** | | | | | |
| Control | 13.79±0.79a | 5.17±0.16a | 13.9±0.99a | | 0.14±0.12ab | 0.55±0.13a |
| FA1 | 9.72±0.95b | 10.3±0.62b | 14.1±1.2a | | 0.21±0.03ab | 0.39±0.09a |
| FA3 | 7.98±0.21c | 16.6±0.36c | 14.1±0.64a | | 0.08±0.02a | 3.07±0.20b |
| FA5 | 5.86±0.25d | 17.5±0.34d | 13.8±0.17a | | 0.23±0.02b | 3.61±0.52c |
| FAA3 | 3.78±0.10e | 11.2±0.44e | 10.3±0.43b | | 0.96±0.11c | 3.86±0.12c |
| FBA3 | 2.75 ± 0.24e | 10.9 ± 0.01e | 11.6 ± 0.72c | | 1.16 ± 0.19c | 3.59 ± 0.34c |

*Note: Mean ± S.D., n=3; - not determine. Mean in the same colum followed by the same script do not differ significantly at 5% level probality. Control (soil with no amendment), FA1 (soil + 1% fly ash), FA3 (soil + 3% fly ash), FA5 (soil + 5% fly ash), FAA3 (soil + 3% fly ash and 3% apatite), FBA3 (soil + 3% fly ash + 3% apatite and 3% biochar).*