Claims

1. A method for heavy metal immobilization, the method comprising:
   - mixing organic-containing media comprising heavy metal with at least one additive to form a mixture; and
   - torrefying the mixture to form biochar, wherein the biochar immobilizes the heavy metal,

wherein when the organic-containing media comprises ≥ 25 weight % organic content, the at least one additive comprises a reducing agent, and when the organic-containing media comprises less than 25 weight % organic content, the at least one additive comprises an inorganic additive.

2. The method according to claim 1, wherein the torrefying comprises torrefying in presence of inert gas.

3. The method according to claim 1 or 2, wherein the torrefying is at a temperature of 1-500°C.

4. The method according to any preceding claim, further comprising treating flue gas produced during the torrefying.

5. The method according to any preceding claim, further comprising drying the mixture prior to the torrefying.

6. The method according to claim 5, wherein the drying comprises drying in presence of inert gas.

7. The method according to claim 5 or 6, wherein the drying is at a temperature of 1-280°C.

8. The method according to any preceding claim, further comprising cooling the biochar following the torrefying.

9. The method according to any preceding claim, wherein the reducing agent comprises: sodium borohydride, hydrazine, aluminium powder, $LiAlH_4$, or a mixture thereof.

10. The method according to any preceding claim, wherein the inorganic additive comprises: lime, limestone, $FeCl_3$, $Fe_2(SO_4)_3$, $FeSO_4$, aluminium powder, iron powder, FeOOH, Fe_2O_3, $MgCO_3$, $MgCa(CO_3)_2$, NaOH, KOH, phosphate, monohydrogenphosphate, dihydrogenphosphate, rock phosphate, phosphoric acid, polyphosphate, hydroxyapatite, milorganite, bentonite, kaolinite, zeolite, manganese oxide, iron oxide, or a mixture thereof.

11. The method according to any preceding claim, wherein when the organic-containing media comprises less than 25 weight % organic content, the method further comprises calcinating the biochar following the torrefying to form calcinated material.

12. The method according to claim 11, wherein the calcinating comprises calcinating in an oxidising atmosphere.

13. The method according to claim 11 or 12, wherein the calcinating is at a temperature of 600-1200°C.

14. The method according to any of claims 11 to 13, further comprising treating flue gas produced during the calcinating.

15. The method according to any of claims 11 to 14, further comprising cooling the calcinated material.

16. The method according to any of claims 11 to 15, further comprising:

- mixing the biochar with at least one further additive to form a biochar mixture; and
- molding the biochar mixture,

wherein the mixing and the molding is prior to the calcinating.

17. The method according to claim 16, wherein the at least one further additive comprises: clay, sand, stone, fly ash, coal ash, furnace slag, incineration bottom ash, construction waste, egg shell, or a mixture thereof.