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## **Supporting information**



Figure S1. Zeta potential of as prepared suspension for (a) MA, (b) LDH-1, (c) LDH-2, (d) LDH-3, (e) kaolin, (f) loess and (g) sepiolite.

The average zeta potential values of *Microcystis aeruginosa* (MA) and clay minerals at neutral pH were determined to be -33.0, -34.7, -38.2 and -19.9 mV for MA, kaolin, loess and sepiolite, respectively. However, the zeta potential values of LDH-1, LDH-2 and LDH-3 showed 27.9, 34.9 and 32.6 mV, respectively, with most zeta potential values lie in the positive region.



Figure S2. Base-pH titration curve for the slag extract solution

The leaching solution of slag has various metal ions such as Mn, Ca, Ca and Al as shown in Table 2. We evaluate base-pH titration curve with NaOH and observed three buffering regions at pH ~4, pH ~8.5 and pH ~11.5. From these buffering regions, we assume that the each buffer regions were attributed by hydrolysis of  $Al^{3+}$ ,  $Mg^{2+}$ , and  $Ca^{2+}$ , respectively. The pH ~11.5 is an optimal condition for preparing SL which allowed all metal species in the leaching solution ( $Mn^{2+}/Mn^{3+}$ ,  $Ca^{2+}$ ,  $Mg^{2+}$  and  $Al^{3+}$ ) to be effectively incorporated into the LDH frameworks.