1. Evaluations of Acute Toxicity and Adsorption of Obtained Particles

1.1. Zebrafish Husbandry

Zebrafish (Brachydanio rerio, average weight: 0.194 g, average length: 2.20 cm) was bred in the laboratory (self-breeding lot no. 20220228) and the parents were provided by the Institute of Aquatic Biology, Chinese Academy of Sciences (parental introduction lot no. 20211123). Before the test, fish were acclimated in laboratory conditions for 7 d (temperature: 23.02 °C; pH: 6.0−8.5; dissolved oxygen: > 60% of the saturated air concentration; light: 12 h−16 h per day). Abnormal growth or dead fish were removed. All fish were fed twice a day until 24 h before the experiment (the main components of the bait were listed as follows: crude protein > 40.0%, crude fat > 2.0%, water quality: same water quality as that used for the test). The mortality rate of zebrafish was 0% after one week of acclimation in laboratory conditions.

1.2. Zebrafish Exposed to Obtained Particles

The acute toxicity of obtained particles was evaluated with zebrafish, according to the Acute Toxicity of the Fish (GB/T 27861-2011). The dosage of the obtained particles was 0.1 g/L, and the experiment was performed in triplicate as well as a blank control. Seven zebrafish were selected randomly for exposure to the aforementioned particles. To assess the acute toxicity of obtained particles, the mortalities of zebrafish were recorded at 24 h, 48 h, and 96 h.

1.3. Adsorption of Congo Red

The adsorption experiments were carried out with a constant adsorbent input dosage and volume of Congo red (CR) solution. 50 mg of the obtained particles was added to 50 mL CR solution under conditions of 150 rpm, 24 h, in a thermostatic oscillator. The initial CR concentrations were set to 10 mg/L, 15 mg/L, 20 mg/L, and 30 mg/L, respectively. The results can be obtained in Fig. S3.

The adsorption capacity (q_t, mg/g) of obtained particles and removal rates (η) of CR were calculated by *Eqs*. (S1) and (S2):

$$q_t = \frac{C_0 - C_t}{m} \times V \quad \text{(S1)}$$

$$\eta = \frac{C_0 - C_t}{C_0} \times 100\% \quad \text{(S2)}$$

Where C_0 and C_t are the concentration of CR (mg/L) at reaction times of 0 and t (min), respectively. V represents the volume of CR solution (L) and m refers to the input mass of particles (g).

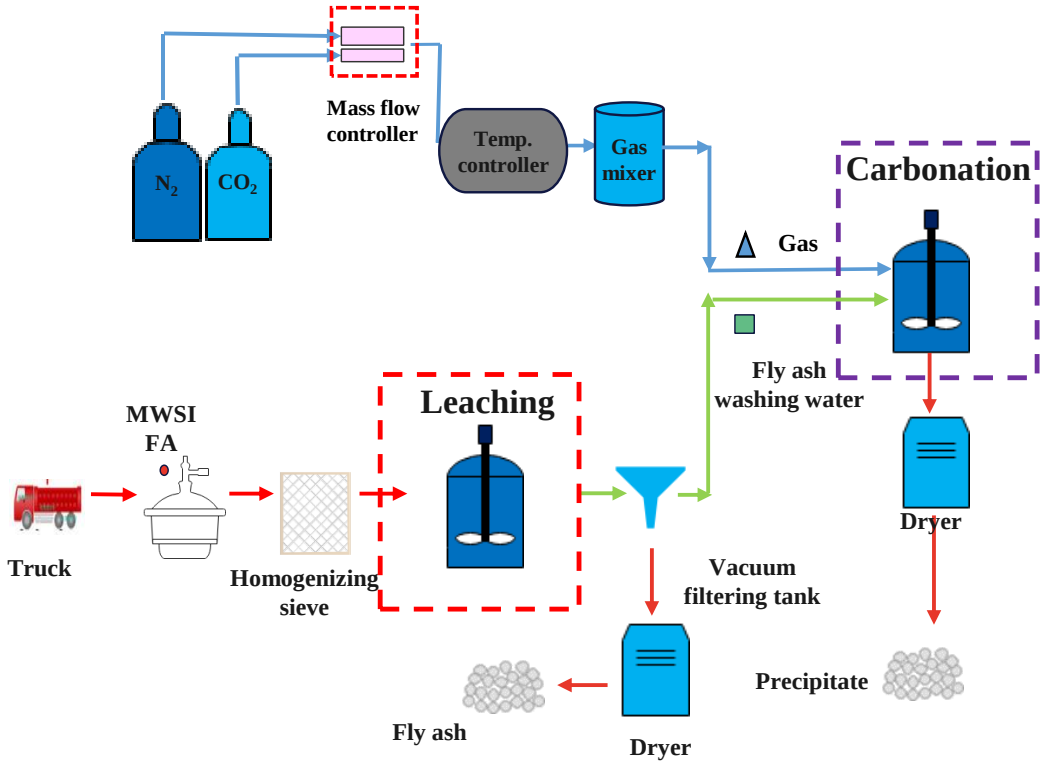

Figure S1. Schematic process flow for MSWI fly ash (FA) carbonation.

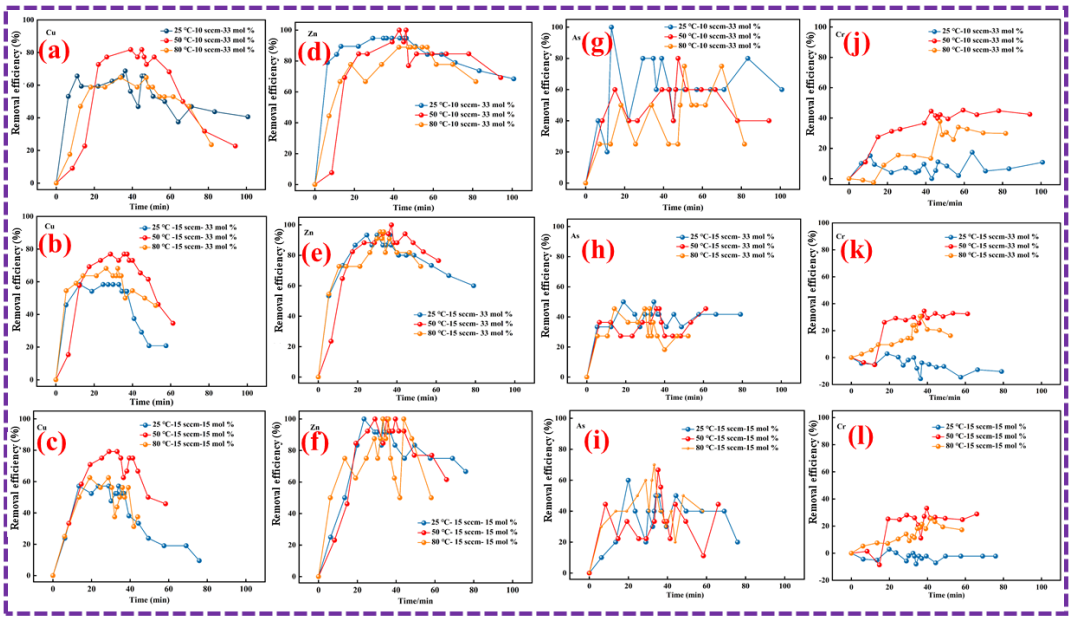

Figure S2. (a–c) Variations in Cu removal efficiency versus bubbling time of simulated exhaust gas; (d–f) variations of in removal efficiency versus bubbling time of simulated exhaust gas; (g–i) variations in As removal efficiency versus bubbling time of simulated exhaust gas; (j–l) variations in Cr removal efficiency versus bubbling time of simulated exhaust gas. Note: the preferred ratio between liquid and solid, L/S = 8 mL/g, washing time = 10 min, washing temperature = 25°C, 50 °C and 80°C, respectively. The CO_2 proportions in simulated exhaust gases were 15 mol% and 33 mol%, and flow rates were selected as 10 sccm and 15 sccm, respectively.

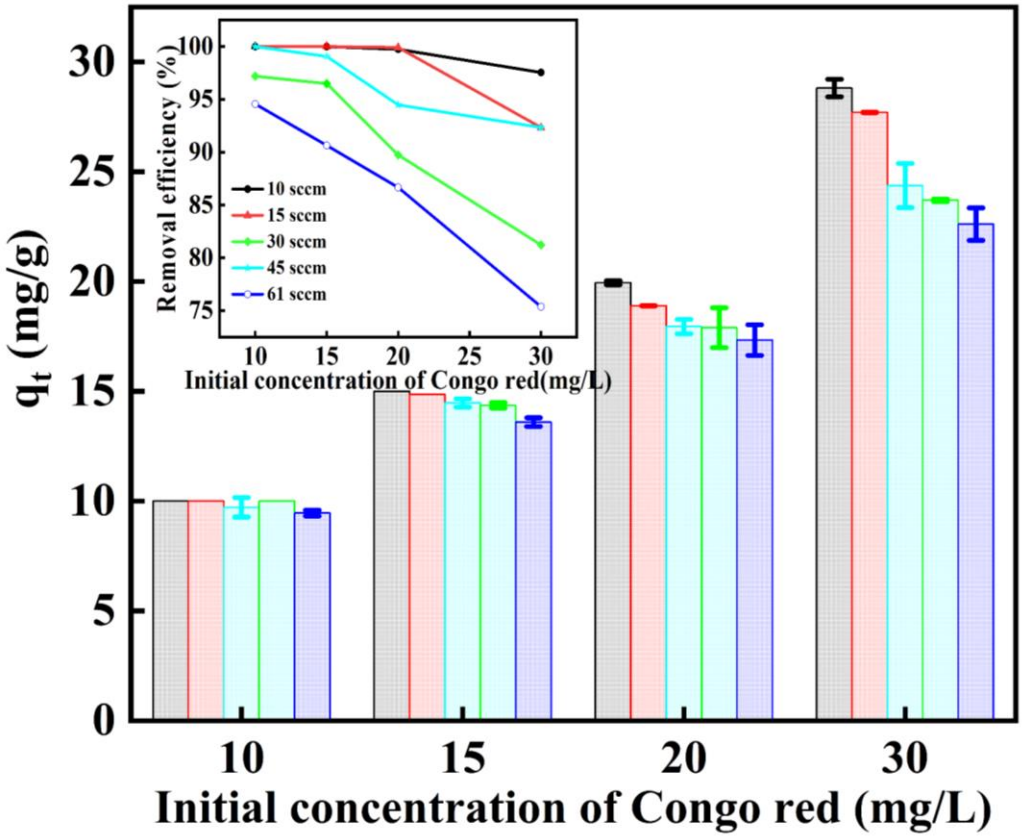

Figure S3. Removal of Congo red dye by particles obtained under CO_2 aeration with different flow rates (10, 15, 30, 45, and 61 sccm).