Appendix A. Supplementary data

Text S1 Synthesis of CaO_2 nanoparticles.

The synthesis of CaO_2 nanoparticles involved the following steps: 12g $CaCl_2$ and 1.2 g CTAB were dissolved in 500 mL distilled water, and slowly add ammonia solution to the stirred mixture to raise the pH to 10. Then 60 mL of 30% H_2O_2 was added to the mixture by rate of 1mL / min. The preparation procedure was carried out in a continuously stirred opened 1000 mL glass beaker at room temperature. The stirrer velocity was kept constant for all the experiments. After 1 h of stirring, a clear and colorless to yellowish solution was obtained. In order to precipitate the product, 1mol/L NaOH was added to raise the solution pH to 11. The white precipitate was separated by centrifuge and after the centrifugation process the powder was washed three times by anhydrous ethanol. Finally, the resultant precipitate was dried by N_2 at room temperature. Fig. S1(a) shows the SEM images of a typical CaO_2 nanoparticles sample. As seen in Fig. S1(a), the nanoparticles are of uniform spherical shape and approximately 20–80 nm in diameter. Chemical composition of the CaO_2 nanoparticles was determined by XRD. The result is shown in Fig. S1(b), the four dominant peaks: 2θ= 29.4, 35.5, 47.3, 52.6 match to the XRD of CaO_2 (JCPDS-PDF: 03-0865). The XRD result strongly proved that the CaO_2 nanoparticles compound was formed by this procedure.

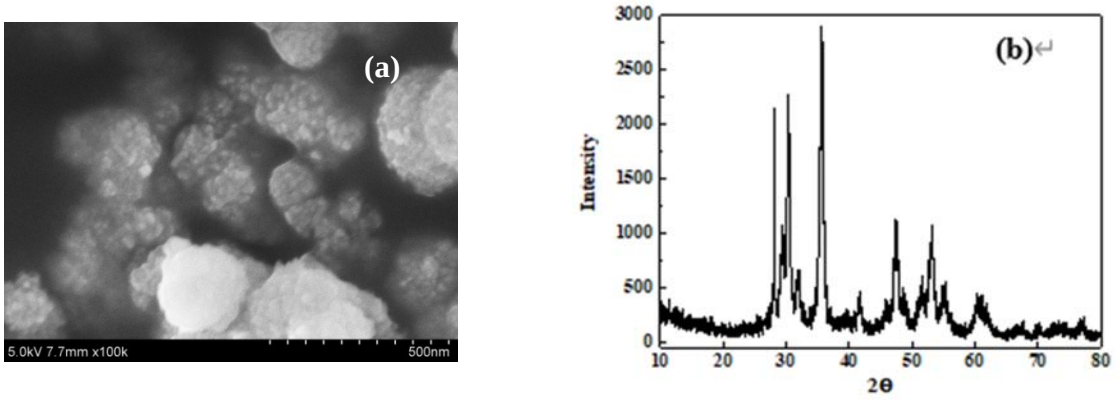

Fig. S1. (a) SEM images of CaO_2 prepared. (b) XRD of CaO_2 prepared.

Text S2: The methods of intermediate products detection by GC-MS and LC-MS

For GC/MS, samples (200 mL) were collected at different reaction times. First, the samples were extracted three times with ethyl acetate and then dried using anhydrous sodium sulfate. The samples were then concentrated in vacuo at 65°C. After the pretreatment step, 1 μL of the sample was injected in splitless mode. The oven temperature was initiated at 40°C and held for 3 min, and then increased to 200°C at 20 °C/min and held for 5 min, after that the temperature was increased to 250°C at 10°C/min and held for 5 min. The flow rate of the carrier gas helium was 1.0 mL/min. Mass spectra were obtained in EI mode with an electron energy of 70 eV. For LC/MS, 20 μL of the extract dissolved in acetonitrile was automatically injected into the LC-MS system. The eluent was the same as that used for HPLC and the flow rate was 0.2 mL/min. The MS spectra were acquired over a m/z range of 40–200 in negative scan mode.

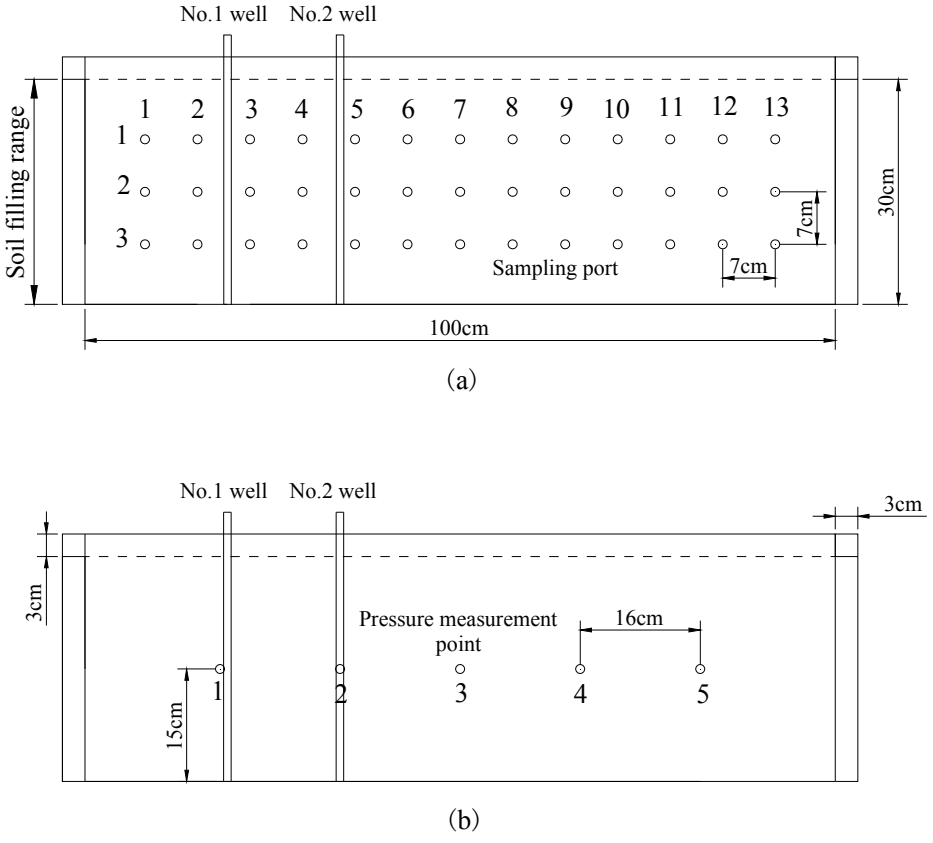

Fig. S2. The schematic diagrams of tank experiments for CaO_2 reaction zone. (a is the front; b is the back)

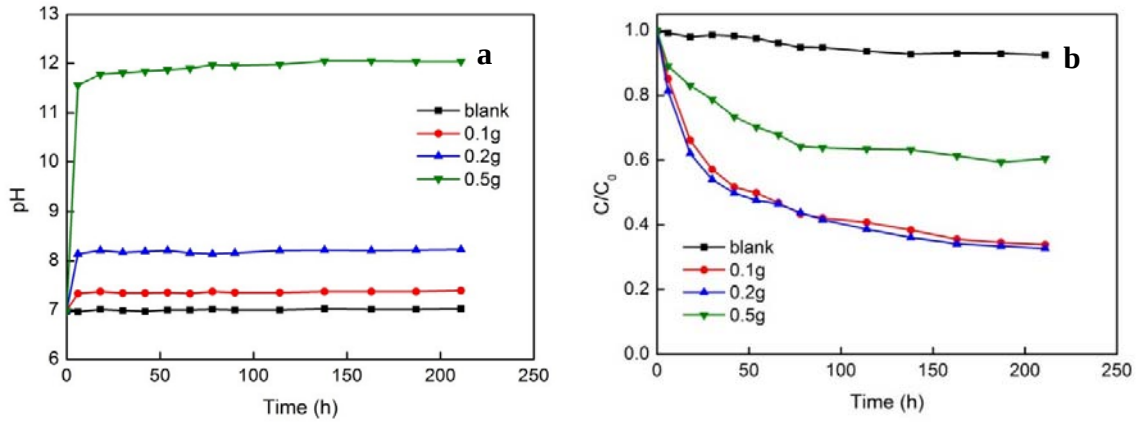

Fig. S3. (a)The 2,4-DCP degradation curves obtained at different CaO_2 concentrations; (b) The change curve of pH with time in the system. Experimental conditions: 2,4-DCP = 30 mg/L, Fe^{2+} =3mg/L, initial pH = 7.0.

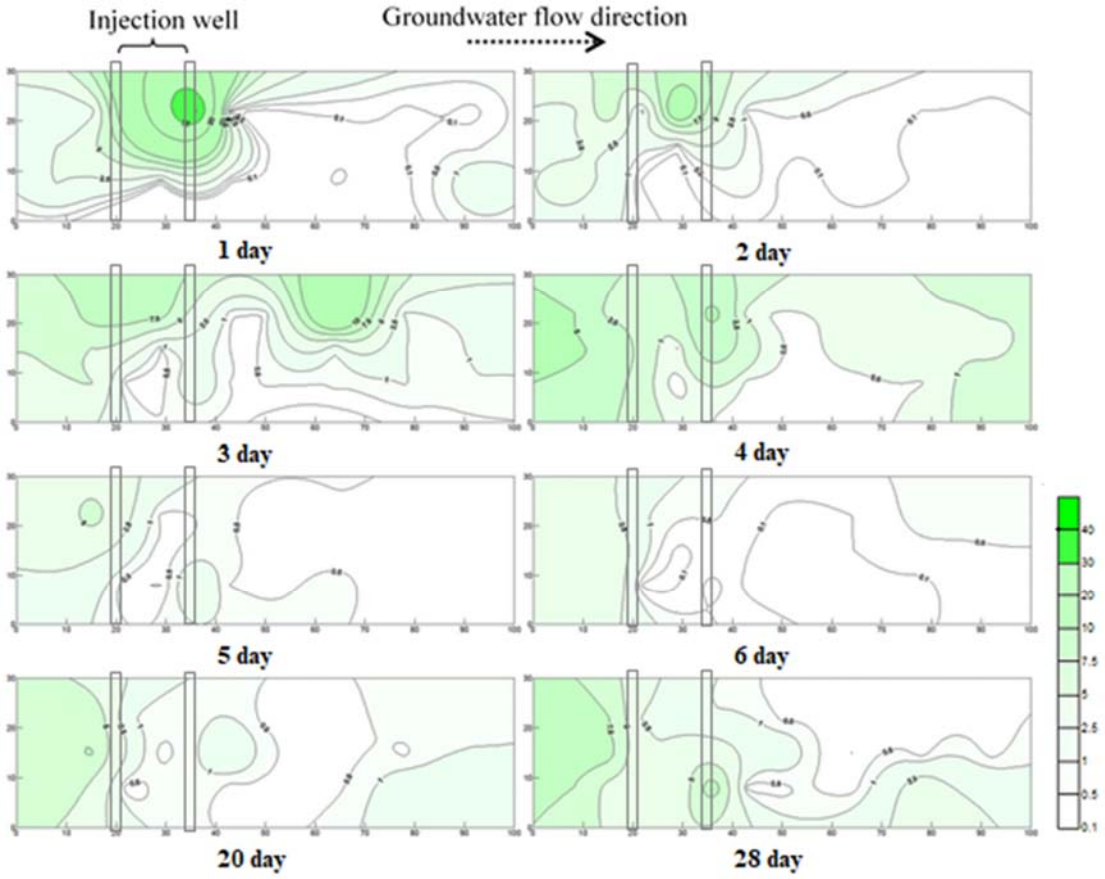

Fig. S4. Change in H_2O_2 concentration in the simulated tank with time.

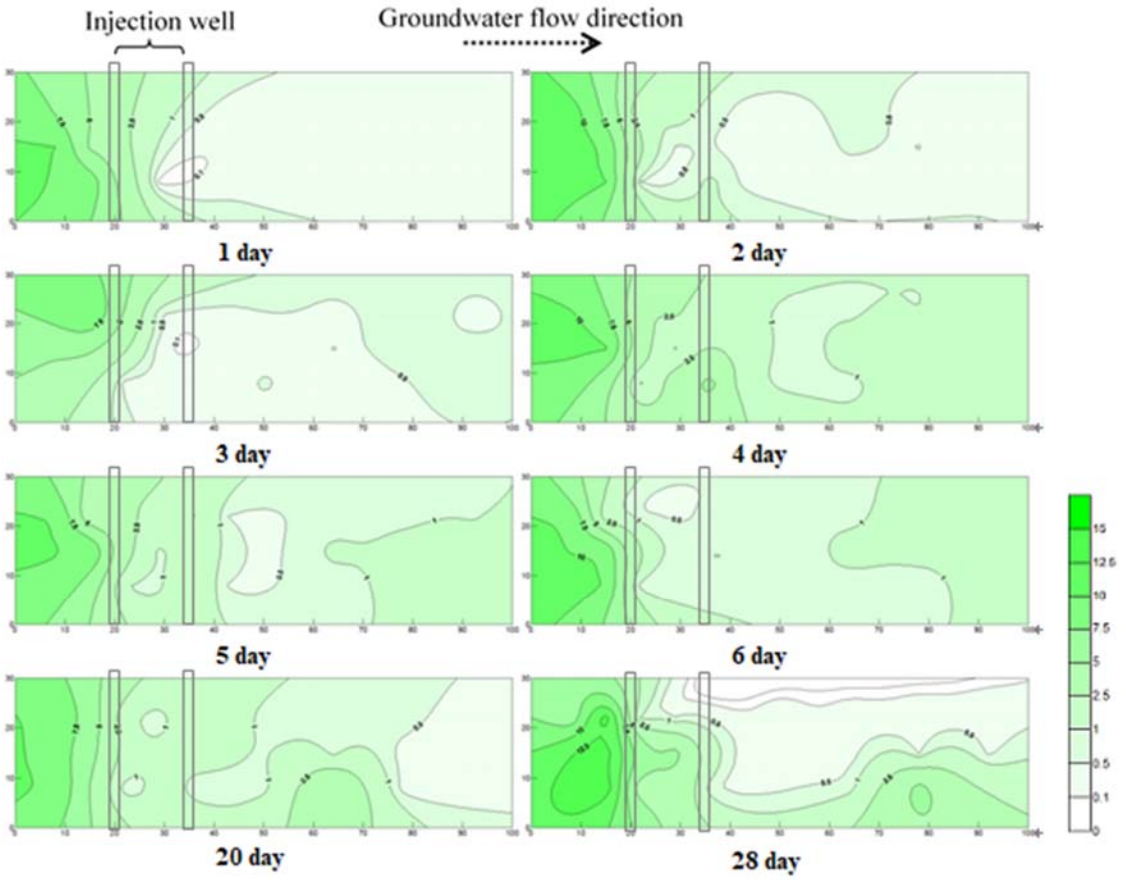

Fig. S5. Change in iron ion concentration in the simulated tank with time.

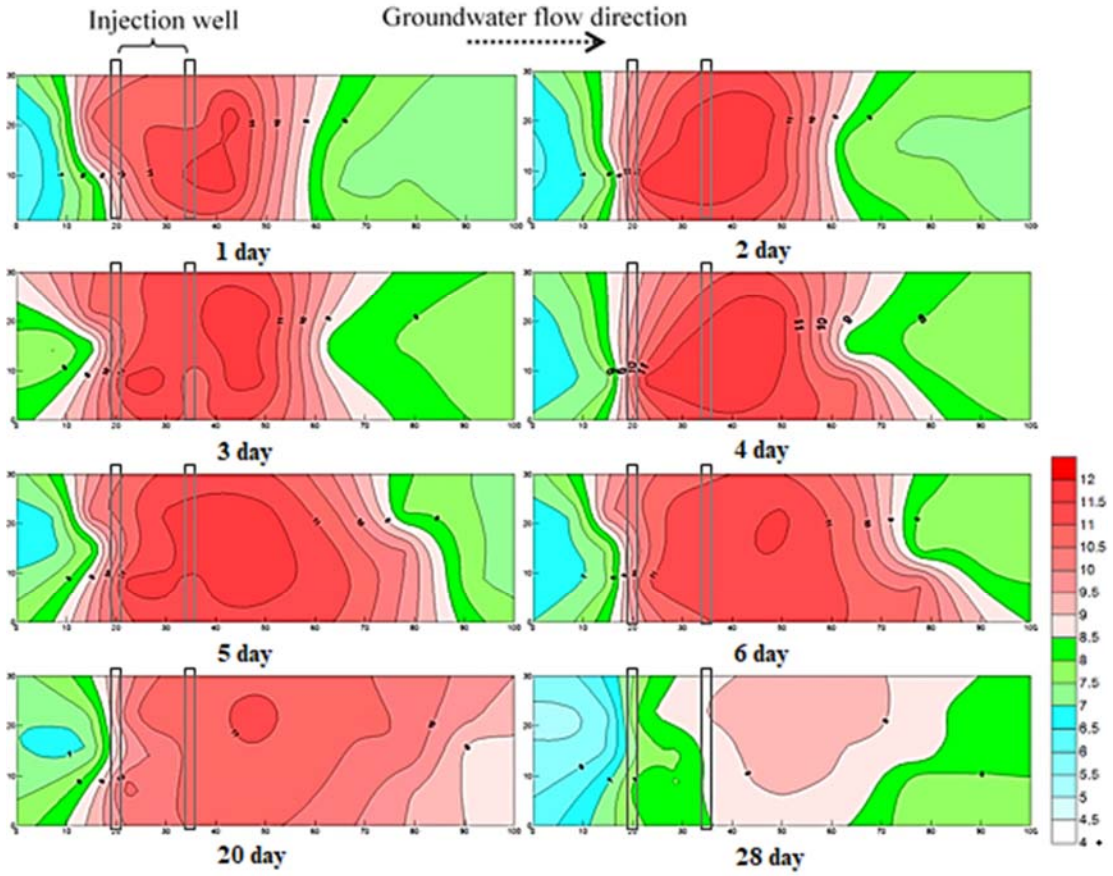

Fig. S6. Change in pH concentration in the simulated tank with time.