Supplementary Material

1. The effects of the duration of the rest phase on BTCs in the SWPP test

Fig. S1 shows BTCs for the pumping phase with different t_{res}, like 6, 12, 24, and 36 hr. Besides, α_L =0.1 m, v_d =3×10^{-6} m/s, Q_{inj}=30 m^3/d, Q_{pump}=-15 m^3/d and the other parameters are the same as those used in Table 1. It is found that the tracer concentration is smaller as t_{res} increases in Fig. S1. This is because a longer time of rest phase means a farther distance of tracer drifting, leading to a smaller portion of tracer mass that can be extracted during the pumping phase. In order to interpret this behavior explicitly, the concentration distributions in a 2D horizontal plane at t_{pump}=0 hr with different t_{res} are shown in Fig. S2. One can see that a longer t_{res} means that more tracer mass drifting over the location of Sp toward downstream, resulting in lower concentrations in the wellbore during the pumping phase in Fig. S2. According to the analysis above, there is a strong interaction between regional groundwater flow and well flow, thus proper choices of the duration of each phase, and the injection and pumping rates are vital for the success of a SWPP test. For instance, for the case of a relatively large regional groundwater velocity, one can decrease t_{res} or increase the magnitude of Q_{pump} to recollect the tracer as much as possible, thus avoiding the over- or under-estimation of hydraulic parameters from the SWPP test.

2. The effects of porosity on BTCs in the SWPP test

Fig. S3 shows the effects of porosity θ on BTCs during the pumping phase. The parameters are given as: θ= 0.1, 0.2, 0.3, 0.4 and 0.5 respectively, v_d=3×10^{-6} m/s, α_L=0.1m, Q_{inj}=30 m^3/d, and Q_{pump}=-30 m^3/d. It can be found that the concentration is smaller at early stage with a smaller porosity. It is also obvious that a smaller θ will result in a longer tailing

at late stage. A smaller θ means a faster pore velocity, resulting in faster solute transport according to Eq. (7).

3. The effects of dispersivity on BTCs in the SWPP test

Fig. S4 shows the effect of α_L on BTCs for the pumping phase. The values of α_L are set as: α_L =0.01 m, 0.05 m, 0.1 m, 0.5 m and the other parameters are given as: v_d=2×10^{-6} m/s, Q_{inj}=30 m^3/d, and Q_{pump}=-30 m^3/d. As shown in Fig. S4, one can see that α_L has a significant impact on BTCs. At early stage of pumping, the concentration shows a decreasing trend with increase of α_L , This is because a larger dispersivity means a faster tracer transport , given the same regional groundwater velocity, which causes much broader solute plume after the injection and rest phases. A smaller dispersivity means a narrower solute plume. Therefore, different dispersivities can change the characteristics of BTCs under the influence of regional groundwater velocity.

Figure Captions:

Fig.S1 BTCs for different values of t_{res} at the well during the pumping phase.

Fig.S2 Concentration distributions in a 2D horizontal plane at t_{pump}=0 hr. a) t_{res} = 6 hr; b) t_{res} = 126 hr; c) t_{res} = 24 hr; d) t_{res} = 36 hr.

Fig.S3 BTCs at the well during the pumping phase with θ=0.1, 0.2, 0.3, 0.4, 0.5.

Fig.S4 BTCs at the well during the pumping phase with α_L=0.01 m, 0.05 m, 0.1 m, 0.5 m.

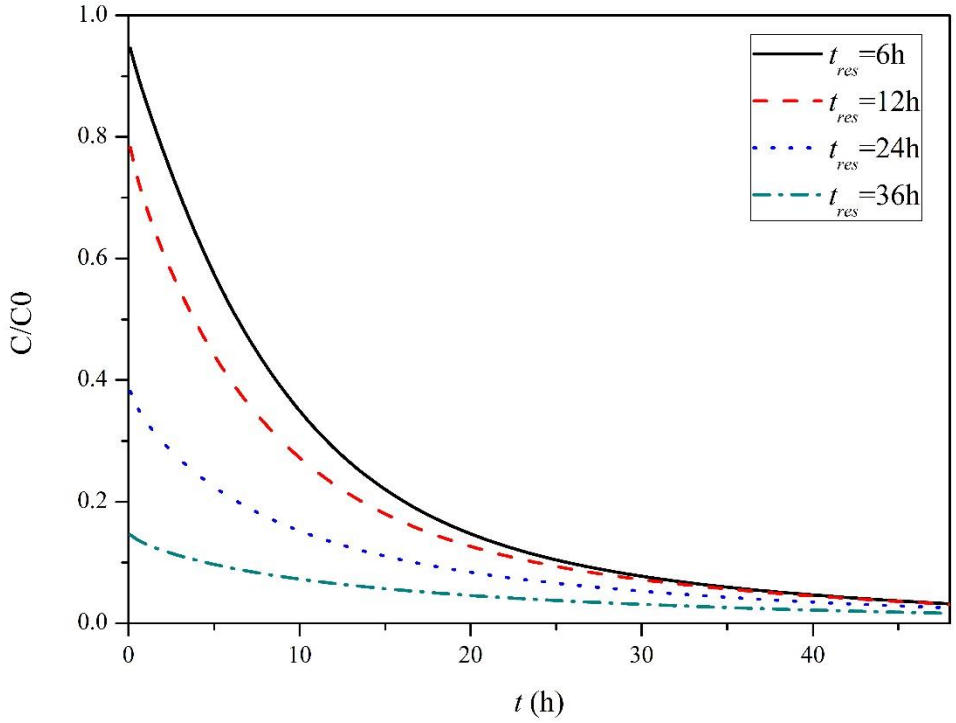
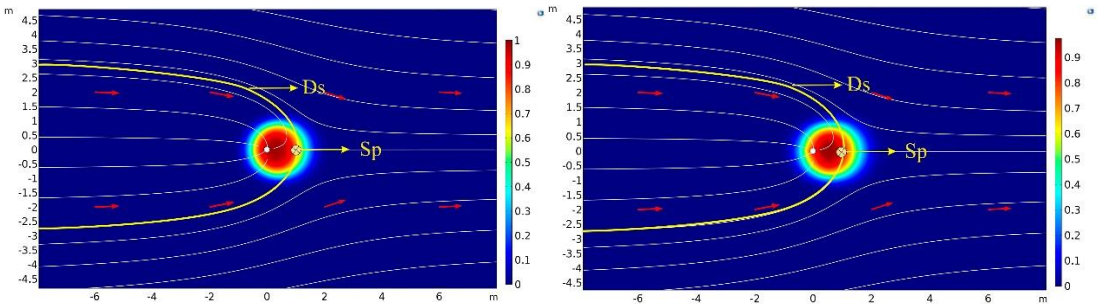
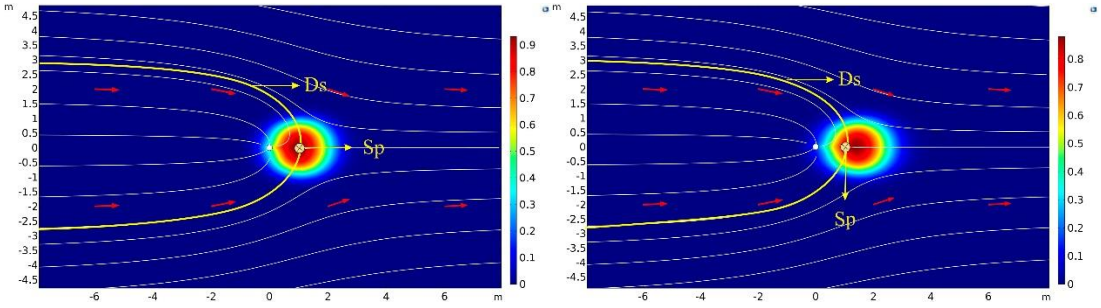

1.0
0.8
0.6
0.4
0.2
0.0
C/C0
0
10
20
30
40
t (h)
t res =6h
t res =12h
t res =24h
t res =36h

Fig.S1



a. t_{res}= 6h

b. t_{res}= 12h



c. t_{res}= 24h

d. t_{res}= 36h

Fig. S2

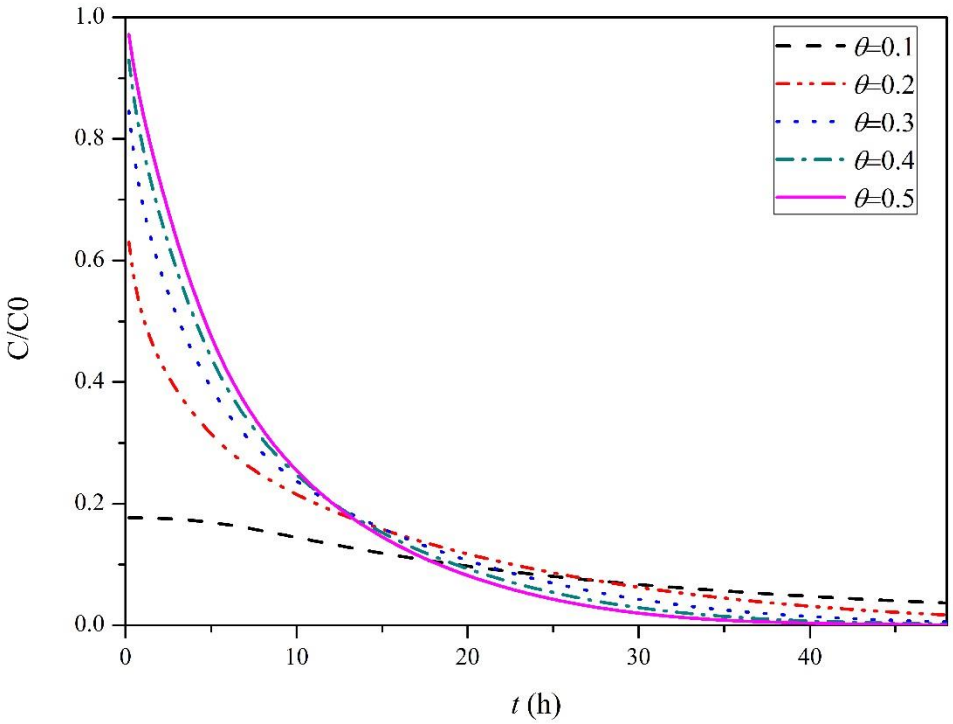


Fig. S3

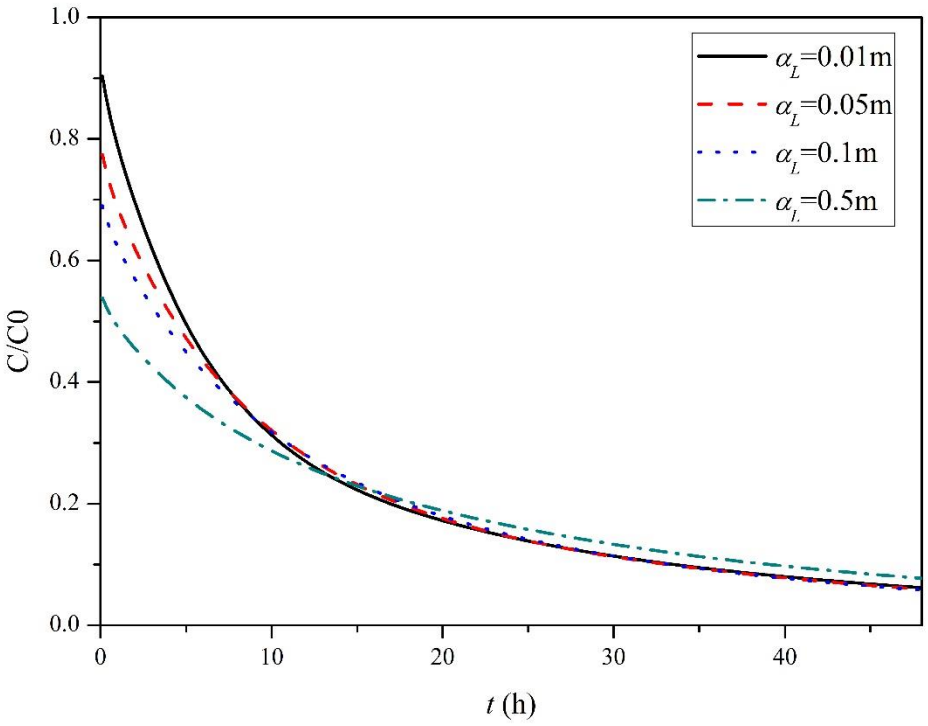


Fig. S4