*Supporting Information*

# Continuous Flow Removal of Anionic Dyes in Water by Chitosan-Functionalized Iron Oxide Nanoparticles Incorporated in a Dextran Gel Column

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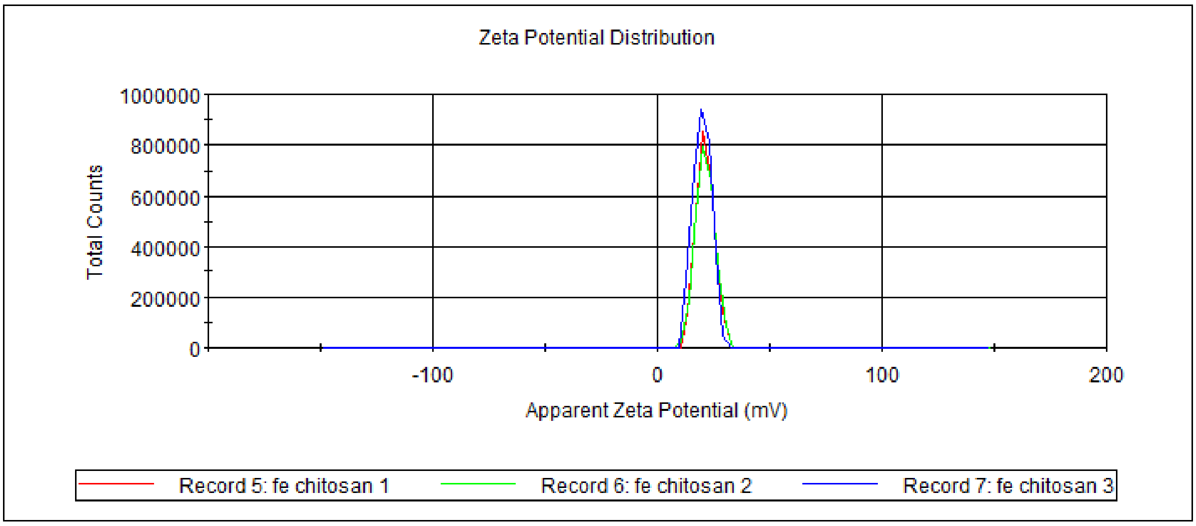
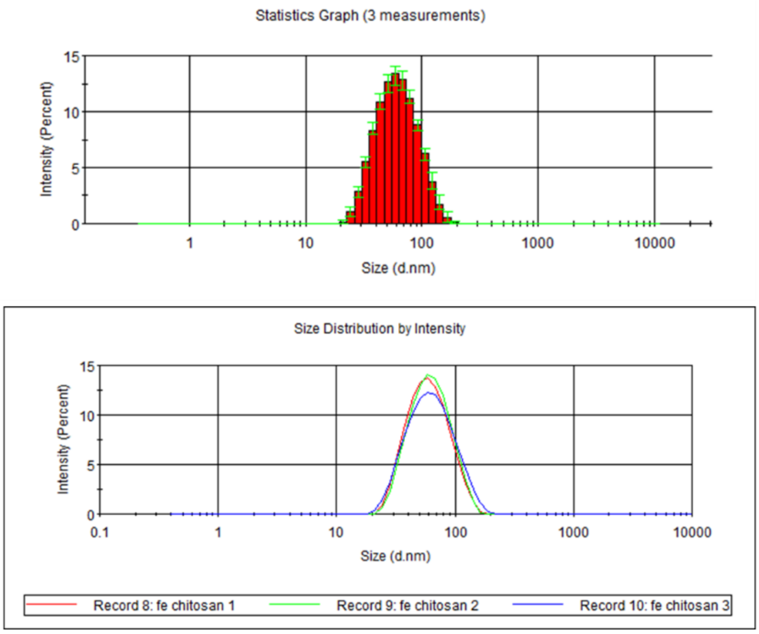
## 1. Hydrodynamic size and surface charge of chitosan-coated $Fe_3O_4$ nanoparticles

Chitosan-coated $Fe_3O_4$ nanoparticles were diluted 1/100 with distilled water and then 50 µL of sample was analyzed for size distribution and zeta potential by using a Zetasizer Nano-ZS90 (Malvern Instruments, UK).




Zeta potential: 21.2 mV (± 3.91)

**Figure S1.** Zeta potential of the chitosan-coated $Fe_3O_4$ nanoparticles.




| Size (nm) | Record 1 | Record 2 | Record 3 |
|---|---|---|---|
| 15.686 | 0 | 0 | 0 |
| 18.166 | 0 | 0 | 0 |
| 21.037 | 0 | 0 | 0.354 |
| 24.363 | 0.949 | 0.661 | 1.458 |
| 28.214 | 3.05 | 2.351 | 3.311 |
| 32.674 | 5.949 | 4.947 | 5.655 |
| 37.84 | 9.032 | 8 | 8.097 |
| 43.821 | 11.655 | 10.906 | 10.229 |
| 50.748 | 13.309 | 13.074 | 11.709 |
| 58.771 | 13.716 | 14.063 | 12.318 |
| 68.061 | 12.854 | 13.672 | 11.989 |
| 78.82 | 10.936 | 11.98 | 10.8 |
| 91.28 | 8.351 | 9.328 | 8.955 |
| 105.709 | 5.578 | 6.253 | 6.746 |
| 122.42 | 3.091 | 3.372 | 4.501 |
| 141.772 | 1.263 | 1.238 | 2.533 |
| 164.183 | 0.268 | 0.156 | 1.083 |
| 190.137 | 0 | 0 | 0.261 |
| 220.194 | 0 | 0 | 0 |
| 255.002 | 0 | 0 | 0 |

Hydrodynamic size: 65.24 ± 1.64 nm

**Figure S2.** Hydrodynamic size of the chitosan-coated $Fe_3O_4$ nanoparticles.

## 2. Photo images showing the preparation of Fe-DC

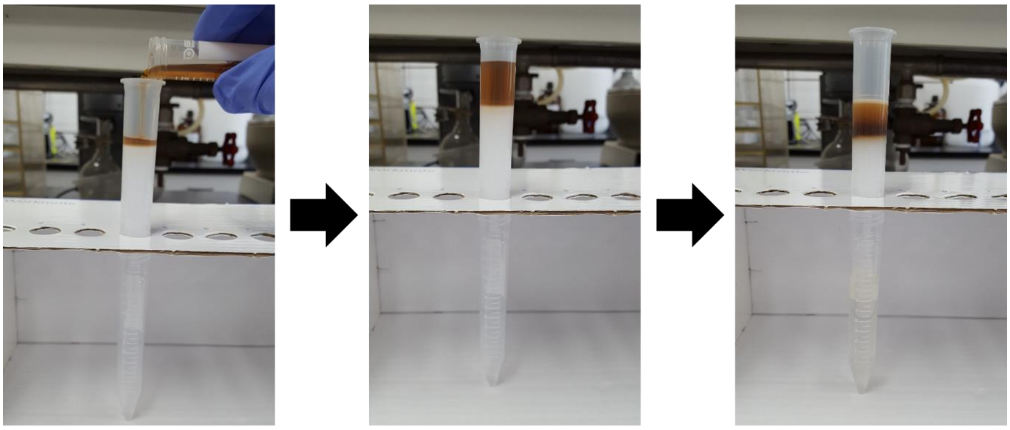


**Figure S3.** Incorporation of chitosan-coated $Fe_3O_4$ nanoparticles in the dextran gel column (PD-10).

## 3. SEM images of dye-adsorbed dextran gel beads (after purification step)

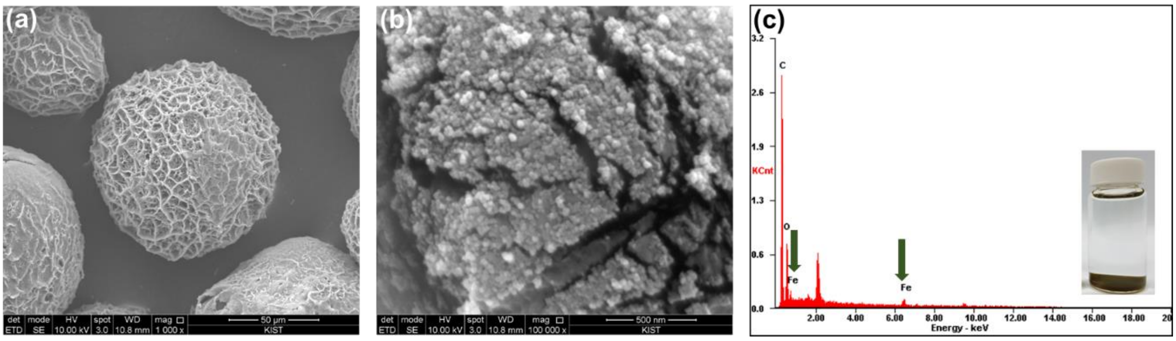



**Figure S4.** (a,b) SEM images of EB-adsorbed dextran gel beads, (c) EDX analysis of EB-adsorbed dextran gels. Arrows in figure (c) indicate the presence of iron elements on the surface the dextran gel beads.

## 4. Photo images showing the purification procedure using Fe-DC

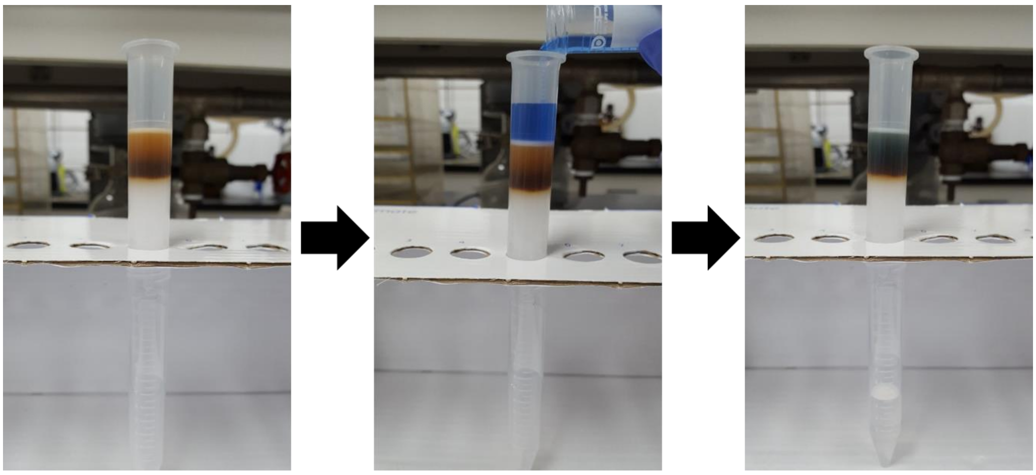


**Figure S5.** Elution of EB solution to Fe-DC, before purification (left), elution of dye (middle), after purification (right).

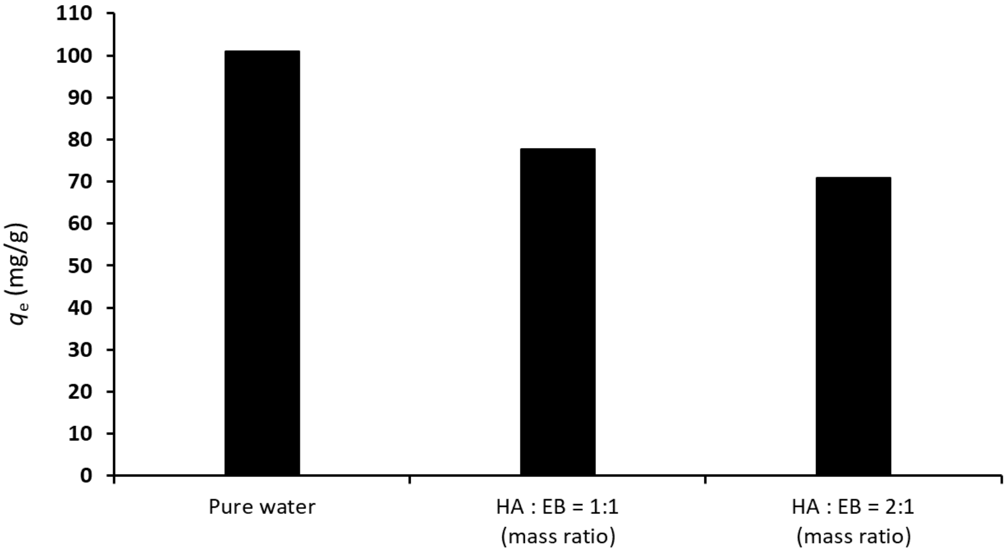



**Figure S6.** Effect of adsorption capacity in the presence of humic acid (HA). (Elution of 15 μM of EB, 10 mL).

**Table S1.** Comparison of $Fe_3O_4$-based adsorbents in terms of their anionic dye removal efficiencies.

| Adsorbent | Anionic dye | Adsorbent used (mg) | $C_0$* (mg/L) | $q_m$** (mg/g) | Ref. |
|---|---|---|---|---|---|
| PVP coated $Fe_3O_4$ | Reactive Orange 13 | 5 | 80 | 32.50 | 21 |
| | Reactive Yellow 15 | | | 25.04 | |
| $ZnFe_2O_4$ | Evans Blue | 50 | 50 | 45.45 | 34 |
| $Ni_{0.5}Zn_{0.5}Fe_2O_4$ | Methyl Blue | 50 | 300 | 54.7 | 39 |
| APTES coated $Fe_3O_4$ | Sunset Yellow | 10 | 10 | 91.74 | 36 |
| DMDAAC coated $Fe_3O_4$ | Methyl Blue | 11 | 19 | 109.89 | 11 |
| Lignin coated $Fe_3O_4$ | Methyl Blue | 20 | 50 | 211.42 | 20 |
| PEI coated $Fe_3O_4$ | Alizarin Red S | 30 | 100 | 256.0 | 10 |
| | Methyl Orange | | 100 | 242.4 | |
| Fe-DC | Evans Blue | 2.5 | 96.1 | 243.90 | This work |

* Initial dye concentration. ** Maximum adsorption capacity.

## 5. Comparison experiments with anion exchange resins

Different amounts (50 or 100 mg) of anion exchange resins (Amberlite® IRA-410 and Amberlite® IRA-900) were incorporated into the dextran gels desalting column. To evaluate removal efficiency, EB solution (15 μM, 10 mL) was added to adsorbent-incorporated columns. The removal efficiency (%) is defined by the Equation (4).

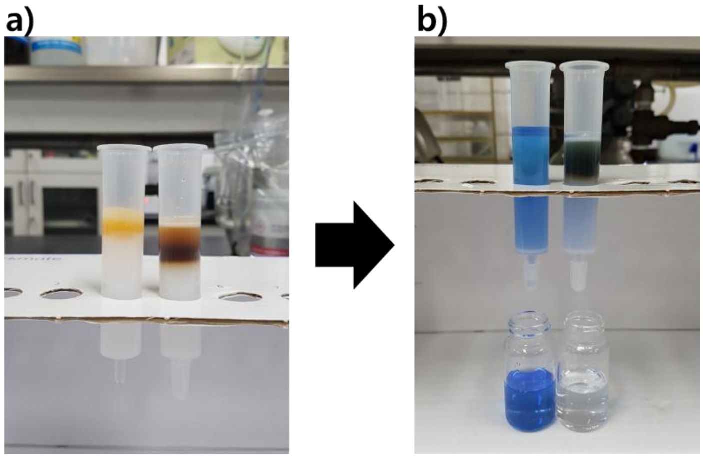



**Figure S7.** (**a**) Amberlite®-410 resin-incorporated dextran gel column (left), Fe-DC (right), (**b**) After elution of EB solution (15 μM) to columns.

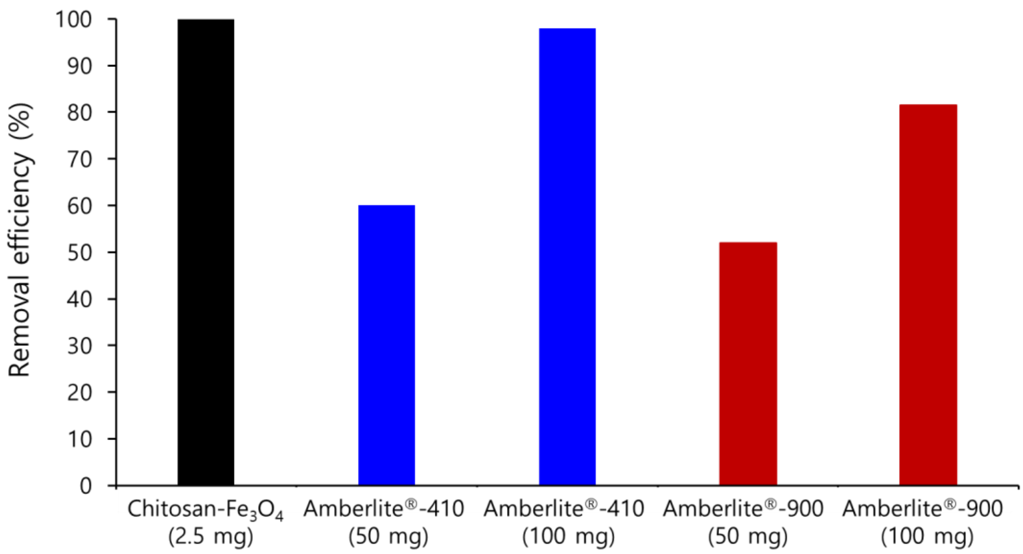



**Figure S8.** Comparison of removal efficiency of EB dyes using adsorbent-incorporated columns.