Algal assisted synthesis of iron oxide nanoparticles and dye removal studies

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1. Introduction

Clean water is essential for human life but due to industrial growth much of the water released in the environment is polluted [1]. Iron oxides (Fe_3O_4) magnetic nanoparticles (MNP) have many applications in the environment because they have high saturation magnetization, biocompatibility, stability under ambient conditions and the simplicity of their preparation process [2]. In present work, we have attempted to synthesize Fe_3O_4 nanoparticles using algae extracts and study their application in dye removal.

2. Synthesis of Fe_3O_4 nanoparticles

Ferrous chloride and Ferric chloride were mixed at a molar ratio of 1:2 in 100 mL of distilled water and to that 100 mL of algal extract was added. The synthesis was carried out at an alkaline pH 12 and the solution was kept in a magnetic stirrer. Then particles were centrifuged and washed with acetone to remove impurities. Calculated amount of SPIONs and adsorbents (1:3) were allowed for reaction in aqueous solution with solvent as water. This can be packed in the column for studies of dye removal.

3. Result and discussion

Powder XRD

XRD reflection peaks correspond to the standard file JCPDS no. 82-1533, confirming the presence of Face Centered Cubic (FCC) Fe_3O_4 crystals in the sample. (Fig 1 (a))

TEM analysis

Synthesized nanoparticles was multiple shape like square, needle and sphere with different sizes (Figure 1(b)). Hybrid nature of nano particles was realized in the HR-TEM (Figure 1 (b) onset) images. Crystalline planes MNP (111) were clearly observed (5.5Å).

VSM

Vibrating Sample Magnetometer (VSM) analysis showed that particles possess superparamagnetic behavior (Fig 2.) with magnetization of around 454 emu/g.

Column based Dye removal studies

Break through curve (BTC) for column based studies was analyzed by Navy blue eluents (1, 2, 3…) from packed column of silica and carbon shown in figure 3. BTC of silica column attained break point (starting of saturation of column) at 37 h (45 mL) but carbon attains it in 64 h (82 mL) only. Complete saturation of column attained at 39 h (60 mL) and 70 h (90 mL). These results indicated that carbon packed column was more effective than silica column.

4. Conclusions

Bio synthesized magnetic nanoparticles were reported in this study. BCT data and dye removal studies shows nanoparticles attached carbon column has higher efficiency than Silica column.

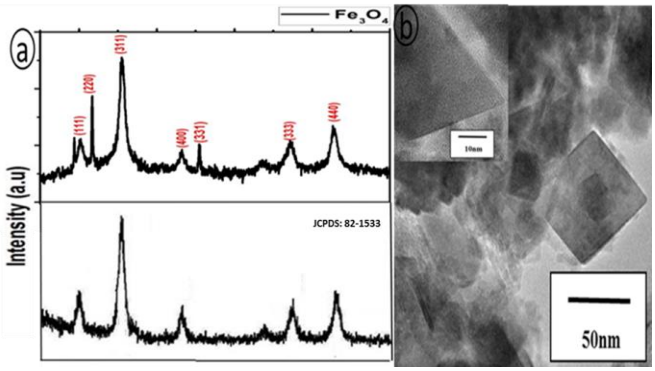

Figure 1. (a) XRD pattern (b) TEM and HRTEM of Fe_3O_4

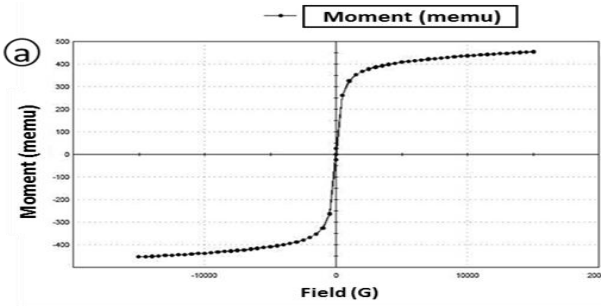

Figure 2. Vibrating sample magnetometer

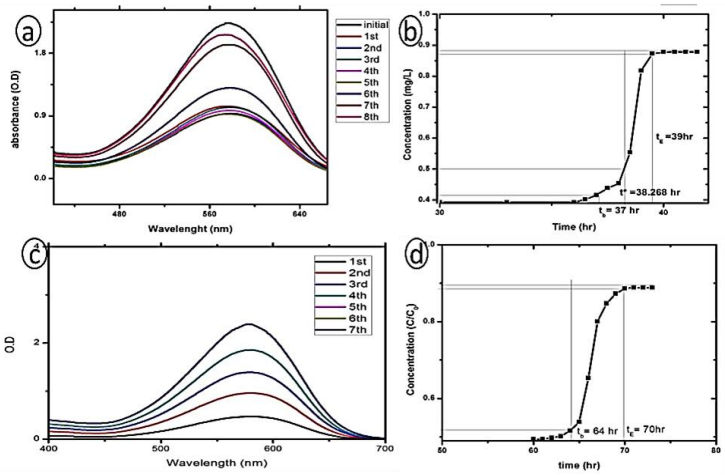

Figure 3: Navy blue removal studies (a) UV spectral analysis (b) BCT curve for silica column. (c) UV spectral analysis (d) BCT curve for carbon column

References

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