SUPPLEMENTARY INFORMATION

Waste mediated synthesis of iron nanoparticles using *Aegle marmelos* peel extract for catalytic degradation of toxic dye contaminants

Anju Srivastava[a], Sriparna Dutta[a] and Reena Jain*[a]

[a]*Hindu College, Department of Chemistry, University of Delhi, Delhi-110007*

S1. Activation Energy

Arrhenius equation given below can be used to calculate the apparent activation energy (E_a) for the degradation of the dye

$$\ln k_{obs} = -\frac{E_a}{RT} + \ln A_o \qquad \text{..... (a)}$$

Where A_o is the pre-exponential factor, E_a is the apparent activation energy (kJ mol^{-1}), R is the ideal gas constant (8.314 JK^{-1} mol^{-1}) and T is the reaction temperature (K). Figure S1 illustrates a plot of $\ln k_{obs}$ versus 1/T depicting a linear relationship with a negative slope of E_a/R and intercept of $\ln A_o$. The excellent linearity so obtained depicts the pseudo-first order model. The values of activation energy (E_a) for oxidative degradation of both the dyes suggest that dye degradation presumably followed a surface-controlled phenomenon wherein the rate-limiting step was essentially a surface-chemical reaction instead of diffusion.

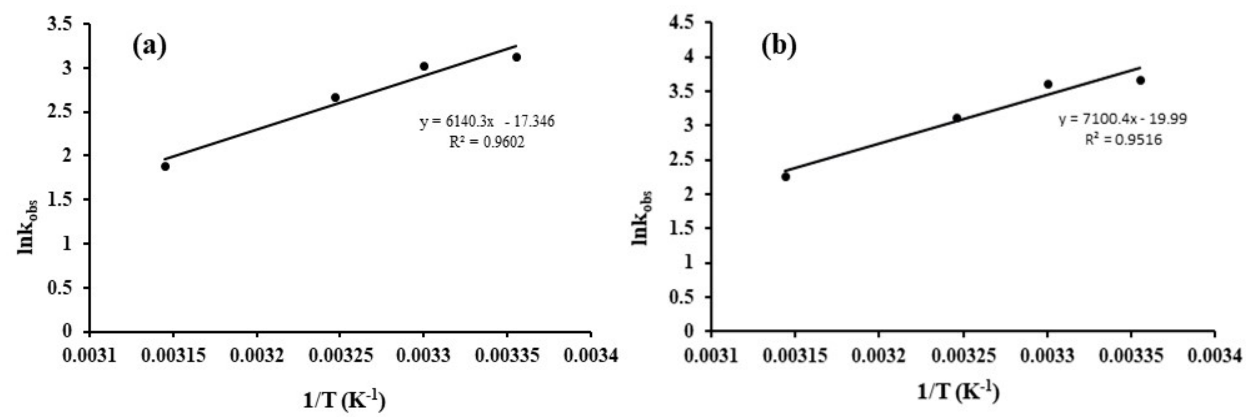

Fig.S1 Plot of $\ln k_{obs}$ versus 1/T for (a) Eosin Yellow and (b) Fuchsin Basic

S2. Reusability of Iron Nano particles

The reusability of the Fe NPs, up to the third cycle of the Fenton-like oxidation reaction was evaluated at 318 K. The removal efficiency values after the first and third cycle did not show much variation and only a slight decrease in catalytic activity of reused nanoparticles was observed (Figure S2). This suggested that nano-catalyst showed good reusability. More so, FT-IR spectrum [Figure S3(a)] of reused catalyst shows the characteristic bands corresponding to surface functionalities similar to those observed in the fresh sample, confirming the identity of reused Fe NPs. The EDX spectrum [Figure S3(b)] however reveals that the elemental composition of degraded nanoparticles shows signatures corresponding to iron and oxygen. Intriguingly, the oxides of iron which were formed in original nanoparticles were still intact and to further validate, PXRD study was conducted. As shown in Figure S3 (c), PXRD result depicted peaks at $2\theta = 33.09°$ (corresponding plain of 104) and 43.48° (corresponding plain of 202) which corresponds to Fe_2O_3. Thus, indicating that the oxides of iron were present even after using the nanoparticles and nanoparticles can be further reused to degrade dye. The decrease in the catalytic activity is presumably due to the deactivation of catalytic sites.

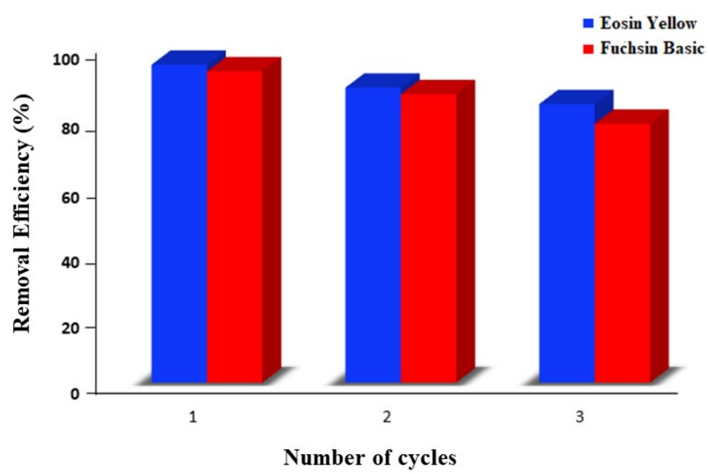

Fig.S2 Reusability of Fe NPs for Fenton oxidation of organic dyes

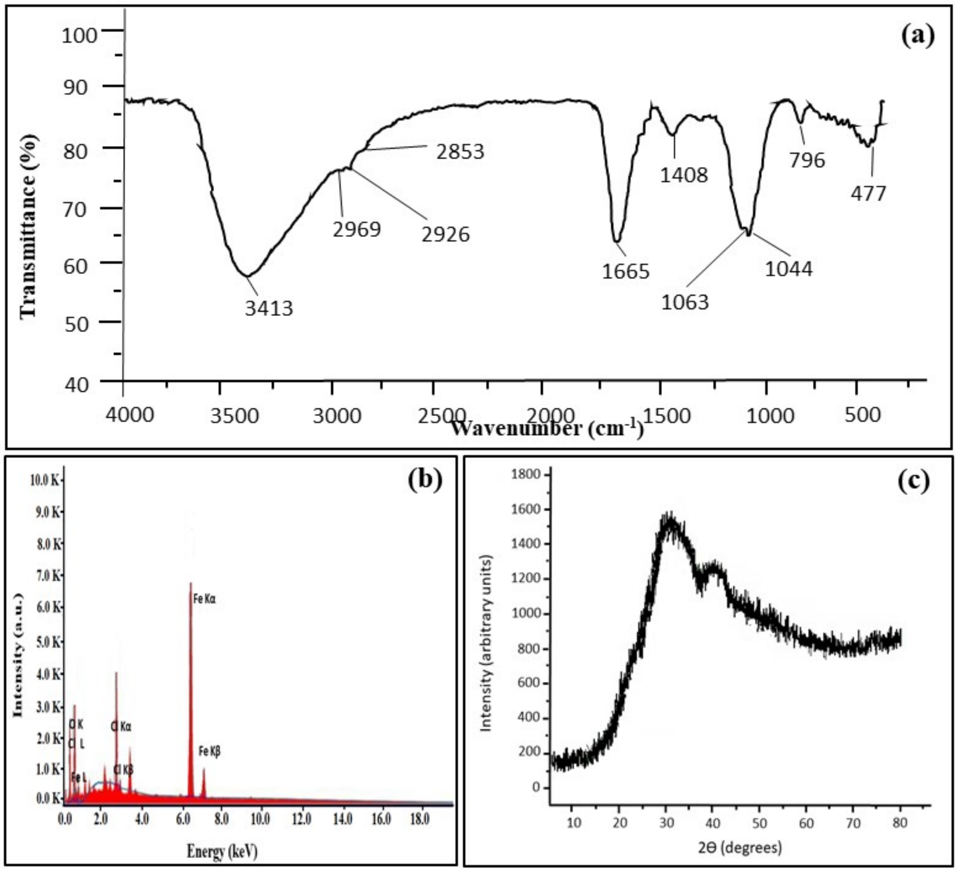

Fig.S3 (a) FT-IR (b) EDX spectrum and (c) Powder X-ray diffractogram of reused Fe NPs