# Immobilization of Horseradish Peroxidase on Magnetite-Alginate Beads to Enable Effective Strong Binding and Enzyme Recycling during Anthraquinone Dyes' Degradation

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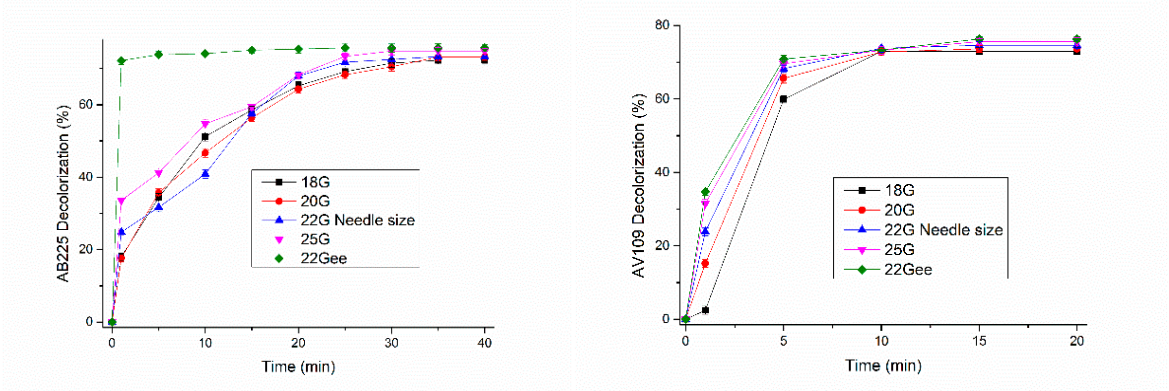
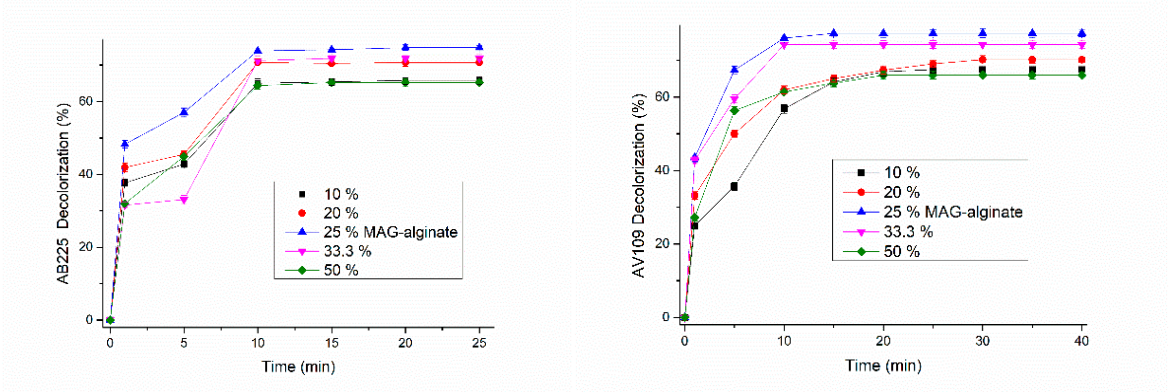
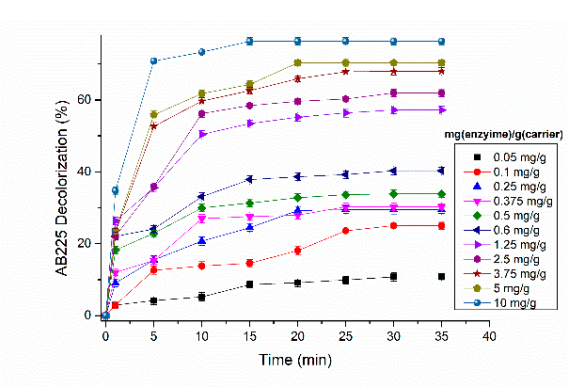


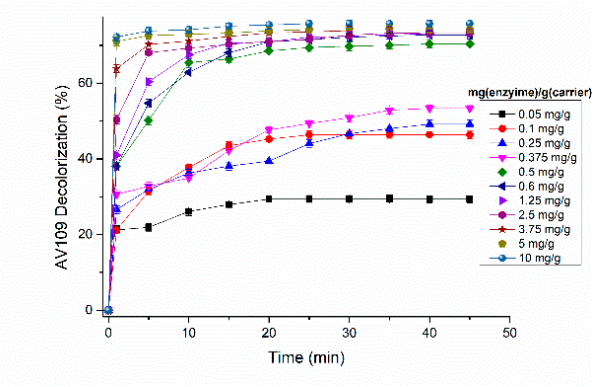

a) b)



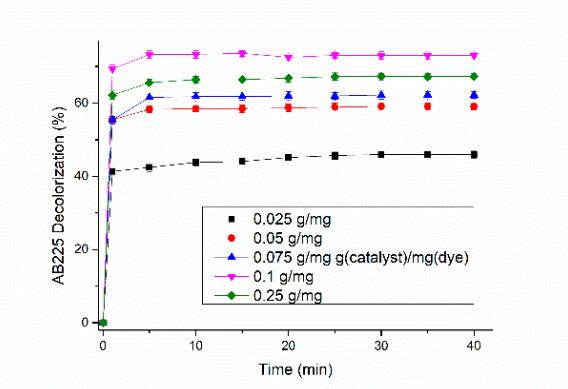

c) d)


AB225 Decolorization (%)
Time (min)
mg(enzyime)/g(carrier)
0.05 mg/g
0.1 mg/g
0.25 mg/g
0.375 mg/g
0.5 mg/g
0.6 mg/g
1.25 mg/g
2.5 mg/g
3.75 mg/g
5 mg/g
10 mg/g

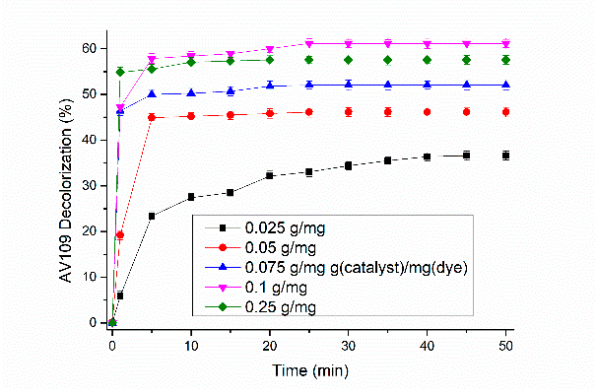
e)


AV109 Decolorization (%)
Time (min)
mg(enzyime)/g(carrier)
0.05 mg/g
0.1 mg/g
0.25 mg/g
0.375 mg/g
0.5 mg/g
0.6 mg/g
1.25 mg/g
2.5 mg/g
3.75 mg/g
5 mg/g
10 mg/g

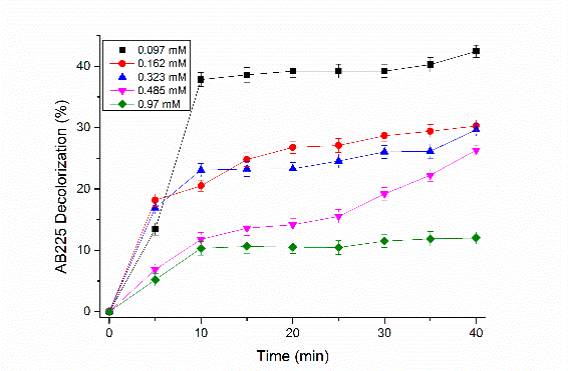
f)


AB225 Decolorization (%)
Time (min)
0.025 g/mg
0.05 g/mg
0.075 g/mg g(catalyst)/mg(dye)
0.1 g/mg
0.25 g/mg

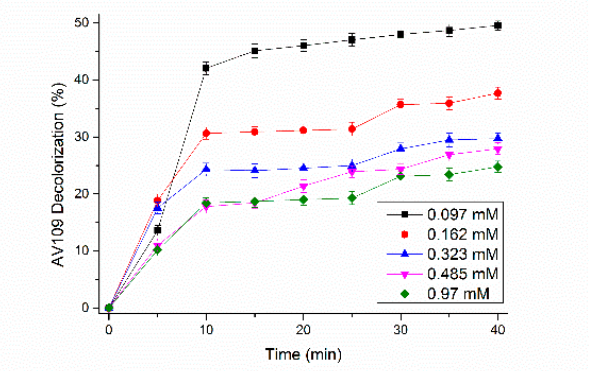
g)


AV109 Decolorization (%)
Time (min)
0.025 g/mg
0.05 g/mg
0.075 g/mg g(catalyst)/mg(dye)
0.1 g/mg
0.25 g/mg

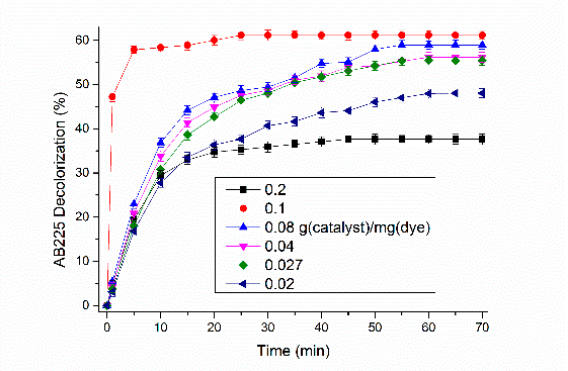
h)


AB225 Decolorization (%)
Time (min)
0.097 mM
0.162 mM
0.323 mM
0.485 mM
0.97 mM

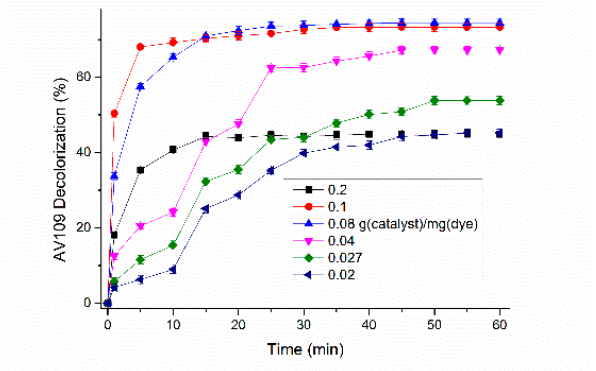
i)


AV109 Decolorization (%)
Time (min)
0.097 mM
0.162 mM
0.323 mM
0.485 mM
0.97 mM

j)


AB225 Decolorization (%)
Time (min)
0.2
0.1
0.08 g(catalyst)/mg(dye)
0.04
0.027
0.02

k)


AV109 Decolorization (%)
Time (min)
0.2
0.1
0.08 g(catalyst)/mg(dye)
0.04
0.027
0.02

l)

**Figure S1:** Effects on the decolorization process: HRP-MAB size (**a**) AB225, (**b**) AV109; MAG-alginate ratio (**c**) AB225, (**d**) AV109; initial HRP concentration (**e**) AB225, (**f**) AV109; HRP-MAB mass (**g**) AB225, (**h**) AV109; initial $H_2O_2$ concentration (**i**) AB225, (**j**) AV109 and initial dye concentration (**k**) AB225, (**l**) AV109.

**Table S1:** Reaction conditions for the optimization of decolorization process of AB225 and AV109 color

| Varied parameter | Time, min | MAG-alginate | $C_{peroxide}$, mM | $C_{color}$, g(catalyst)/mg(dye) | Beads mass, g(catalyst)/mg(dye) | $C_{HRP}$, mg(enzyme)/$g_{carrier}$ | Nozzle size |
|---|---|---|---|---|---|---|---|
| **MAG-alginate** | AB 25 AV 40 | 1:10 – 1:2 | 0.097 | 0.1 | 0.05 | 2.5 | 22$G_{ee}$ |
| **$C_{peroxide}$, mM** | AB 40 AV 40 | 1:4 | 0.097 – 0.97 | 0.1 | 0.025 | 10 | *22$G_{ee}$ |
| **$C_{color}$, g(catalyst)/mg(dye)** | AB 70 AV 60 | 1:4 | 0.097 | 0.02 – 0.2 | 0.05 | 2.5 | 22$G_{ee}$ |
| **Beads mass, g(catalyst)/mg(dye)** | AB 50 AV 40 | 1:4 | 0.097 | 0.1 | 0.025 – 0.25 | 2.5 | 22$G_{ee}$ |
| **$C_{HRP}$, mg(enzyme)/$g_{carrier}$** | AB 35 AV 45 | 1:4 | 0.097 | 0.1 | 0.05 | 0.05 - 10 | 22$G_{ee}$ |
| **Nozzle size** | AB 40 AV 20 | 1:4 | 0.097 | 0.1 | 0.05 | 10 | 18G – 22$G_{ee}$ |

$C_{peroxide}$ – $H_2O_2$ concentration; $C_{color}$ – Dye concentration; $C_{HRP}$ – HRP initial concentration; *ee – electrostatic extrusion