Preparation of Magnetized Biopolymer-clay Adsorbents

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Introduction

- Water pollutants can be removed from contaminated water by:
- Adsorption
- Electro dialysis
- Flocculation
- Ion Exchange
- Precipitation, and
- Other techniques

- Adsorption is frequently the simplest to apply but is not always the most economic technique because of the price of the synthetic adsorbents
- Clays are inexpensive and relatively efficient adsorbents but are, due to their colloidal nature, rather hard to separate from water
- However, magnetized clay adsorbents can easily be removed from water with either permanent magnet or electromagnet

Objectives

- To study the magnetization of clay: biomaterial aggregates at different:
  - [clay]/[biomaterial]
  - $[Fe^{3+}]/[Fe^{2+}]$ ratios, and
- To develop a simple model for detection of optimal conditions for magnetization of aggregates

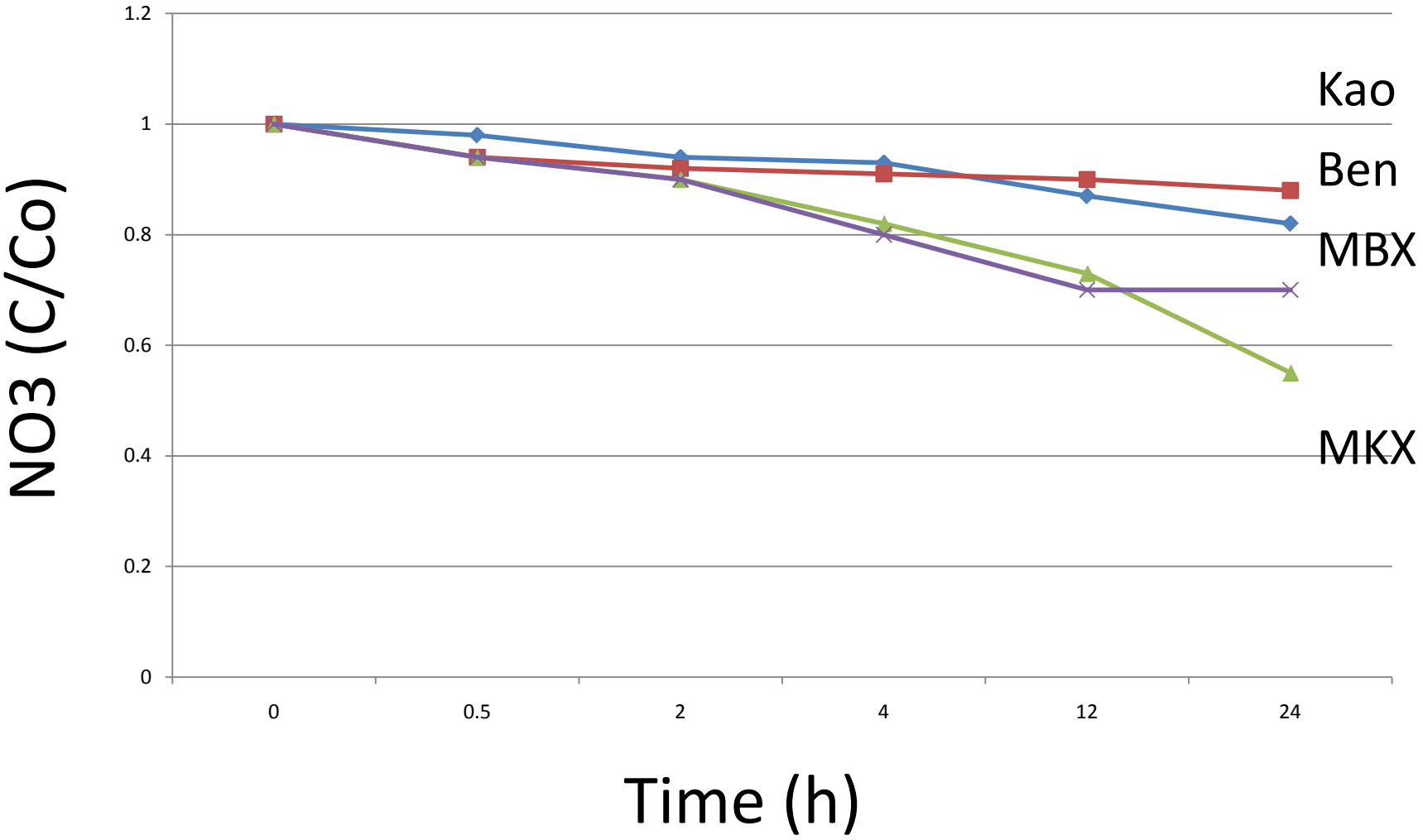
Materials and Methods

- We prepared adsorbents:
  - Two clays (bentonite and kaolin), and
  - Two biomaterials (humic acids and starch)

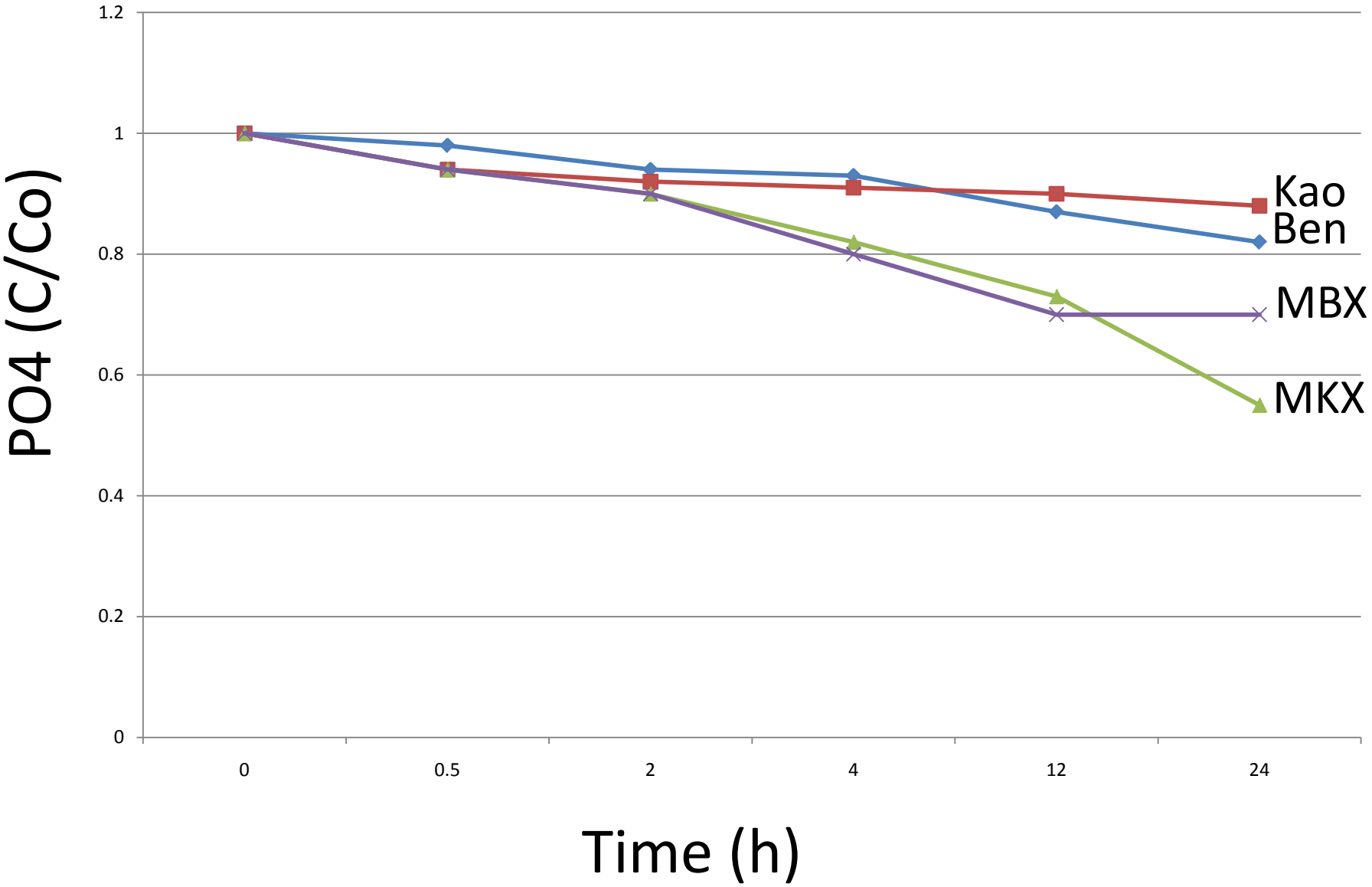
- Clay/biomaterial ratios was in range of 2.5 to 27.6
- Fe^{3+}/Fe^{2+} ratio was in range 0.6 to 3.9

- Adsorbents were removed from suspension using a low intensity magnet (7.69 $\pm$ 0.8 mT)
- Adsorbents were tested in simultaneous adsorption on nitrate (NO_3) and phosphate (PO_4)
- The Response Surface Methodology (RSM) was used to plan the experiments and analyze results (Central Composite Design)

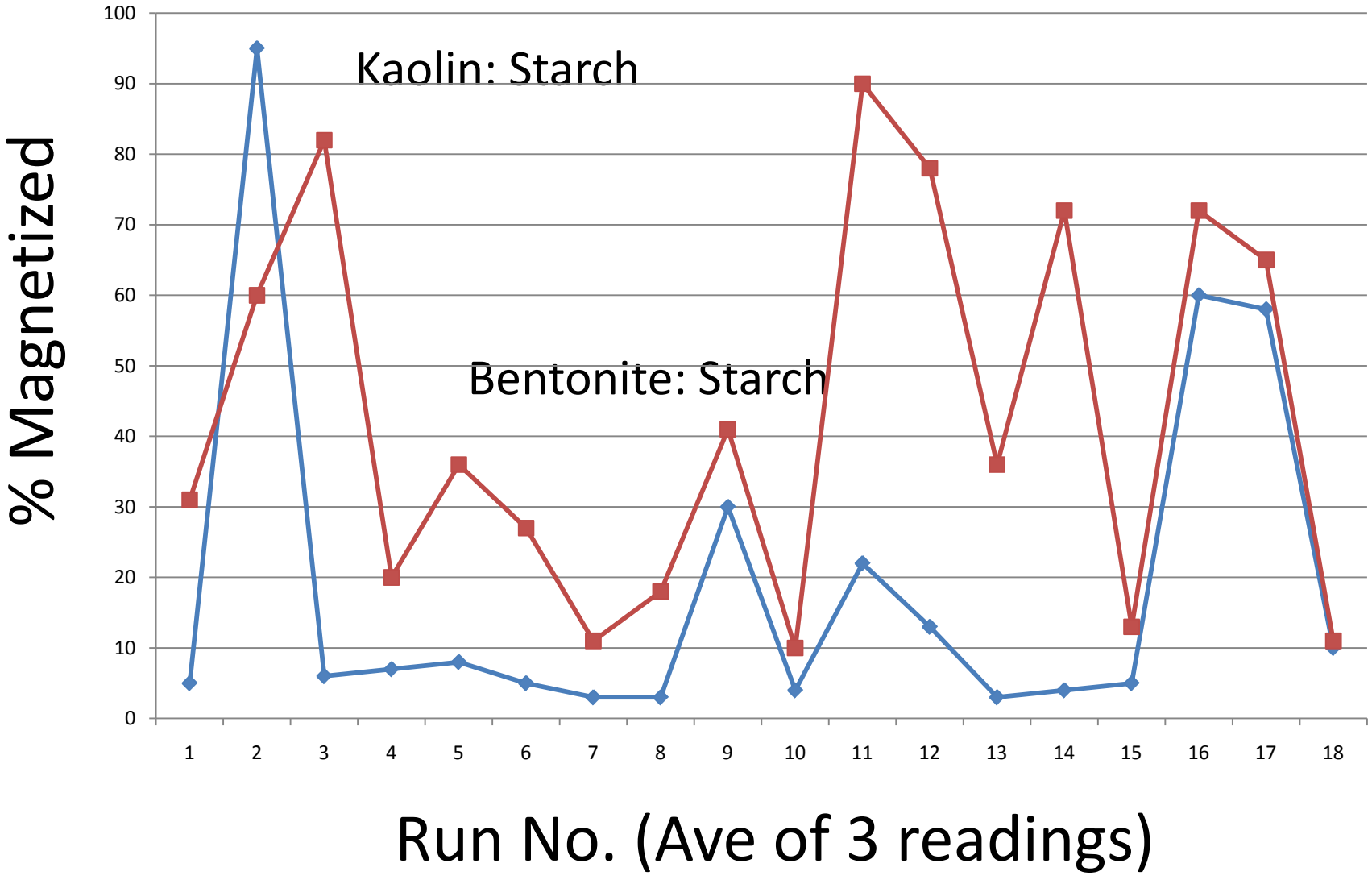
Results



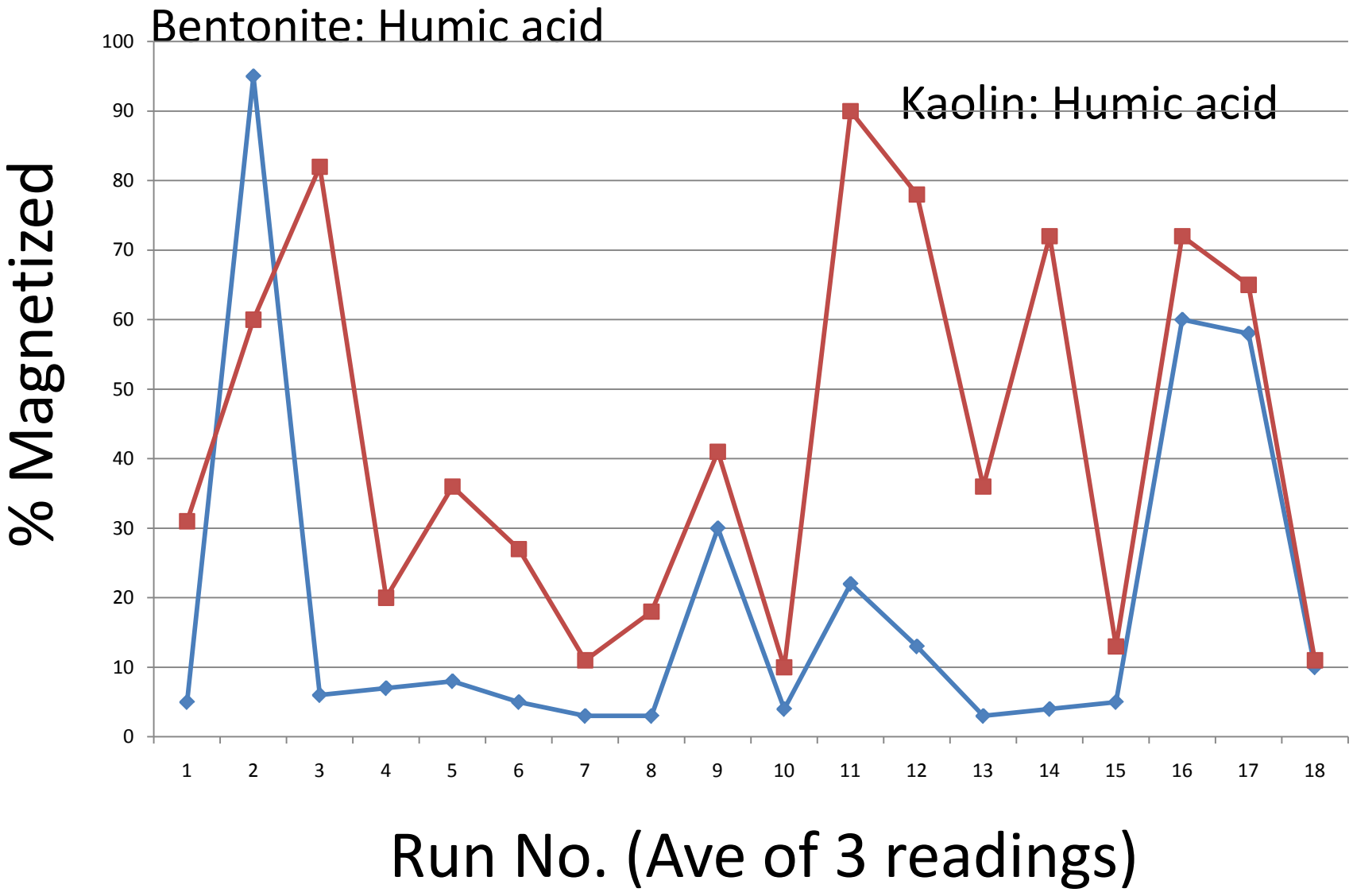
Results



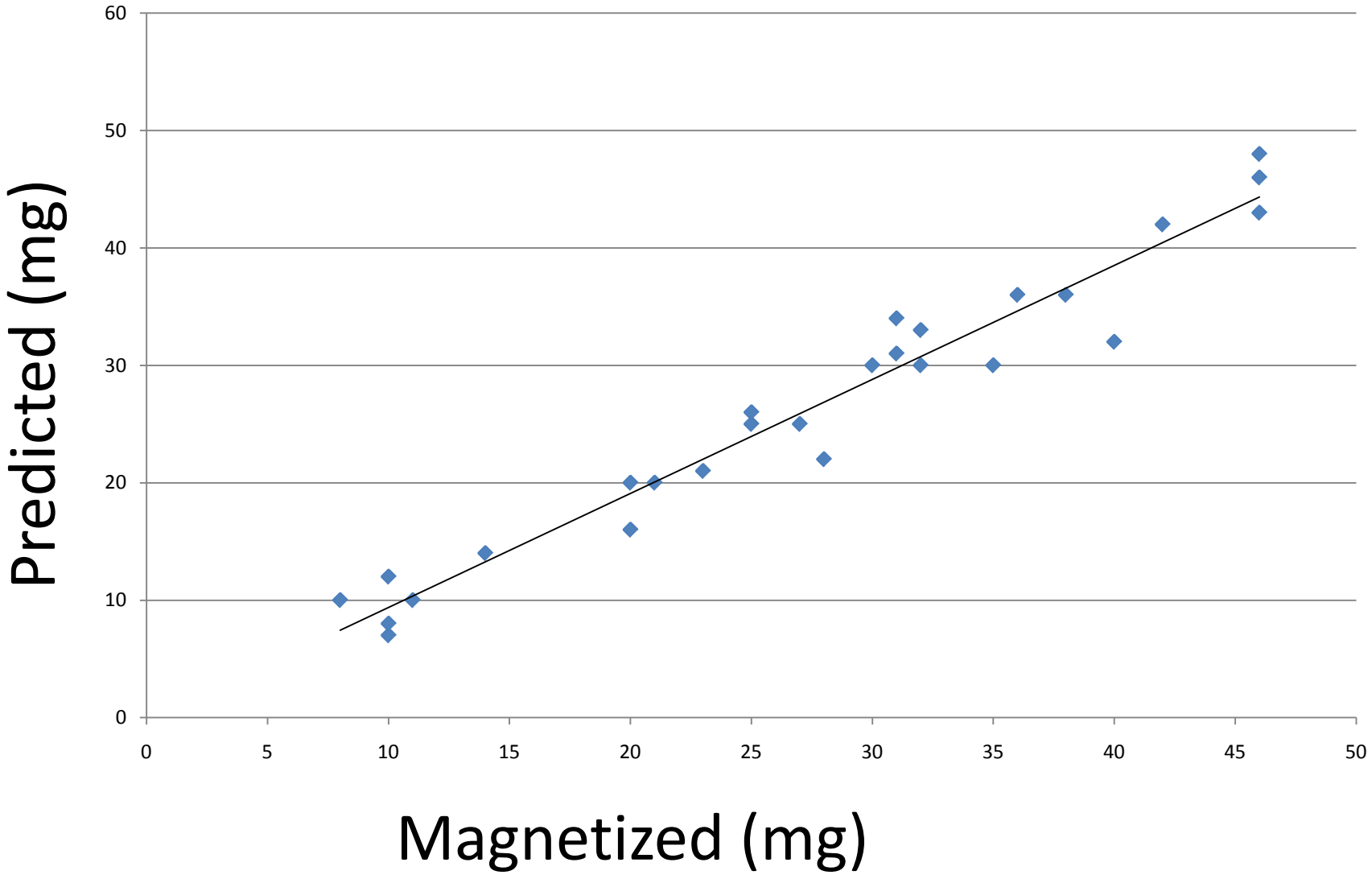
Results


% Magnetized
100
90
80
70
60
50
40
30
20
10
0
Kaolin: Starch
Bentonite: Starch
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Run No. (Ave of 3 readings)

Results


Bentonite: Humic acid
Kaolin: Humic acid
% Magnetized
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Run No. (Ave of 3 readings)

Results


Predicted (mg)
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
50
Magnetized (mg)

Conclusion

- Maximal concentration of magnetized absorbents in bentonite/starch and kaolin/starch weight ratio of 6.1 and Fe^{3+}/Fe^{2+} molar ratio of 0.6 and 1.1
- Maximal concentration of magnetized absorbents in bentonite/humic acid and kaolin/humic acid weight ratio of 6.1 and Fe^{3+}/Fe^{2+} molar ratio of 0.6 and 1.1
- The model predicted and experimental results are in good agreement over entire ranges of variables tested

Questions ?
Thank you