INFLUENCE OF IRON VALENCY ON THE MAGNETIC SUSCEPTIBILITY OF A MICROBIALLY PRODUCED IRON SULPHIDE BIOSORBENT

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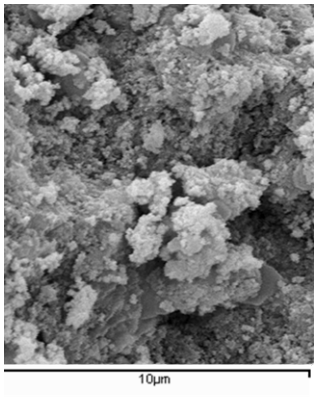
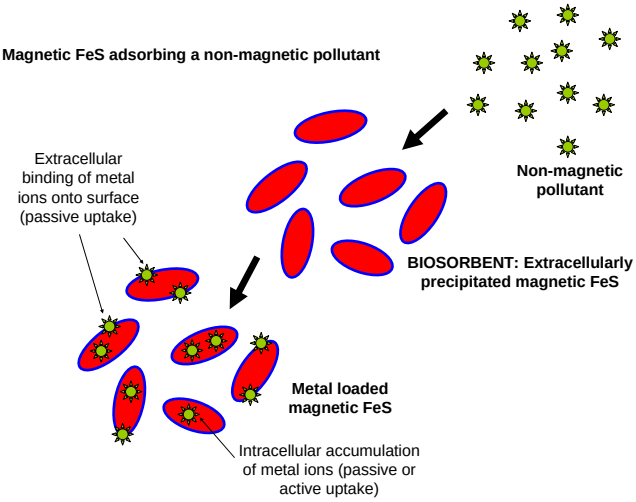
Introduction

- Sulphate Reducing Bacteria (SRB) are a genera of dissimilatory bacteria which utilise iron to form an iron sulphide, FeS, which can be magnetic.
- The magnetic FeS forms an extracellular coating on the bacteria which is a good absorbent due to its high surface area to volume ratio.
- The absorption capacity of the FeS has been extensively researched as an alternative for heavy metal recovery.
- A highly magnetic FeS would enable efficient, cheap and environmentally friendly recovery by the process of magnetic separation.



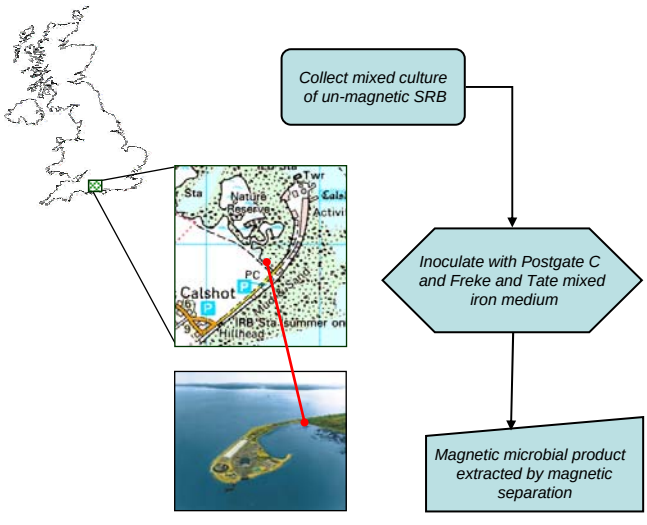
Scanning Electron Microscope image of anaerobically dried FeS

Magnetic FeS adsorbing a non-magnetic pollutant



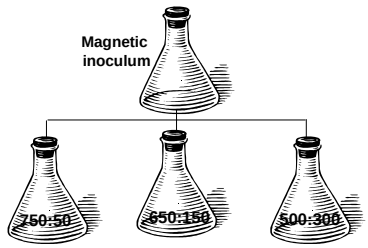
Obtaining a Magnetic Culture

- Salt marsh sediment containing a mixed culture of non magnetic SRB was obtained from a previously used sampling location in Hampshire, UK.
- The bacteria were cultured in batch under non sterile conditions at 30^{0}C and the magnetic product extracted for use as seed for a new bioreactor.



Refining the Magnetic Culture

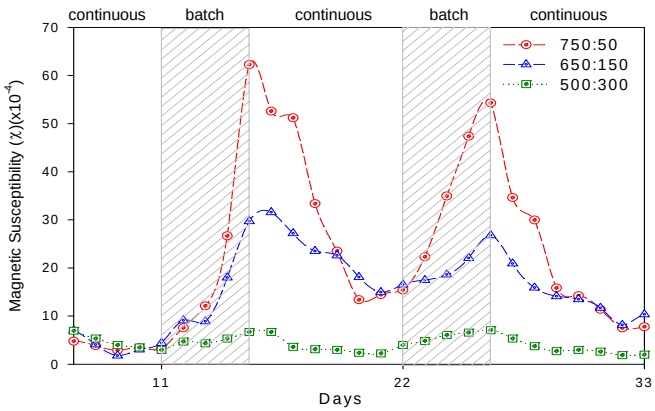
- An 11 day mixed culture cycle was utilised; 5 days in batch, 6 days in continuous at a dilution rate of 0.028hr^{-1}.The culture conditions were uniform in all bioreactors, with the total iron concentration being maintained (800ppm), however the relative concentration of Fe^{2+}:Fe^{3+} was varied.



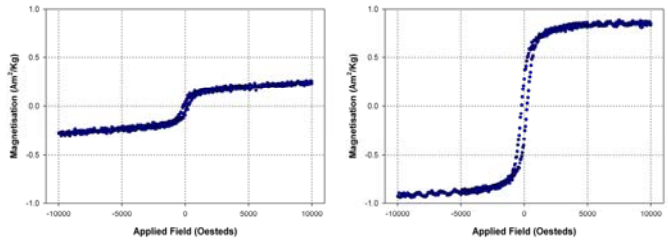
- The magnetic susceptibility of the produced material was quantified using an MSB-Auto (Sherwood Scientific Ltd).

Magnetic Susceptibility Measurements

- A comparison of the magnetic susceptibility trends relative to the reference concentration (650:150) was conducted over a period greater that 2 cycles (>22days).



Magnetic susceptibility measurement of microbial FeS during switched batch: continuous culture. Dependency on Fe(II):Fe(III) ratio in culture medium is shown.



Typical magnetisation measurements of FeS (650:150 Fe(II):Fe(III) culture) produced during the continuous (left) and batch (right) stages of the culture cycle

- The average of 3 daily readings was recorded, and this revealed that the mixed feed ratio of 750:50 yielded the most magnetic FeS (58 x10^{-8}SI units). This value is approximately 20 times more magnetic than any previously recorded microbially produced FeS

Conclusions

- Increasing the relative concentration of Fe(II) in the growth medium solution appears to increase the magnetic susceptibility of the magnetic product.
- Future work will further refine the relative iron concentration mix and investigate whether increased magnetic susceptibility adversely affects the metal recovery properties of the FeS.

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