Utilisation of ochreous sludge

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(with acknowledgement to staff of the Coal Authority, Yorkshire Water Services and Biffa Waste Management Services, and research personnel at Imperial College)

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The Problem
The problem (2)

* Minewater

Wide distribution; variable flow and content

* Minewater iron

Visible at >1 mg/l and adsorbs on surfaces

* Ochre sludge

Variable composition (particularly water) and difficult to manage (particularly to de-water)
The problem (3)

Low value
Low tonnage
High risk
Applications and potential applications

* Construction: cement, pigments, steel

* Water purification: coagulants, adsorbents

* Surface restoration: artificial top-soils

* Sub-surface restoration: engineering fill
Cement
(Lafarge, Glacier ARM)
Discharge and lagoon sludge pumping/centrifuging
Coagulant
Typical minewater and potable water flowsheets

Minewater → Aeration (Cascade) → Sedimentation (Lagoon) → Filtration (Wetland) → Discharge (River)

Iron salt, lime → Dosing (Mixer) → Sedimentation or flotation (Tank) → Filtration (Sand) → Potable supply (Pipework)

Sludge (Drying bed, centrifuge) → Sludge (Centrifuge or sewer) → Potable supply (Pipework)
Laboratory wastewater coagulation (Yorkshire Water Bradley Depot)

Pilot scale coagulation (Silkstone STW)
Artificial top-soil
ATS trial at the former Woolley colliery

Shale, lagoon ochre and compost

Yellow lagoon ochre

Brown wetland ochre

Coned and quartered mixture
Artificial top-soil cells

General view of 24 Cells

Top: with ochre
Below: without ochre
Engineering fill
Conceptual flowsheet for mineral/organic compacted fill
Biffa Skelton Grange Landfill: initial excavation
Mixing spoil, sewage sludge, lime and water
Filling and compacting the mix with C&D waste in a clay lining
Completed emplacement with clay and spoil cap
Finished Pilot Scheme at Skelton Grange Landfill
Conclusions

1. No clear economic or logistic routes now
2. Clear benefit of ochre not yet demonstrated
3. Increasing landfill tax an incentive
4. Refined regulatory framework needed