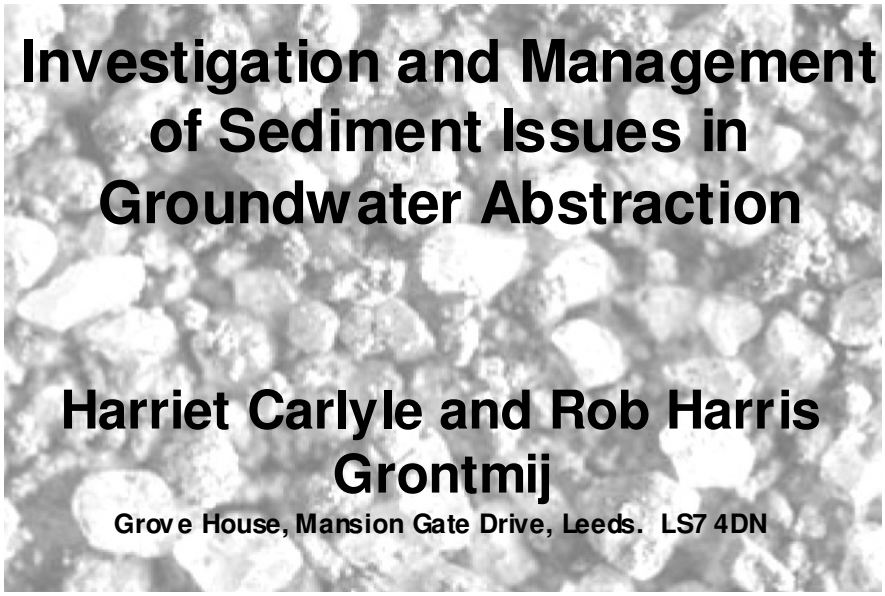

Investigation and Management of Sediment Issues in Groundwater Abstraction

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THE PROBLEM

Groundwater treatment plant can be affected by:

- Turbidity
- Silt
- Sand
- Metals (dissolved and oxidised)

Leading to:

- Clogging of membranes, reactive media and filters

Affects deployable output and treatment plant requires more maintenance = more money!

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4 CASE STUDIES……..

1. Sherwood Sandstone boreholes – sand, high iron & manganese
   - filters blinded by sediment

2. Sherwood Sandstone boreholes – sand, high nitrate
   - ion exchange vessels clogged

3. Sherwood Sandstone boreholes – high iron & manganese
   - backwash failing to clear filter media

4. Carboniferous Limestone boreholes – high cryptosporidium risk
   - membranes clogged and early failure

RAPID GRAVITY FILTERS

Sherwood Sandstone boreholes – filters blinded by sediment

5km main between boreholes and WTW

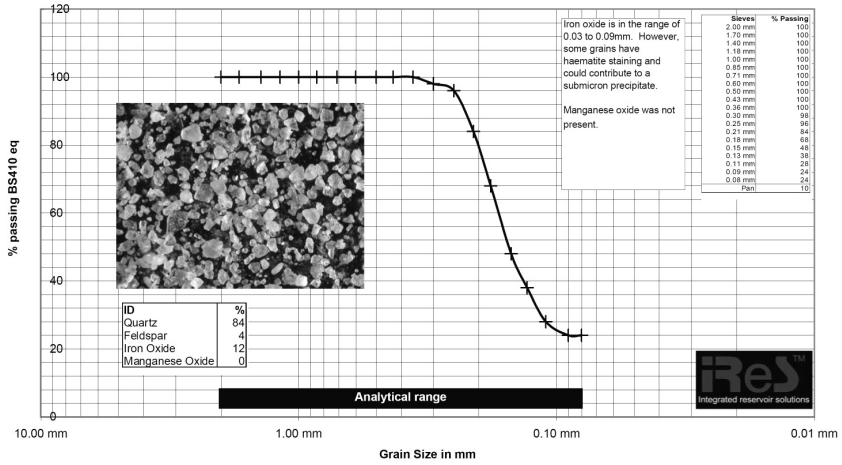
Aeration cascade to oxidise Fe & Mn

Cascade takes out sand but fine sediment blinding filters

Investigation included:

- Measuring sand concentrations during pumping tests
- Mineralogical analysis of sediment at borehole, in cascade and at filters

Sand tester content



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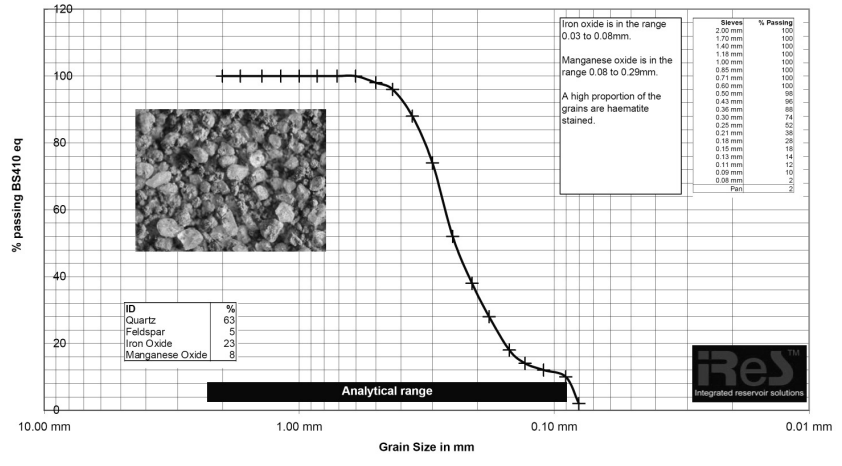
Sediment in cascade



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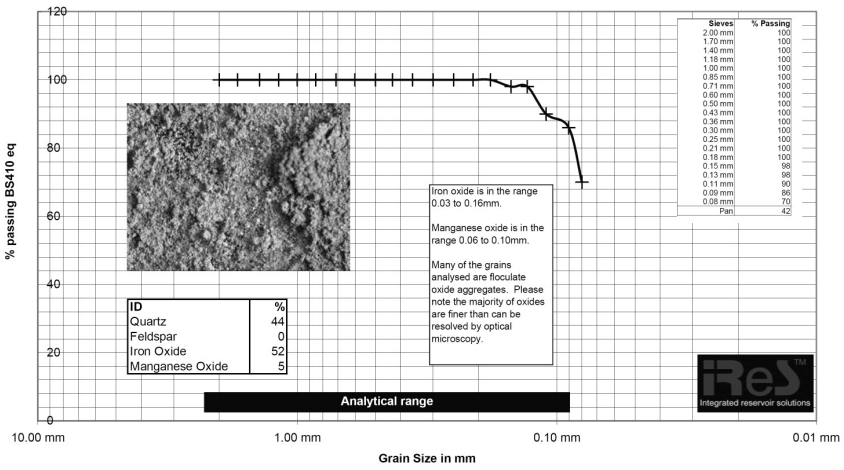
Sediment reaching filters



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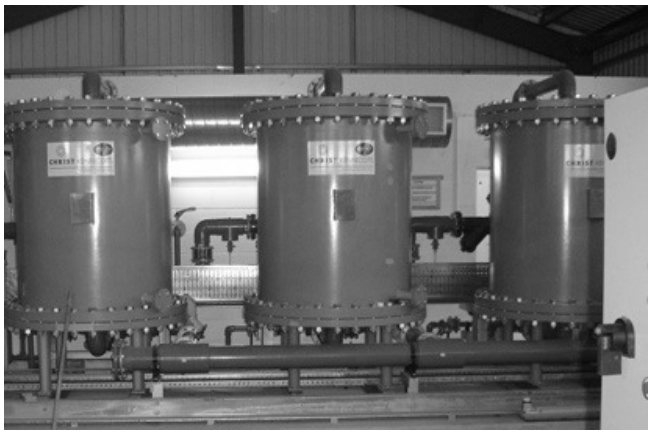
NITRATE TREATMENT PLANT

Sherwood Sandstone boreholes – sediment clogging treatment vessels

- 50um filter upstream of treatment vessels to remove sand
- Backwash to remove finer sediment from resin



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Sediment Testing and Analysis

Analysis of sediment samples from vessel

Start-up, ramp-up and constant rate testing

- Sand testing (to 1um)
- Mineralogical analysis
- Water quality analysis

At each borehole

At end of transfer main

Downstream of 50um filter

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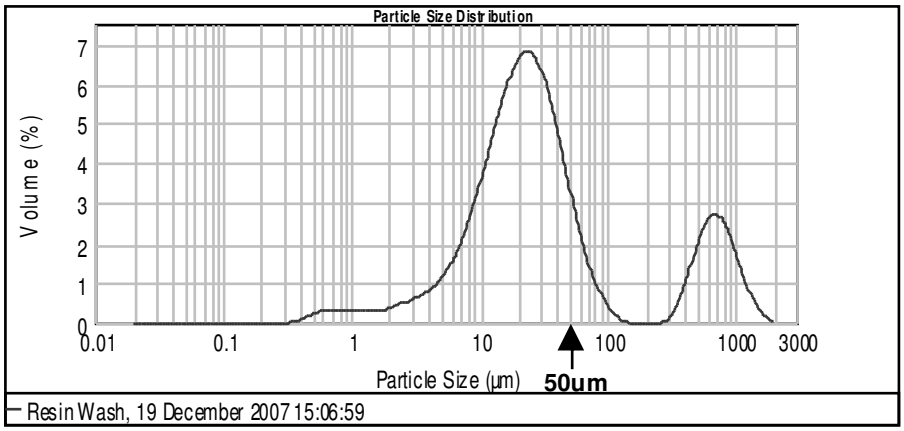
Washings from ion exchange resin



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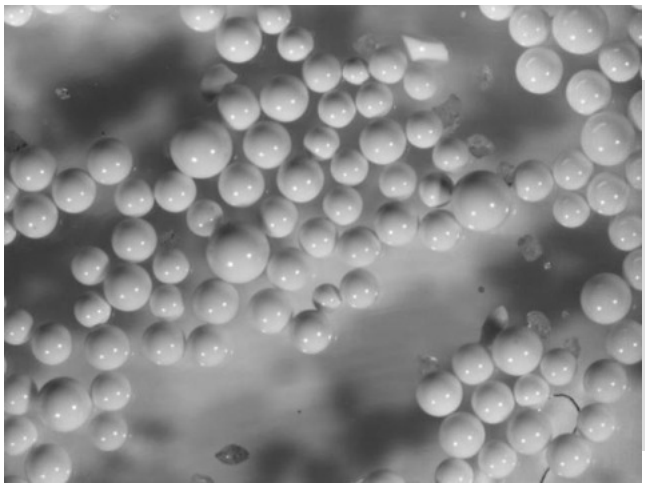
Washings from ion exchange resin

- Resin has high surface area to maximise exchange capacity
- Exchange Cl for NO_3
- Resin refreshed by washing with chloride solution



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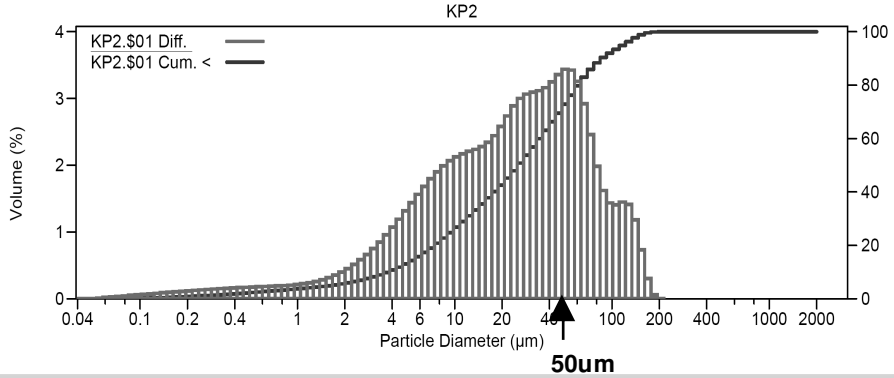
Sediment from base of ion exchange vessel

Sediment fraction >50um. Why?

- 50um filter failure?
- Flocculation of fines in more saline environment?



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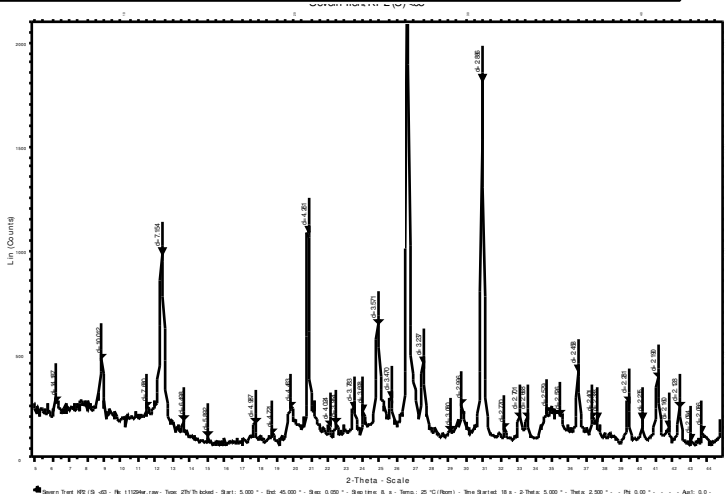
Sediment from base of ion exchange vessel

XRD trace of

Silt & clay fraction

(0 – 63um)

- kaolinite,
- illite
- chlorite



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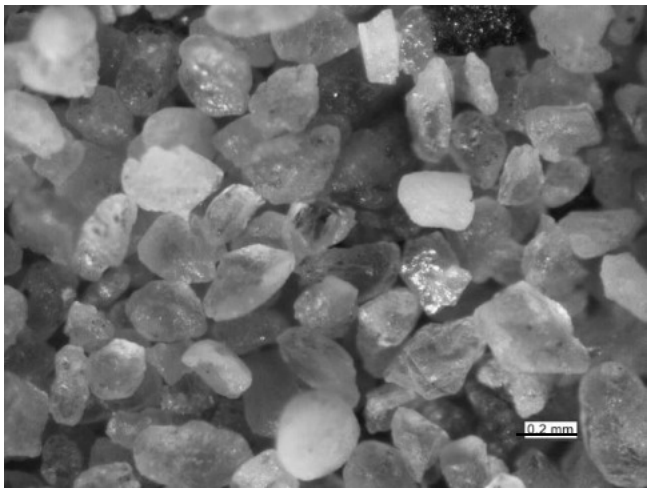
Sediment from base of ion exchange vessel

Fraction

125-250um



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IRON & MANGANESE TREATMENT PLANT

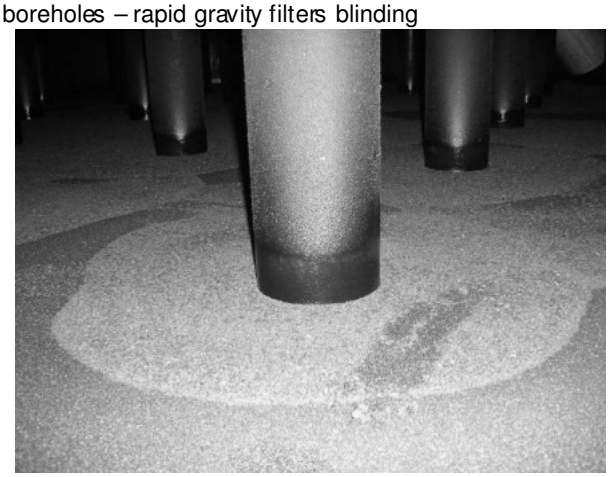
Sherwood Sandstone boreholes – rapid gravity filters blinding

Increasing Fe & Mn

Oxides blinding filter

Backwash failing to adequately remove solids because:

- Downstream sewer too small
- High levels of sludge building up



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IRON & MANGANESE TREATMENT PLANT

Solution

Make plant more efficient by:

- More constant backwashing
- Catalytic media to increase adsorption of manganese
- Reduce output from site so sewer can cope

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MEMBRANE TREATMENT PLANT

Carboniferous Limestone boreholes – high crypto risk

Membranes clogged by sediment

Identified as silt

Membrane cleaning reviewed

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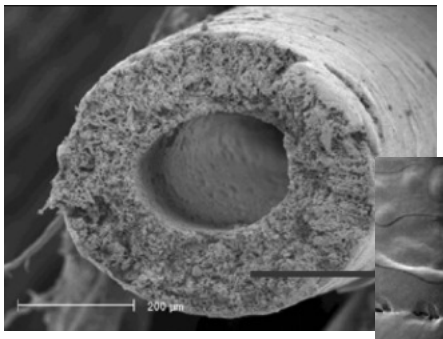
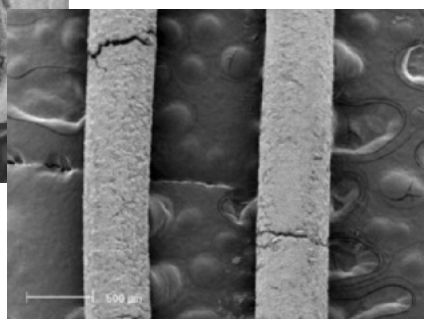
MEMBRANE TREATMENT PLANT



Dissolved metals (lead) made membranes brittle, leading to early failure



Membranes changed from polypropylene to PVDF (polyvinylidene fluoride)

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SUMMARY

Treatment plant performance affected by

- Turbidity, silt, sand and metals (dissolved and oxidised)

Affects deployable output and requires more maintenance

Important to investigate:

- Source of sediment
- Rate of production
- Particle size
- Mineralogy

Answer is not usually rocket science!