

Potable Sludge Treatment and Disposal

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Simon Parsons

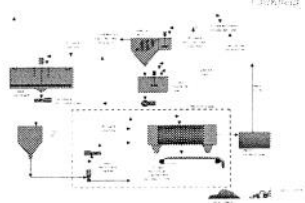
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What will we cover

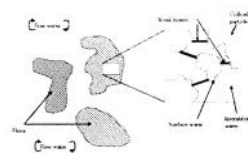
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Sludge Production

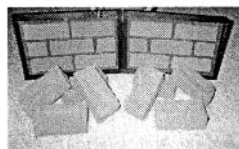
Source Water	Average range of residue (kg dry solids per Ml)
Good quality reservoir	150-200
Fair quality reservoir	200-300
Average river water	350-450
Poor quality reservoir	400-500
Poor river water	500-600



Sludge Structure



Becks



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Sludge Production

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Sludge Sources

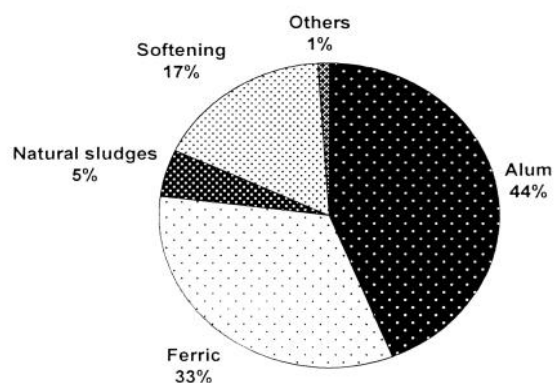
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Sludge Source	Solids Concentration (%)
Upflow clarifier	2-5
Filter backwash water	0.1 (1000 mg L ⁻¹)
Flotation clarifier	2-5
High rate clarification	1-2

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Types of Sludge - UK

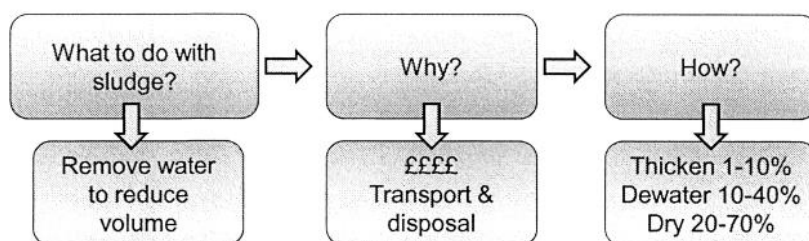
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Sludge Production

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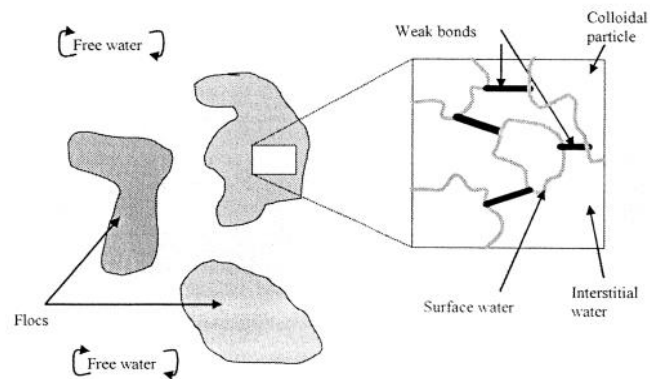
other option

Send to sewer

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Sludge Structure

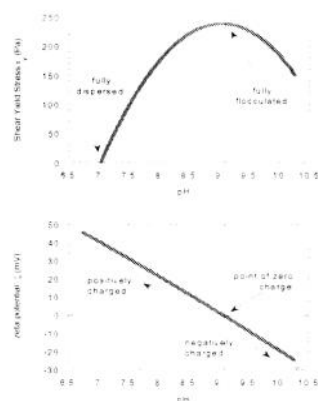
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Sludge Rheology

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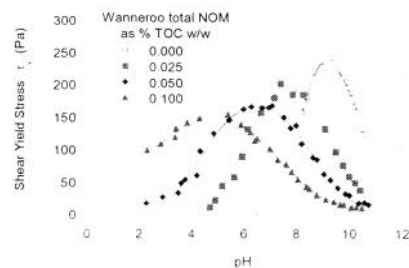
- Rheology of sludge gives a measure of inter-particle forces in sludges.
- At zero charge you get a fully flocculated sludge - ideal for dewatering
- As charge increase particle interaction lead to greater dispersion

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Effect of NOM

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- NOM gets adsorbed onto flocs.
- Adsorbed layer acts as a barrier to interparticle forces
- As the concentration increases attraction between particles is reduced (weaker sludge)



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Sludge Characteristics

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	Ferric sludge	Alum sludge
Total solids (% mass)	1.85-17.6	0.1-27
Volatile solids	N/A	10-35
Suspended solids	N/A	75-99
pH	N/A	5.5-7.5
COD (g/L)	9-70	0.5-27
Aluminium (% TS)	4.5-10	4-11
Iron (% TS)	19-38	6.5
Phosphate(mg/L P)	0.34-6.22	0.3-300
Arsenic (mg/L Al)	0.002	0.04
Total plate count	N/A	30-30,000

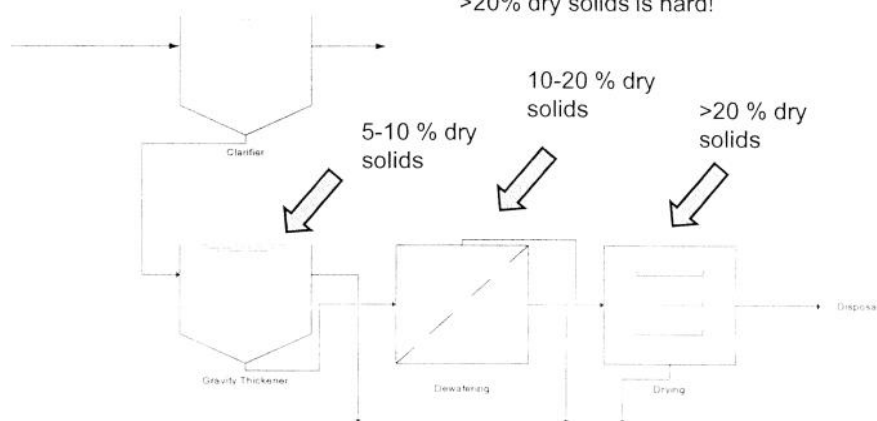
Godbolt et al., 2003

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Treatment

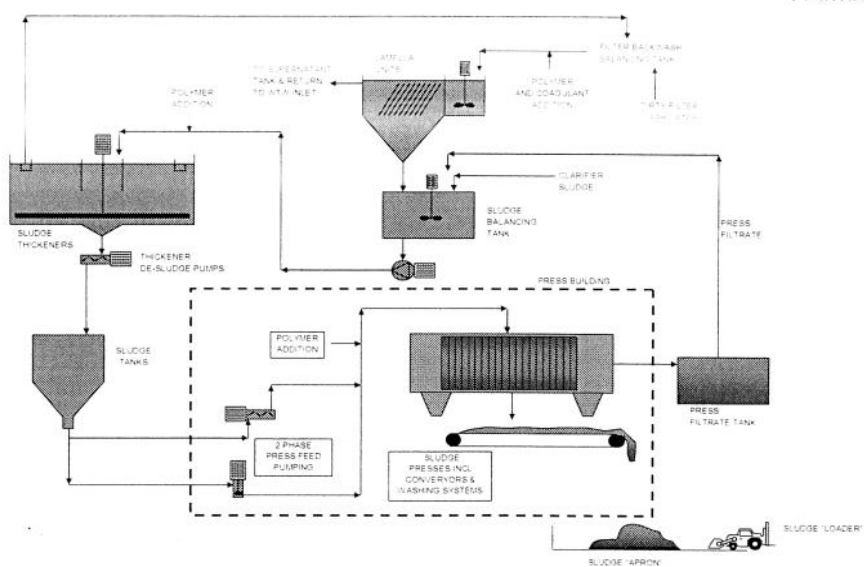
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WTW sludge = difficult to dewater
40% water is chemically bound to floc
particles
>20% dry solids is hard!



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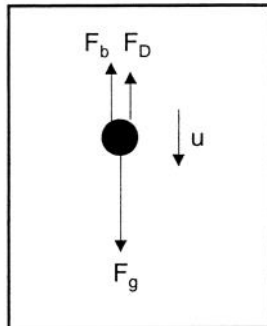
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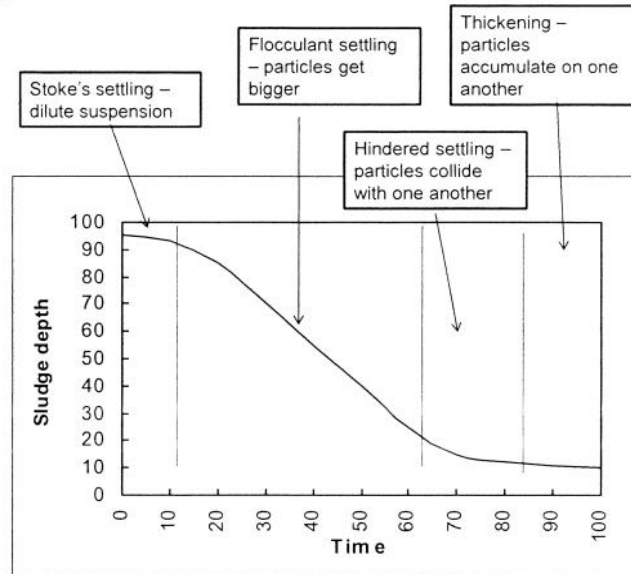
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Sludge thickening - fundamentals

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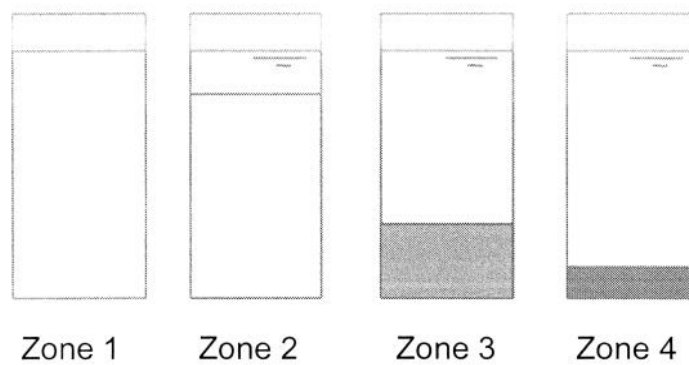
Sedimentation process



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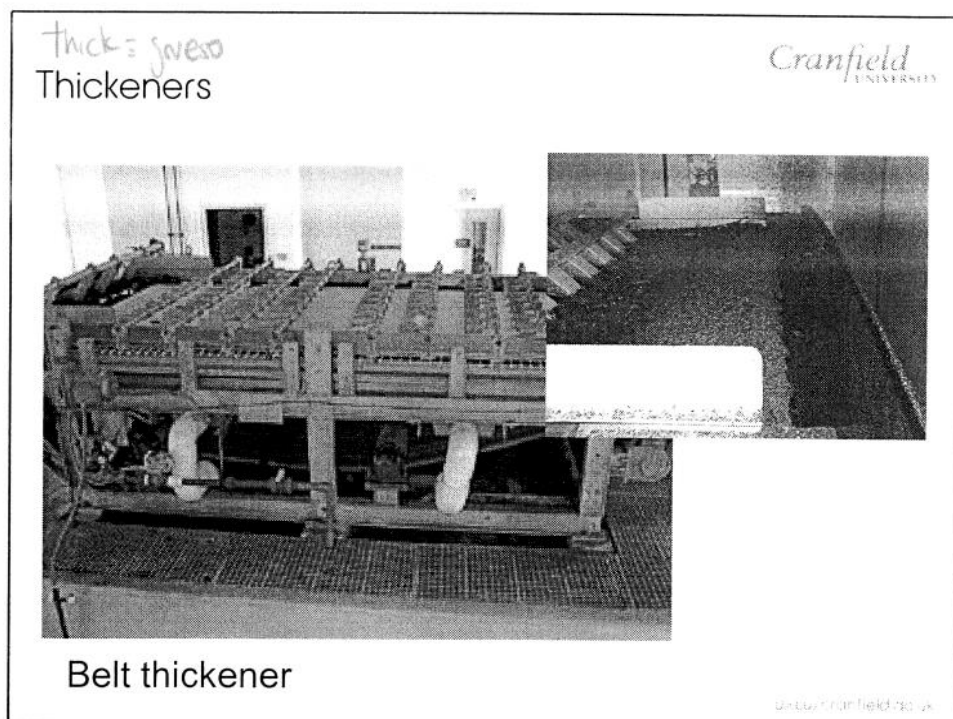
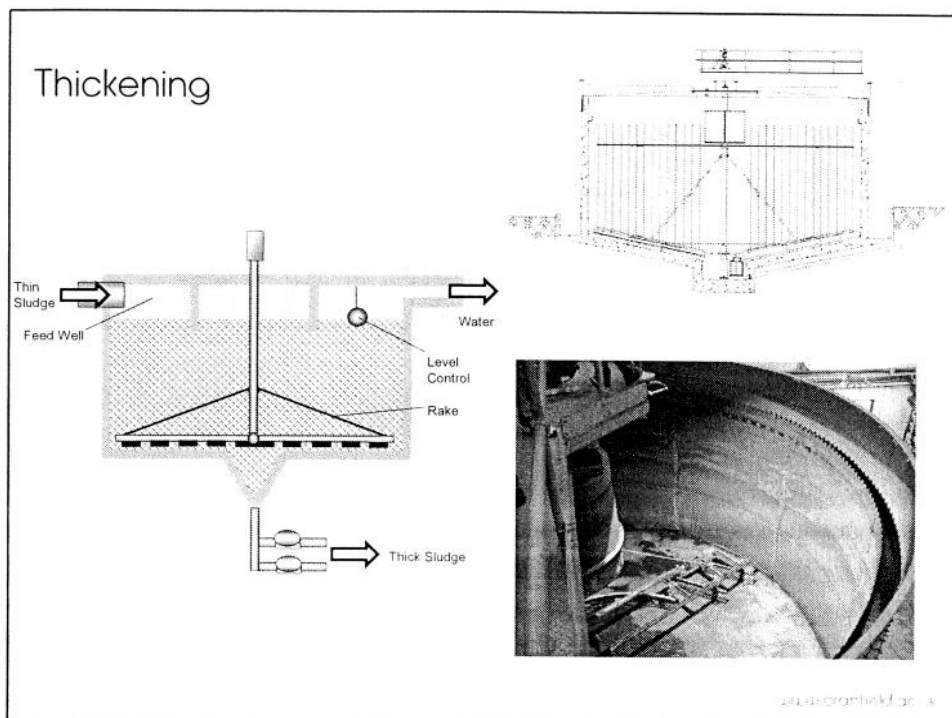
Zone Settling

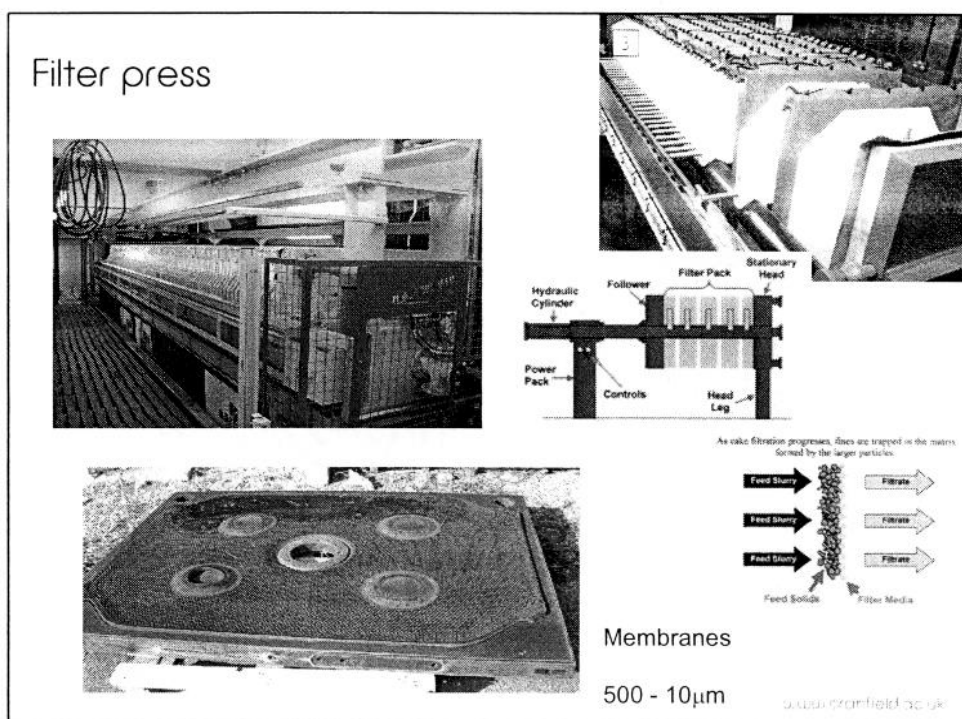
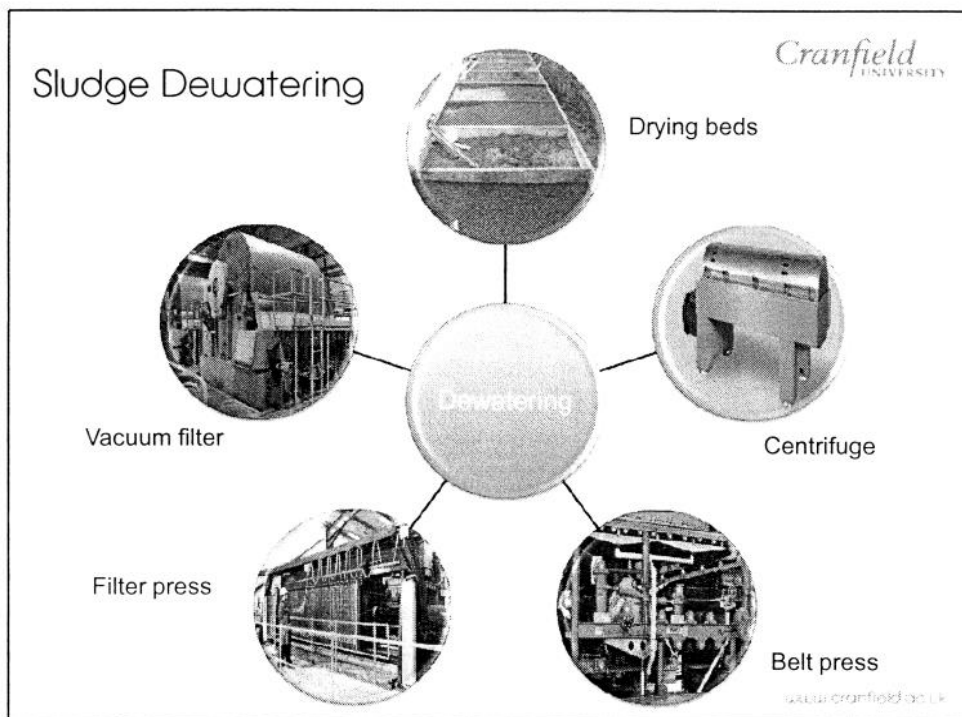
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Zone settling

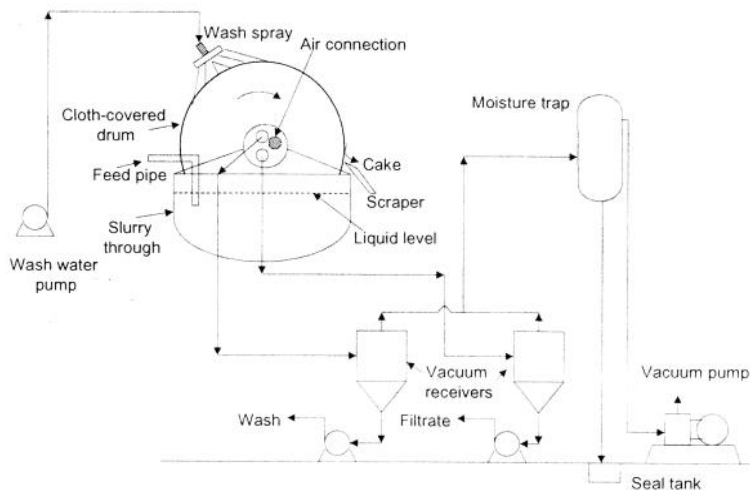
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Rotary vacuum filters

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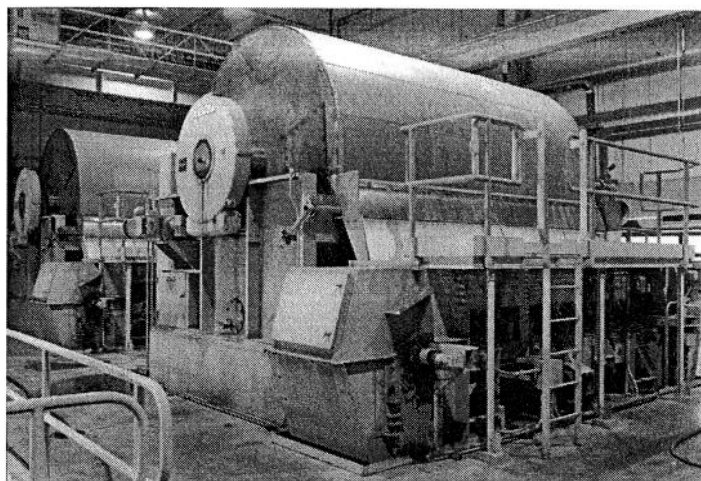


Rotary vacuum drum filter

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Filters

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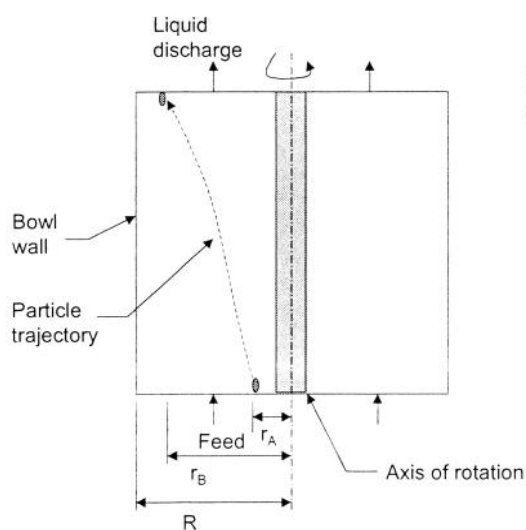
Rotary vacuum drum filter

vacuum tumbler

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Centrifuges

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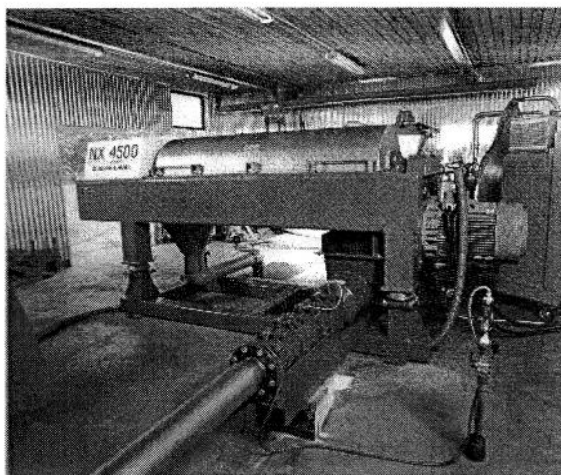


Particle trajectory in a centrifuge

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Centrifuges

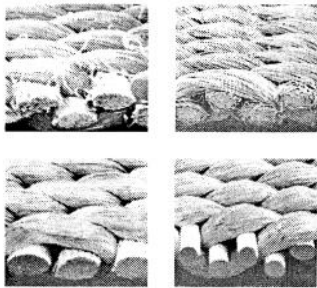
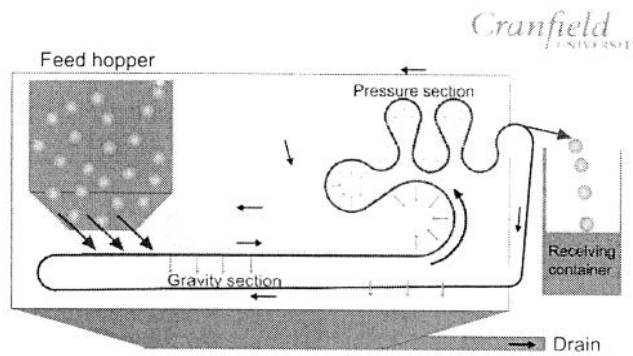
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Alfa Laval
decanter centrifuge on
a sludge dewatering
duty at a waterworks

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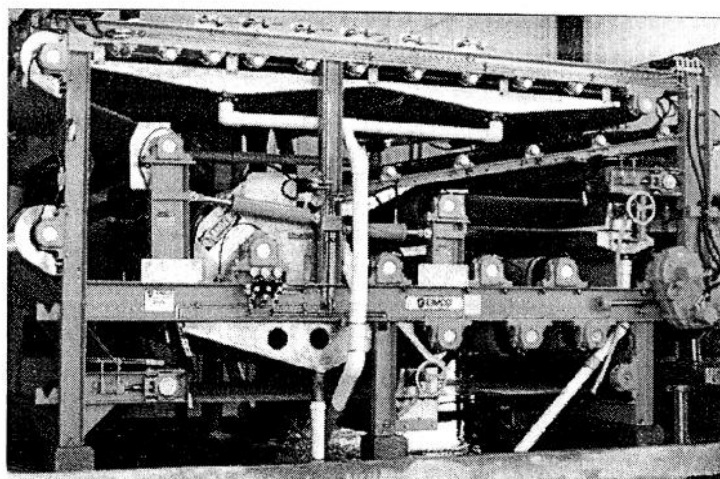
Belt press



500 - 10 μ m

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Belt press



Belt press

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Treatment

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Sludge Treatment	Sludge produced (% ds)
Gravity thickener	5
WRc Thickener	5-20
Superthickener	20
Membrane thickener	10
Centrifuge	10-20
Filter Press	10-20
Belt press	10-15
Storage lagoon	10-15
Freeze thaw	40-80
Drying	50

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Sludge Disposal

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Sludge Drying

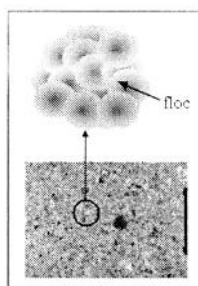
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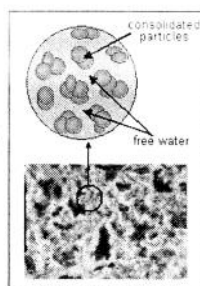
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Freeze Thaw

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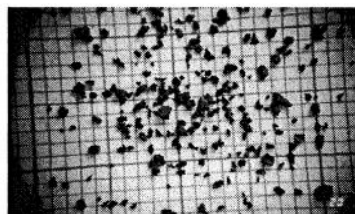
Untreated sludge



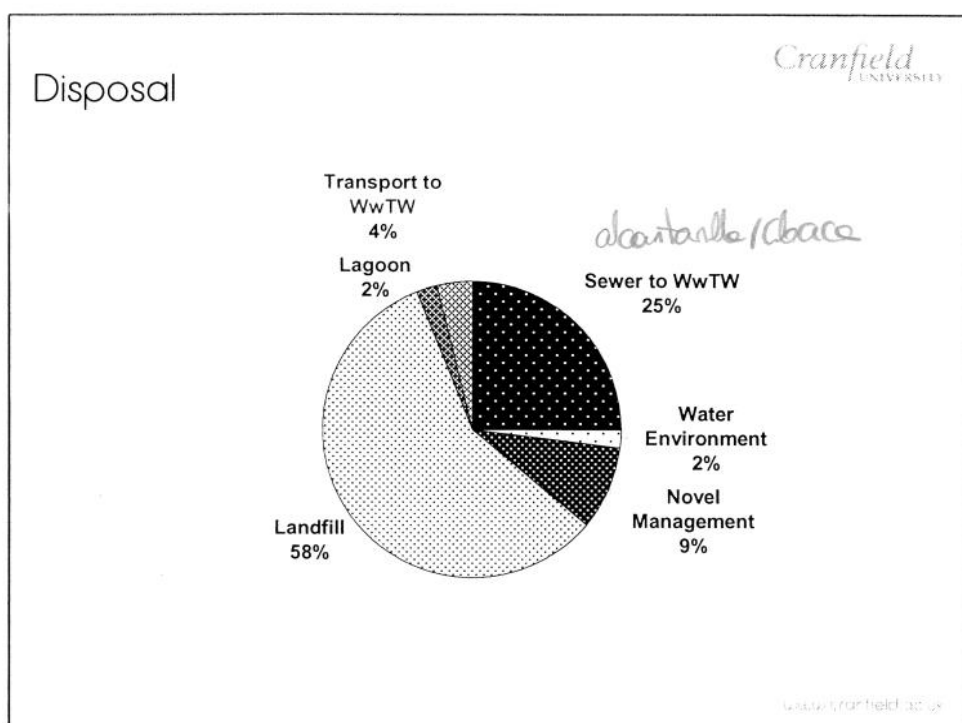
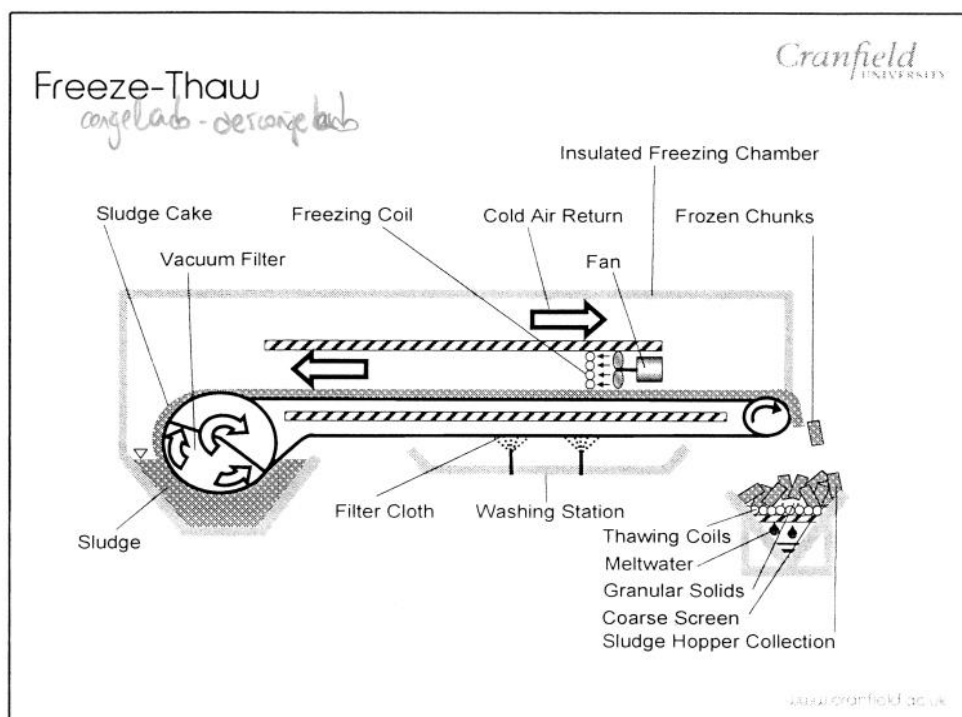
Freeze / thaw sludge

As water freezes, water crystals consolidate, forcing particulates to consolidate. When thawed, water does not re-combine with particles.

>40% dry solids



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Sludge Classification

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Customs & Excise	Old Classification	New Classification
£2 / tonne	Inactive	Inert
£14 / tonne rising to £35+ / tonne	Active	Stable non-reactive Hazardous
		Hazardous



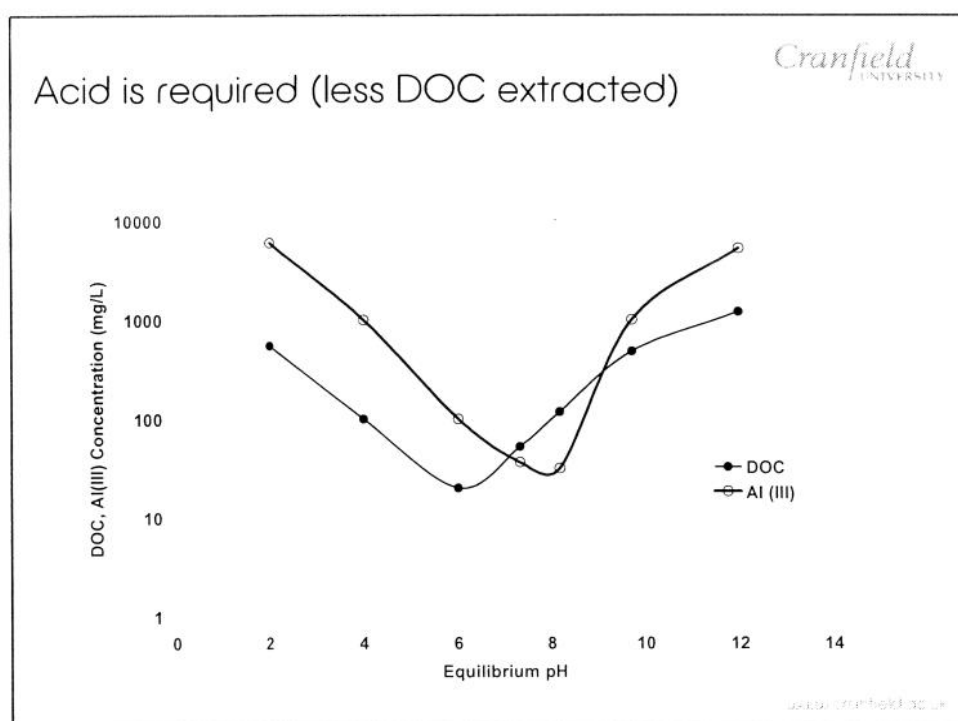
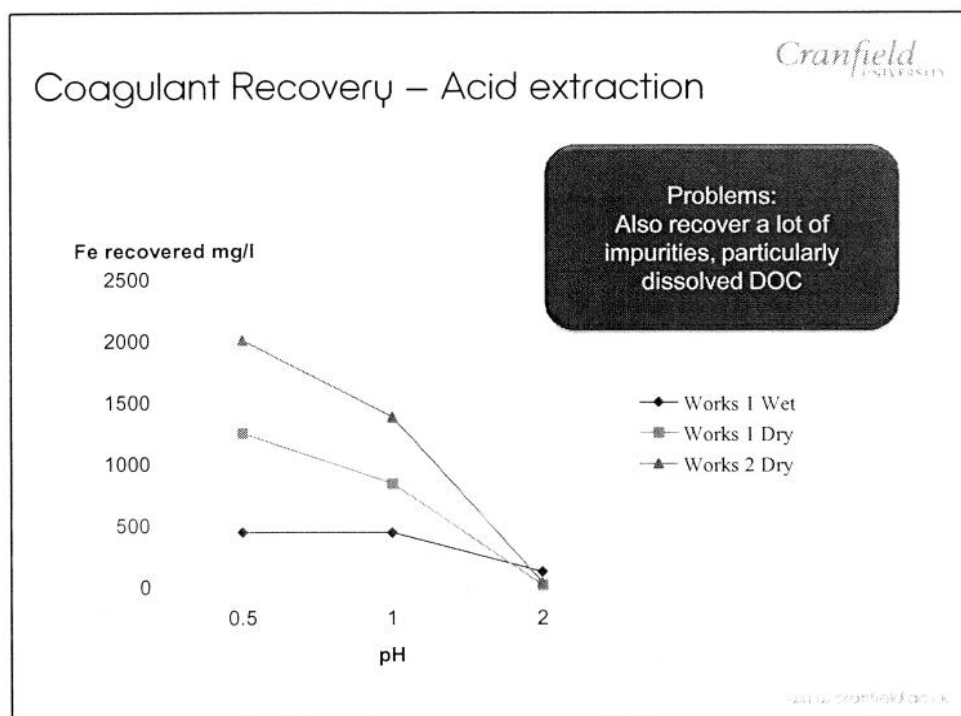
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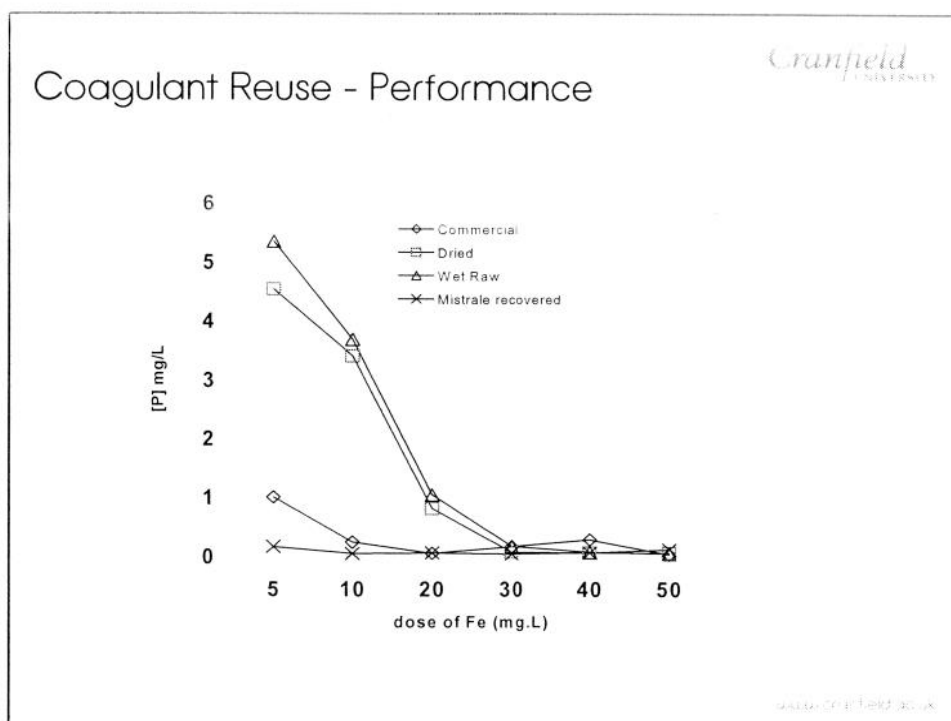
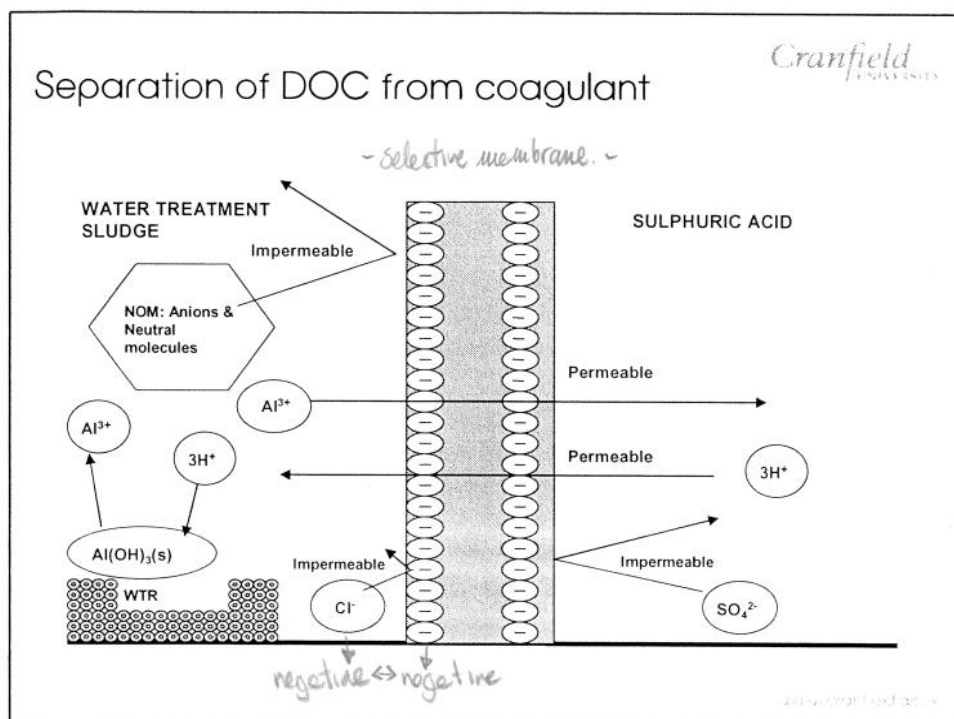
Beneficial Re-use of sludge

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- Sludge recycling
- Agricultural soil conditioning
- Hydrogen sulphide binding
 - Direct addition
 - Disposal to sewer
- Land reclamation
 - Mainly for surface mined areas
- Bricks and Cement

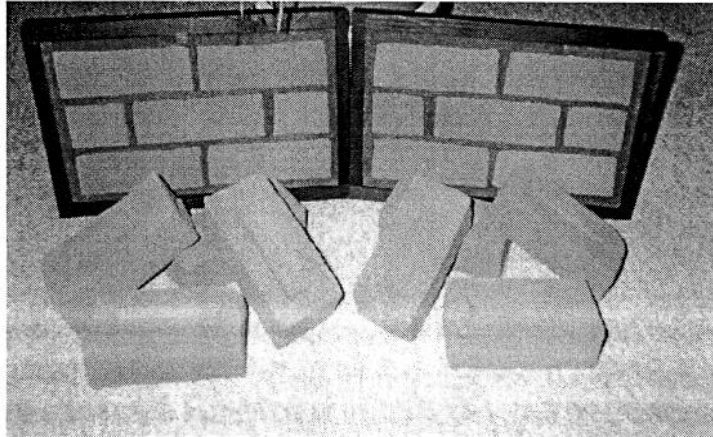
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Bricks

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Summary

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- WTW sludge is different in character to WwTW so practices do not necessarily transfer across.
- Treatment dependent on disposal route
 - Sewer – no treatment
 - Landfill – thicken, dewater, dry
- Disposal to landfill likely to be more expensive
 - Alternative routes requires

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DOC $\mu\text{g/L}$

15

→ Principal Contaminant → Coagulation

Conductivity $\mu\text{S/cm}$

64

DESIGN TREATMENT FLOW SHEET

• What do you have to remove

• Use Cards plus any other processes you have heard...

• Disinfection strategy

SVVA

6

Aluminium $\mu\text{g/l}$

310

Iron $\mu\text{g/L}$

1086

Manganese $\mu\text{g/L}$

60

PH

5.9

Turbidity NTU

5.0

— RAW WATER RESERVOIR —

