

Treating Sewage is Not Always Easy!

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Why Bother?



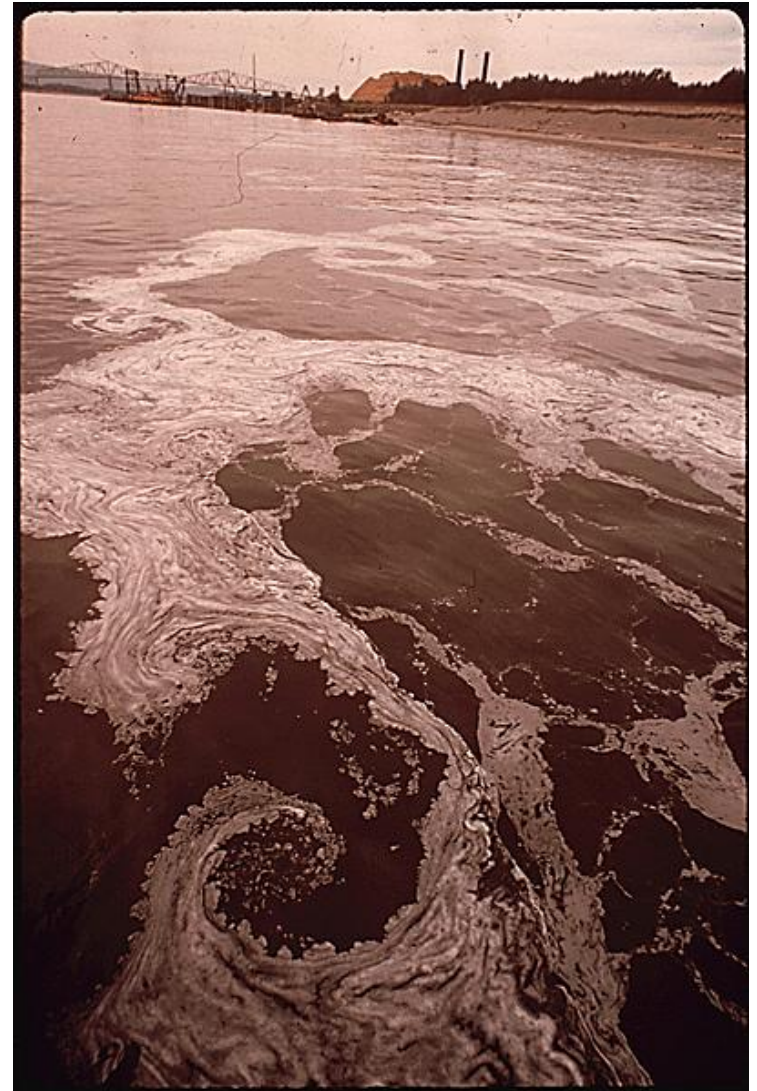
What's wrong with drinking this?



“Polluters along two of China's main rivers have defied over a decade of clean-up efforts, leaving much of the water unfit to touch, let alone drink, and a risk to a sixth of the population, state media says”

ABC News

Anyone for a swim?



1858 – “The Great Stink”



Dirty Father Thames - Punch

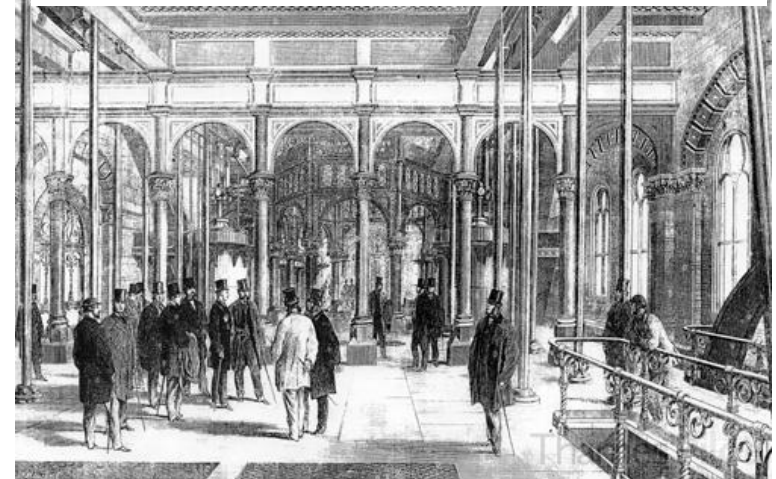
- Industrial Revolution
 - Industrial growth
 - Crowded cities
- Parliament suspended
- Cholera & typhoid rife
 - 1851 life expectancy
 - Okehampton – 57
 - Liverpool - 26
- Sewerage
 - Sir Joseph Bazalgette

What to do with the sewage?

- Princess Alice Disaster (1878) - 650 killed
 - mostly by “*toxic combination of raw sewage and industrial pollutants*”
- 1882-1915 Royal Commissions
 - 20:30 with 8:1 dilution
 - Sludge dumped at Sea
 - “*Bovril Boats*”
 - *Lord Mayors Barge*
 - Ceased 1998
 - Chester WWTW - 1870



Prince of Wales Opens Crossness STW



Purpose of Sewerage and Sewage Treatment?

- Sewerage – protect public health
- Safe disposal of waste



- Protect the environment
 - Sewage = food for bacteria
 - Aerobic bacteria+O₂+sewage = more bacteria+CO₂+H₂O
 - Purpose – provide O₂ before it reaches environment

Environmental impact - WFD

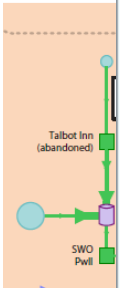
- Fresh waters
 - DO levels
 - Anaerobic bacteria
 - Methane, H₂S
- Bathing Waters
- Shellfish
- Etc.






Taking sewage away - Sewerage



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Measuring Sewage

- How strong is it?  ■ Impact?
 - BOD / COD
 - O₂ required by bacteria
 - O₂ required chemically
- What else is in it?  ■ Effect?
 - Suspended solids, ammonia, metals, nutrients
 - Fish spawning
 - Toxicity
 - Eutrophication
- Where does it come from?  ■ How to estimate?
 - People, Industry
 - 60g BOD, 8g NH₃ , 2.5g P
 - Trade

Treatment - Preliminary

- Screening + screening handling
- Grit removal



Primary Treatment

- Size depends on flow
 - Suspended solids removed $< 1.2\text{m/hr}$
- What's the benefit?
 - 40% BOD removed



Secondary / Biological Treatment

Fixed film - biofilters



Suspended biomass



Fixed Film

- Biofilters
 - Media supports biomass
 - Stone, blast furnace slag or plastic
- Rotating Biological Contactors
 - Mesh supports biomass
 - Rotates on shaft
- Big surface area / exposure to air
- Humus sloughs off
 - Settled in tanks $< 0.9\text{m/hr}$



Suspended Biomass - continuous

- Two main types
 - Extended aeration / oxidation ditch
 - Activated sludge
- Continuous recycle of biomass
- O_2 entrained in flow
- Biomass changes to utilise influent
 - Types of effluent

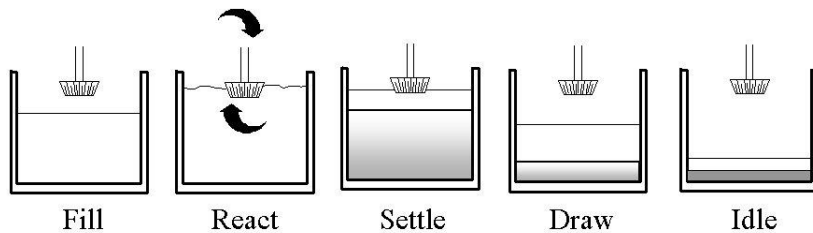


Suspended biomass – batch processes

Sequence batch reactor - SBR

Holyhead, Ganol, Llanasa, Cardiff

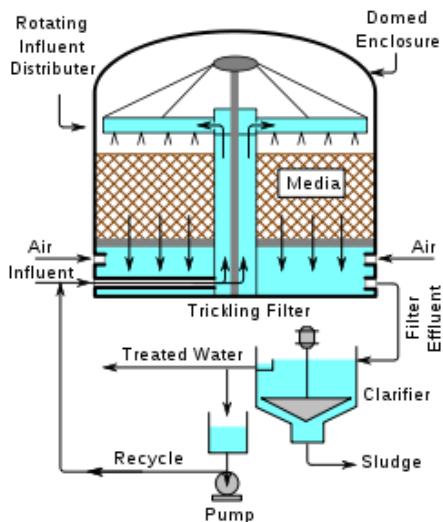
Sequencing batch reactor



Holyhead WWTW

Tertiary Treatment

- Additional standards
 - Disinfection
 - Chemical dosing
 - Sand filters – solids or iron
 - Nitrifying filters



Thanks for your time
Questions?



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