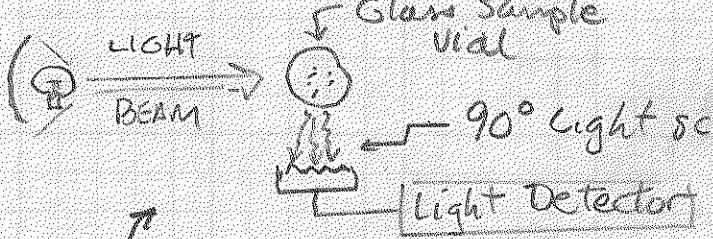
Supplemental Notes

(1) GOAL: • Removal of TSS
• Disinfection via particle removal
• Improve H_2O aesthetics

HISTORY: • Long known to disinfect water
• After chlorination invented, became important initial step. But...
• Chlorine seen as the critical step
FILT = 99% removal; Cl_2 = 99.9 - 99.99%

Now seen as equally important
Cl_2: Viruses (maybe not filtered), bacteria
Filtn: Crypto & Giardia oocysts

(2) TURBIDITY: "Cloudiness"; Index for TSS & particles
Measure by NEPHELOMETRY (Greek: Nephelos = cloud)



Very sensitive. UNIT: NTU ≡ Nephelometric Turbidity Unit

1 NTU = 1 JTU (Jackson Turbidity Unit; older system)
↑ Used attenuation of candle flame.

Standard soln: 5 g hydrazine sulfate + 50 g hexamethyl
Suspension Polymer = 4000 FNU = 4000 NTU
Formazine Neph. Units

③ LT-2 RULE (USEPA)

For conventional (w/ coagulation) or direct (no coag'n) filtration systems:

→ Max. leaving plant: 1.0 NTU

→ 95% of monthly samples: ≤ 0.3 NTU

Many plants strive for 0.1 NTU

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④ Focus on conventional rapid sand filter w/ dual media (sand + anthracite)

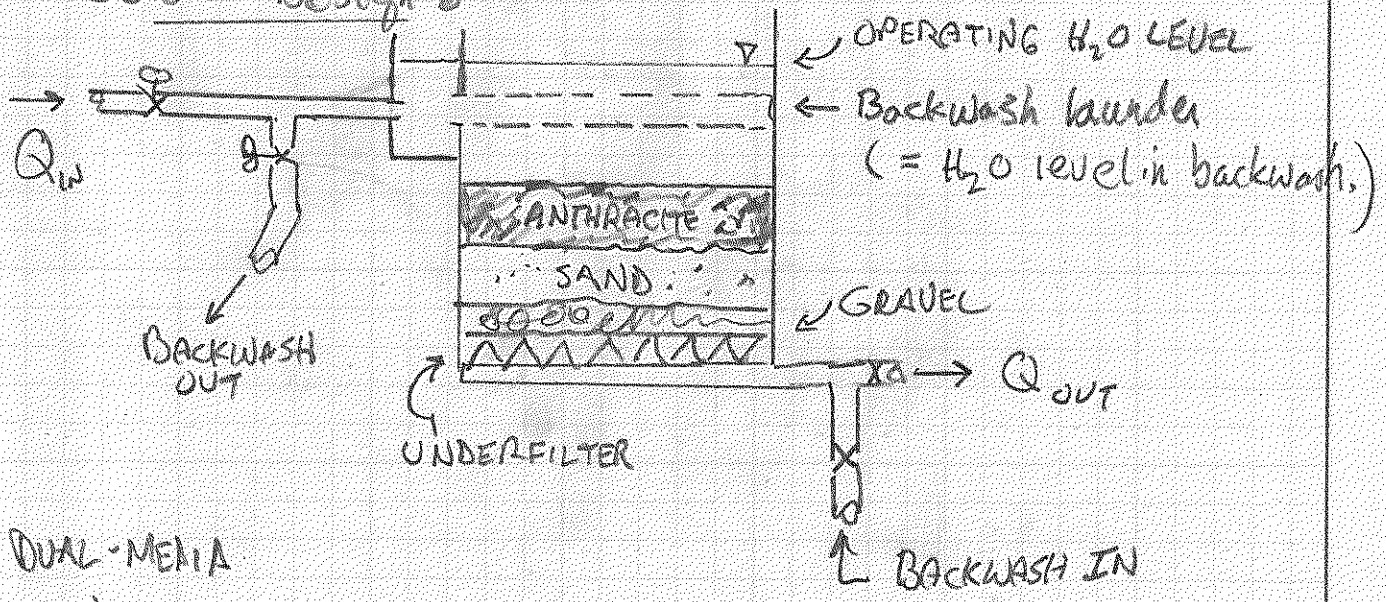
GRAVITY driven; so HEAD & HEADLOSS are important.

Mechanisms:
- Straining
- Interception
- Flocculation
- sedimentation

[See graphic in main notes]

Heuristics:
- Proper flocculation; correct floc size LEAVING the clarifier
- Surface loading rate: Recommended gpd/ft² (just as with clarifiers).
- Media properties: Grain size & specific gravity.
- Media depth & headloss.
- Backwash frequency & flow rate for proper resuspension.

General Design:



DUAL-MEDIA

Anthracite is a PRE-FILTER & Coarse & Less Dense

PROCESS

1. Divide medium into size percentiles

5-20 %
20-40 %
40-60 %
⋮
80-95

2, Plot d_{10} & d_{60} on log-P vs log-d paper

Read off d_1 = lower end } of each
d_2 = upper end } % -ile bracket

	d_1	d_2	GEOM. MEAN
5-20	~	~	
20-40	~	~	$\sqrt{d_1 d_2}$
⋮	~	~	
80-95	~	~	

3 In table ↖ Find geometric mean for each % -ile bracket

Find:

a) $R_e = \dfrac{\rho_w v_s \psi d}{\mu}$ ← For each mean d

b) $f_i = 150 \dfrac{1-e}{R_e} + 1.75$ e = known porosity

c) $\dfrac{x_i}{d_i}$ ← 0.20 Percentile size (20%)
← Mean size

d) Partial head loss (per percentile) $= \dfrac{f}{f_i} \dfrac{x_i}{d_i}$

e) Σ to total head loss.