

ACTIVATED SLUDGE ENHANCEMENTS

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OBJECTIVE: PROVIDE AWARENESS ABOUT PROCESS ENHANCEMENTS

- Integrated fixed film activated sludge
- Mobile organic biofilm
- Membrane aerated biofilm reactor
- Activated sludge Densification
- Low do operation
- Membrane Bioreactor
- Magnetic sludge flocs



INTEGRATED FIXED FILM ACTIVATED SLUDGE (IFAS)

- Plastic media added to aeration tank
- Requires screens to retain media
- Increases Organisms that prefer to grow on media
 - Many are nitrifying organisms
 - Can increase capacity without pouring concrete



AccuWeb
media
without
biomass



Collapsed
biomass
removed
from water



Growing
biomass on
submerged
AccuWeb



IFAS PROS & CONS

PROS

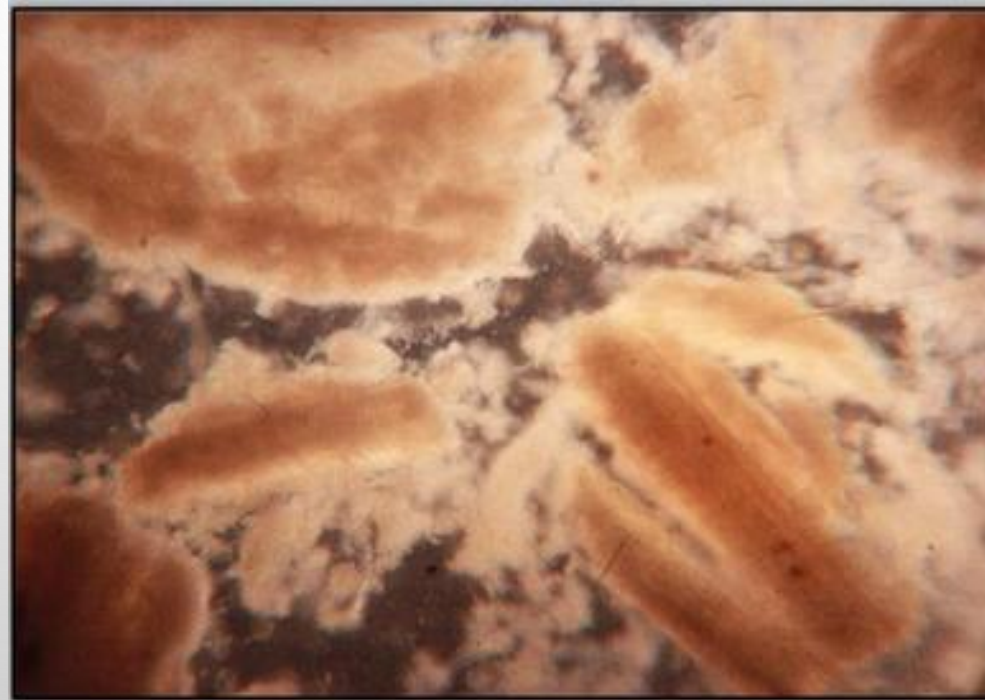
- Lower cost upgrade
- Extra treatment organisms provides safety factor
- Proven track record

CONS

- Screen failure can be catastrophic
- Hydraulic backup (aeration tank overflow) can be catastrophic
- Requires extra aeration for mixing
 - Can impact low do operation
 - How do you calculate MCRT?
 - Can damage instrumentation
- Foam can be trapped in aeration tank

MOBILE ORGANIC BIOFILM (MOB)

- “Kenaf” IFAS
 - Kenaf is a fast growing plant
 - Kenaf Processed into a particle for biofilm growth
 - Core of a dense floc
- Can be ‘harvested’ from was and reused
- Sold by Nuvoda



MOB PROS & CONS

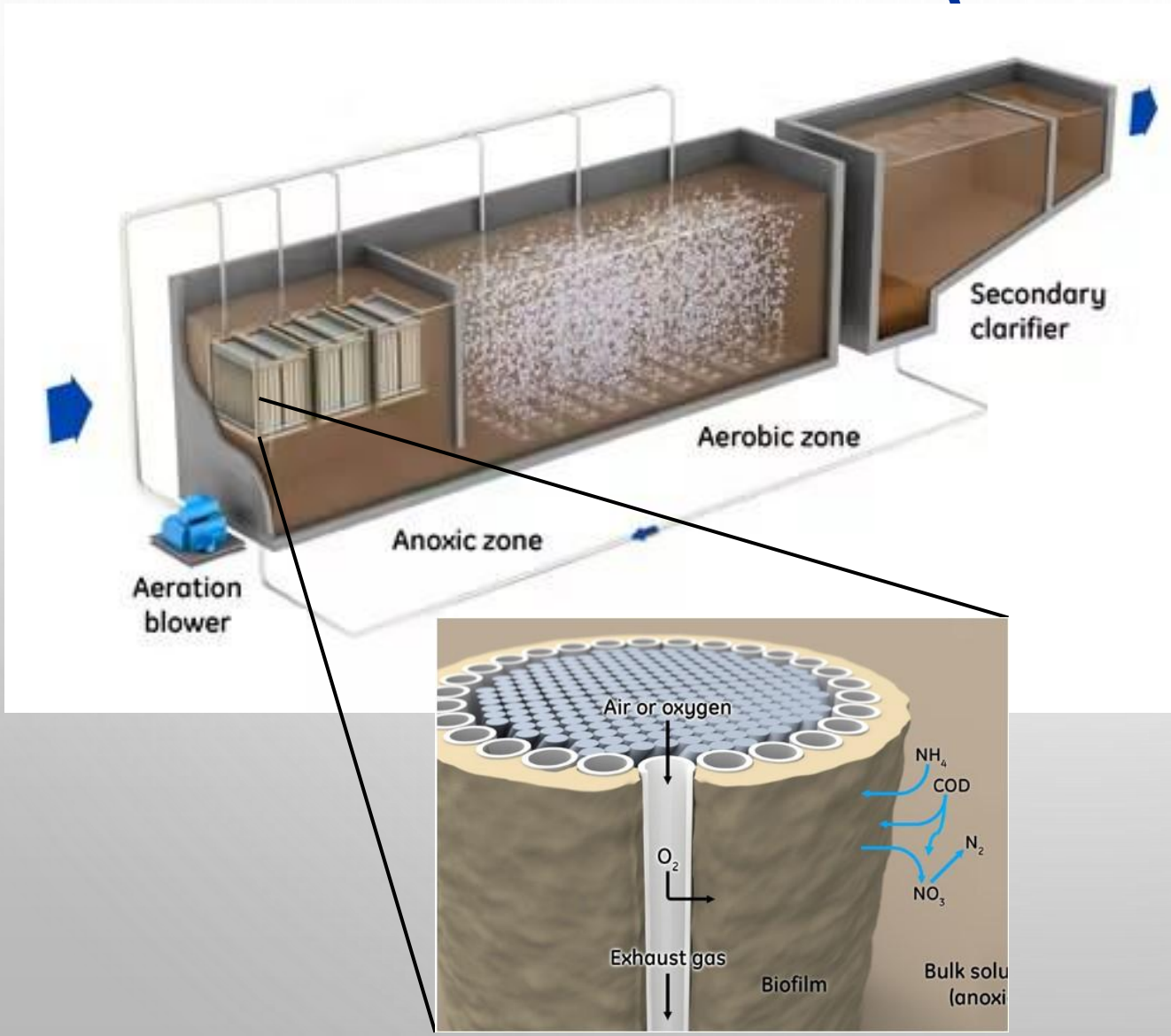
PROS

- Low cost upgrade
- Extra treatment organisms provides safety factor
- Decreases svi – improves settleability
- No screens required
- Typically No additional mixing energy required

CONS

- Extra process for harvesting kenaf from was and reusing
- How do you calibrate TSS probes?
 - Suspended MLSS test requires a sieve
 - WAS screening – rags, hair, etc?
- Very new - Do we even know all the costs?

MEMBRANE AERATED BIOFILM REACTORS (MABR)



- Gas permeable membranes deliver oxygen to a biofilm on the membrane
 - Delivers oxygen to microbes without bubbles
 - At atmospheric pressure
 - Significant energy savings
- Simultaneous nitrification/denitrification
 - No nitrate recycle pumping required
- Many suppliers

MABR PROS & CONS

PROS

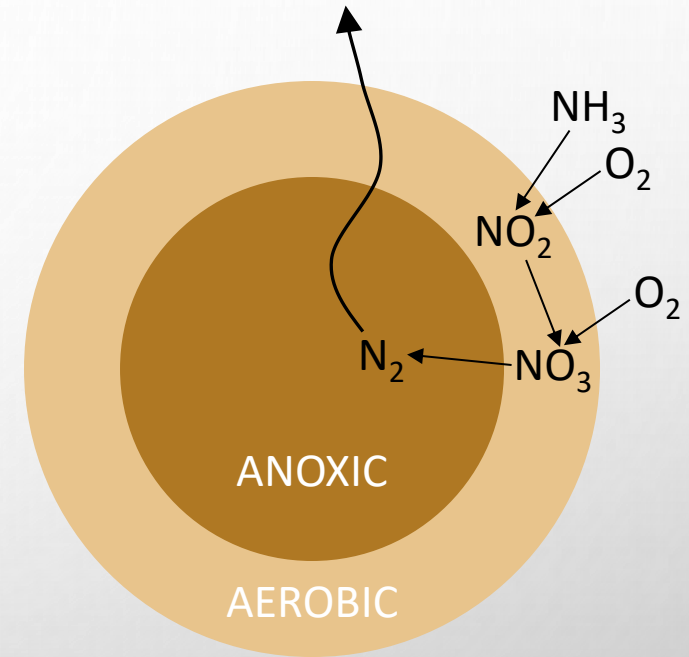
- Aeration Energy savings
- No nitrate recycle pumping
- Reduces denitrification in clarifiers

CONS

- Expensive membrane equipment
- May Require additional blowers, piping
- Very new - Do we even know all the costs?

LOW DISSOLVED OXYGEN OPERATION

- Aerate to 0.00mg/L DO – or up to 0.50mg/L
- Promotes simultaneous nitrification/denitrification
- Can reduce filaments
- May not be appropriate for ebpr processes that need more do for p uptake
- Papers are published dating back to 2000 by some guy named Schuyler



LOW DO PROS & CONS

PROS

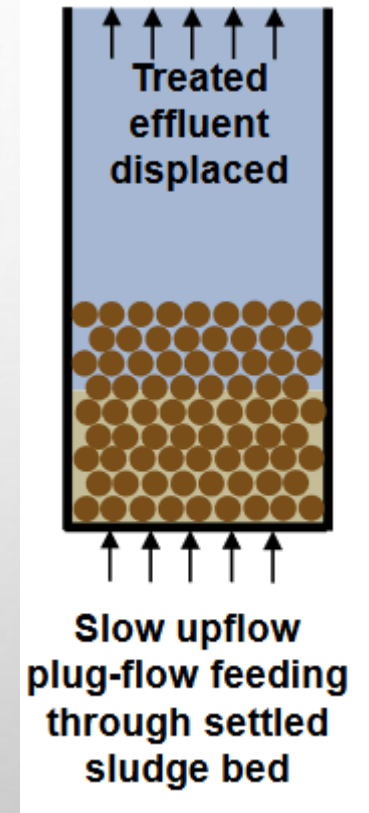
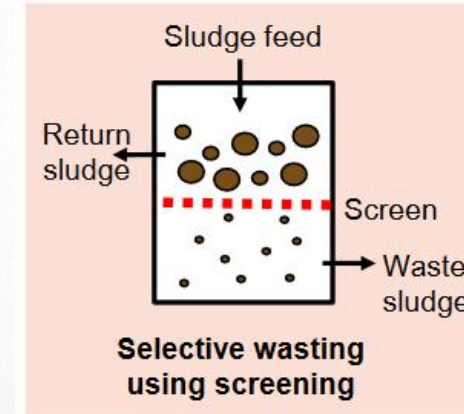
- Low cost upgrade
- Decreases svi – improves settleability
- Decreases aeration energy costs
 - Well proven operation

CONS

- Good sensors and controls required
 - Scary for people that don't understand it

ACTIVATED SLUDGE DENSIFICATION

- Creating an environment for flocs to become stronger and denser
 - screens
 - Hydrocyclones
 - Upflow hydraulics
 - Anaerobic reactor (PAO growth)
- Could go all the way to a granule
 - Typical Activated Sludge SVI: 80-120 mL/g
 - Densified activated sludge svi: <80 ml/g
 - Granular activated sludge svi: <50ml/g



DENSIFICATION PROS & CONS

PROS

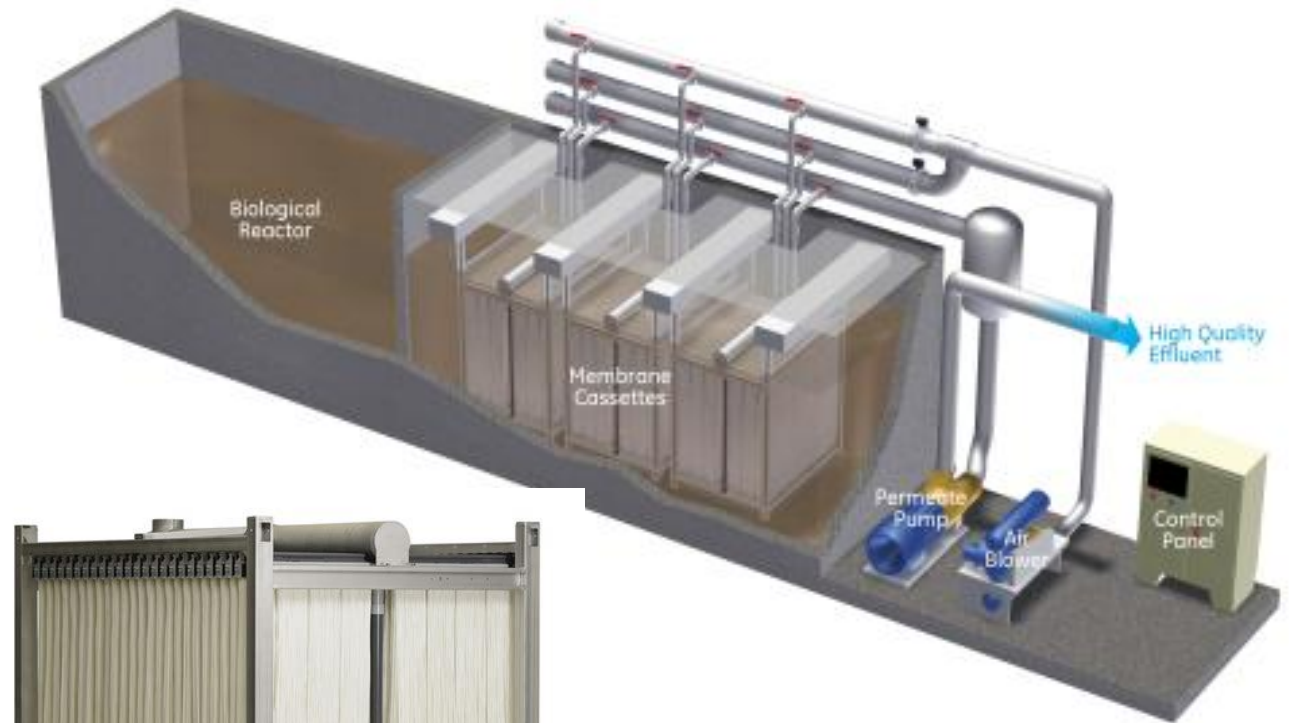
- Low cost upgrade
- Decreases svi – improves settleability

PROS

- Pinfloc/Straggler floc can still be an issue
 - Extra equipment required
- Seed granules need to be purchased (for Nereda systems)
- Very new - Do we even know all the costs?

MEMBRANE BIOREACTOR (MBR)

- Who needs clarifiers? Use membranes for liquid/solid separation
- MLSS concentrations 8,000 – 12,000 mg/L
- Effluent/permeate tss < 1mg/L
- Multiple configurations available
- Many suppliers



MBR PROS & CONS

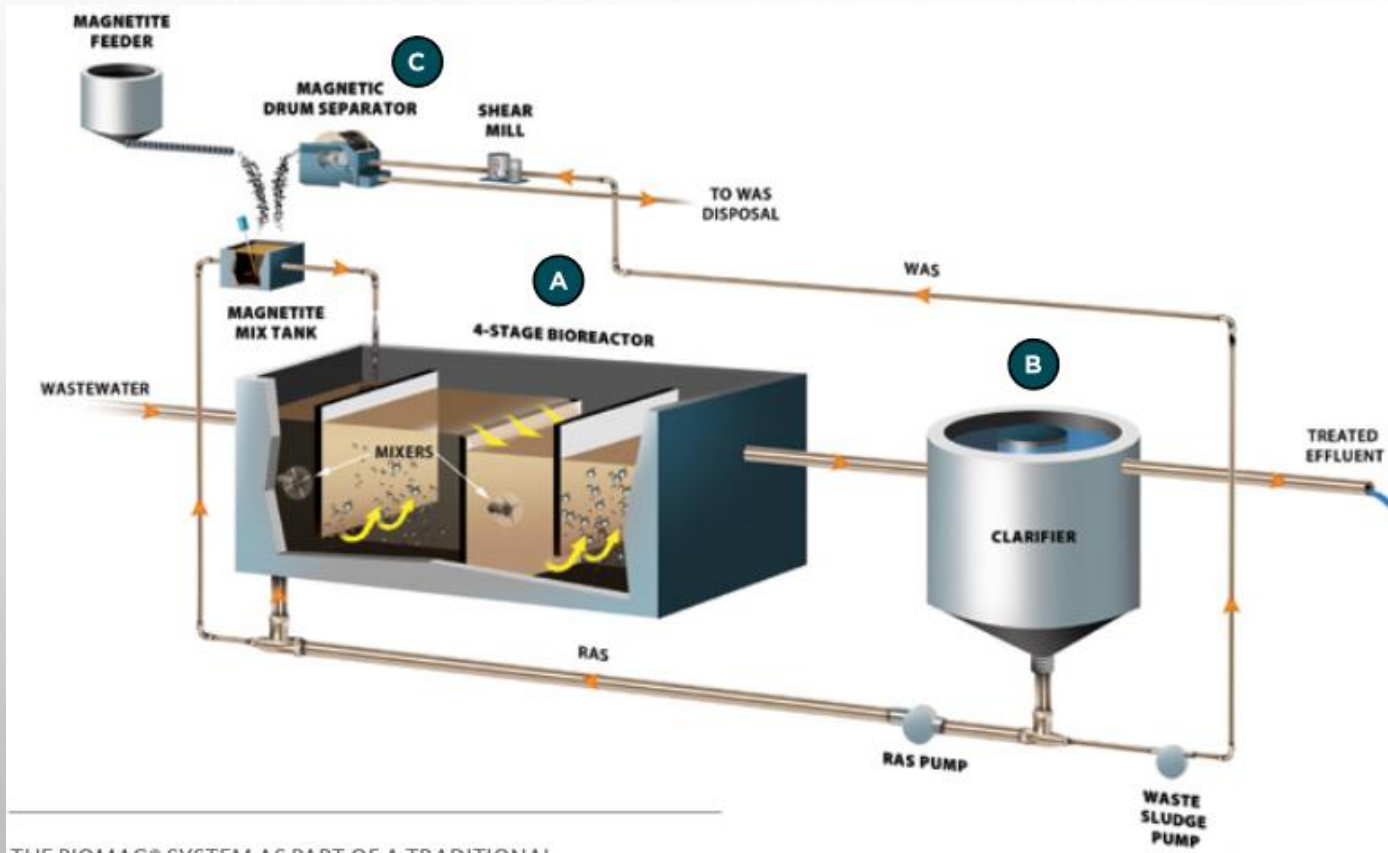
PROS

- High quality effluent
- No need to care about settleability
- Can be configured for Biological nutrient removal
- Well proven technology

CONS

- Expensive equipment
- Energy hog – aeration, pumping
- Periodic Chemical cleaning required
 - Periodic cartridge replacements
- Difficult to denitrify in preanoxic due to high D.O. in recycle

MAGNETIC SLUDGE FLOCS (BIOMAG)



- Similar to MOB, but uses magnetite particles
- Requires magnetic drum separator to recover magnetite from was
- Rapid settling enables a 2-3x increase of MLSS
- Sold by Evoqua

BIOMAG PROS & CONS

PROS

- Increase capacity without pouring concrete
- Decreases svi – improves settleability

CONS

- Need specialized equipment – magnetic drum separator, shear mill, magnetite mix tank
- How does it impact clarifier rake mechanics?
 - How does it impact sludge pumping?

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