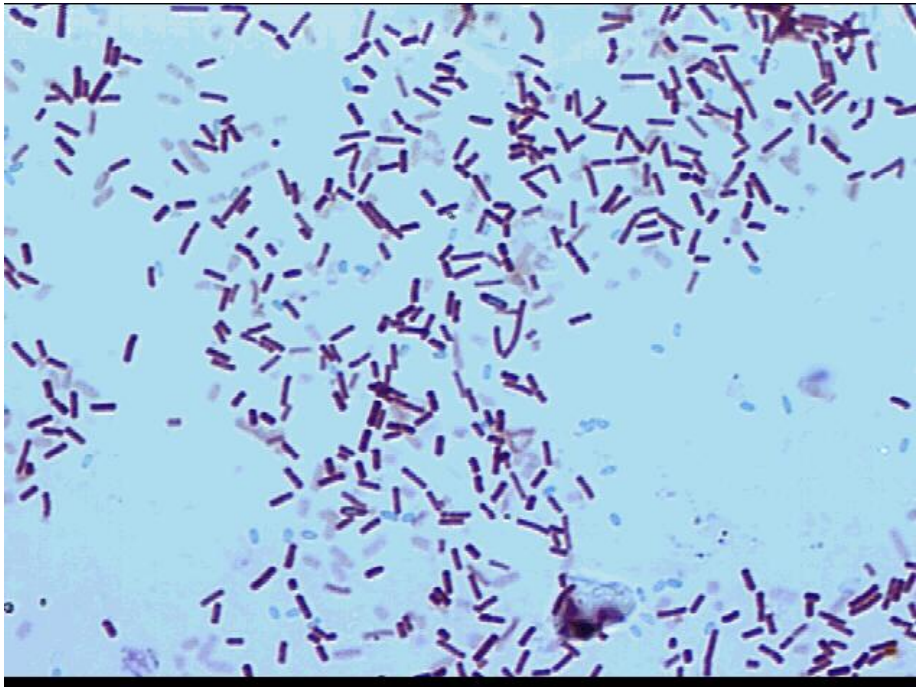
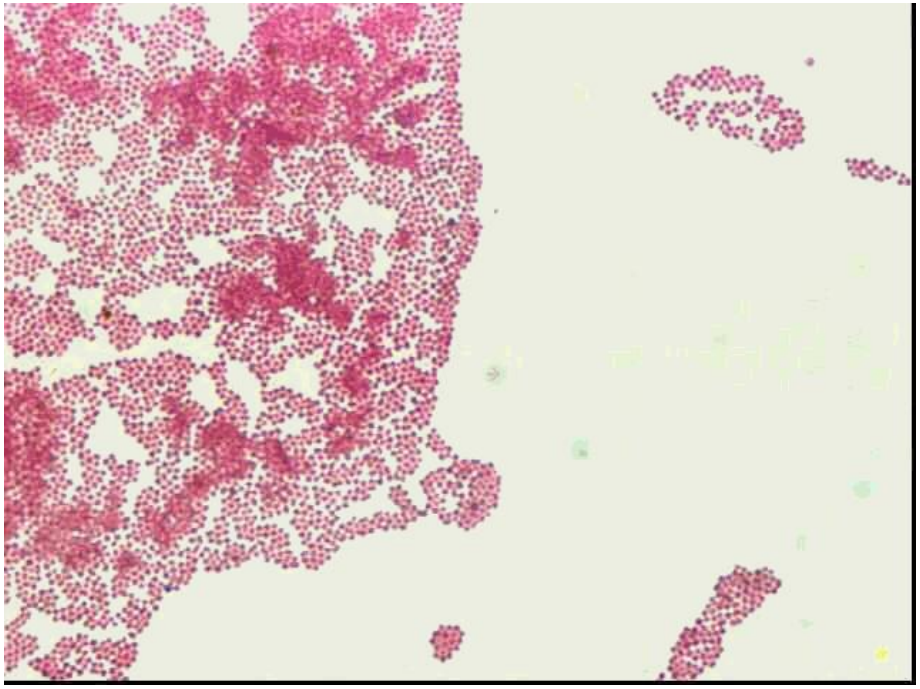
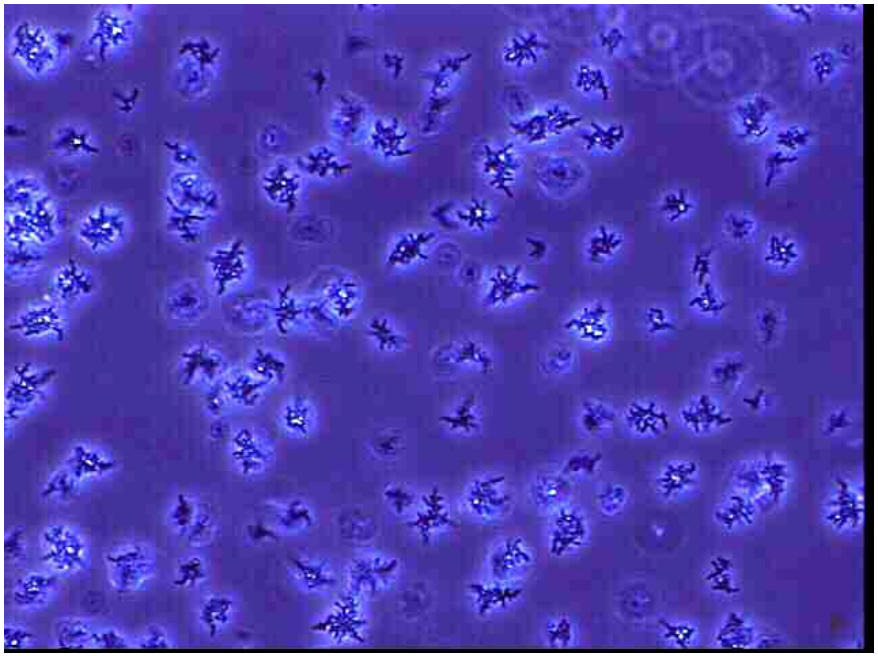
Wastewater Treatment Plant Microorganisms

Floc forming bacteria (saprophytes): primarily facultative heterotrophs, soil and aquatic genera	*Pseudomonas, Achromobacter, Flavobacterium, Alcaligenes, Arthrobacter, Zooglea, Acinetobacter, Citromonas, Bacillus*
Nitrifying bacteria: ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB)	*Nitrosomonas, Nitrobacter, Nitrospirillum*
Predators: protozoa, rotifers, nematodes	*Vorticella, Aspicidica, Paramedium*
Nuisance bacteria and eucaryotes: bulking, foaming, overgrazing	*Nocardia, Microthrix, Sphaerotilus*, fungi, snails
Specialty populations	Phosphate accumulating organisms (PAO), algae (lagoons)
Other	Viruses (bacteriophage), yeast, pathogens (*Campylobacter, E. coli, Salmonella, Giardia, Cryptosporidium*)

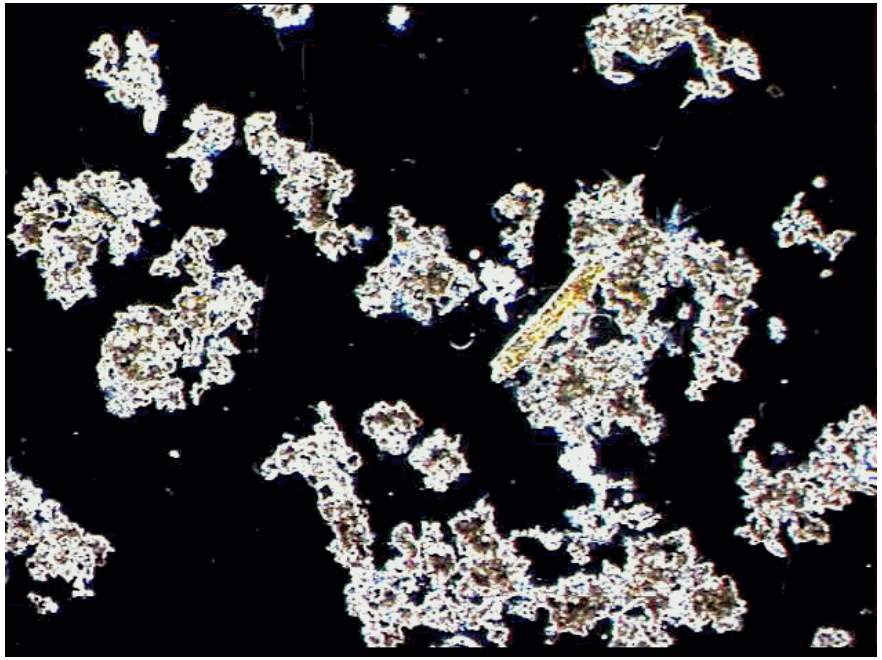


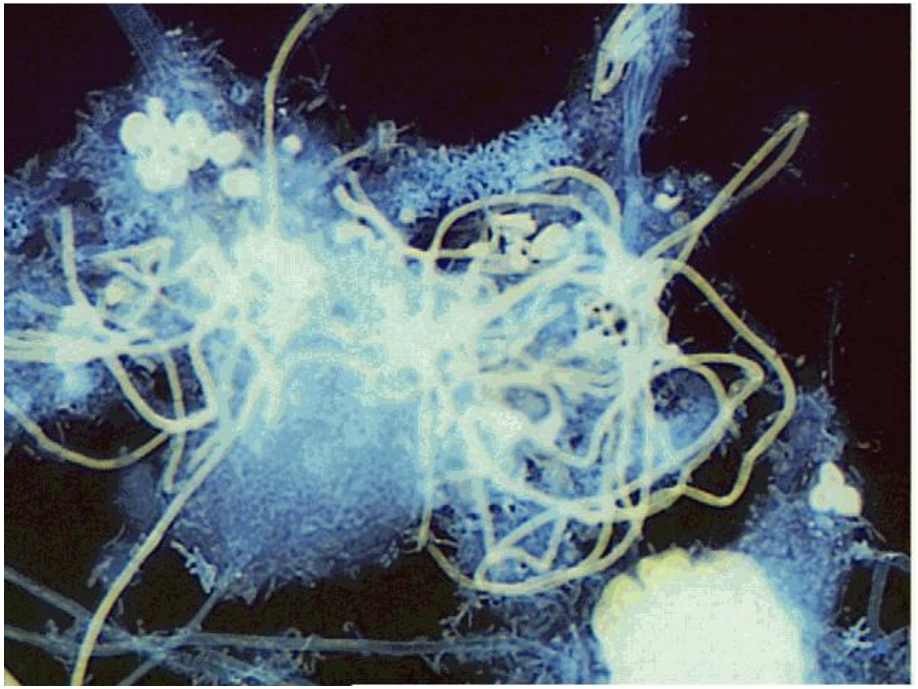


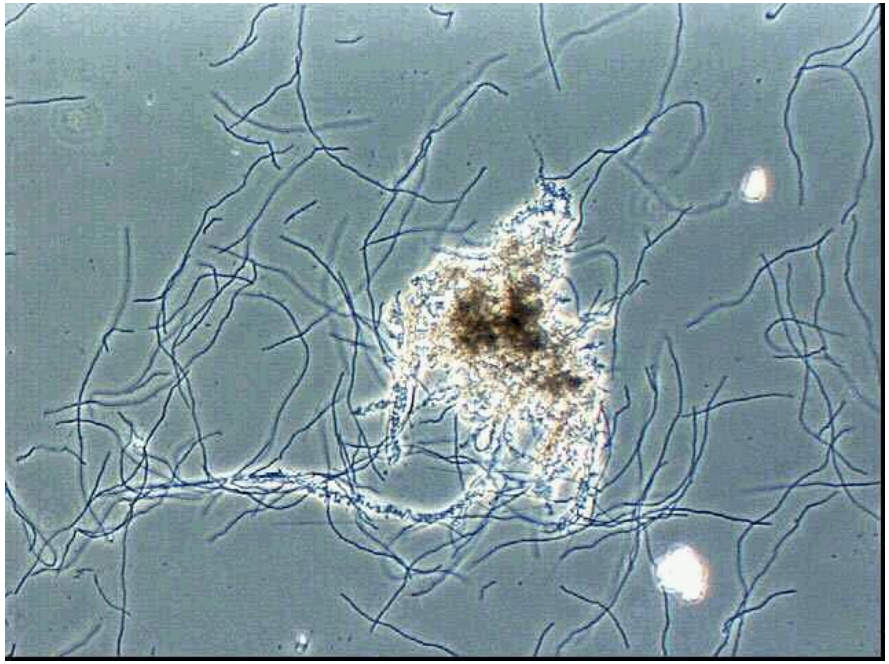


Single cell or small aggregates in cultures.

Can degrade contaminants, but not efficiently separated or recycled.



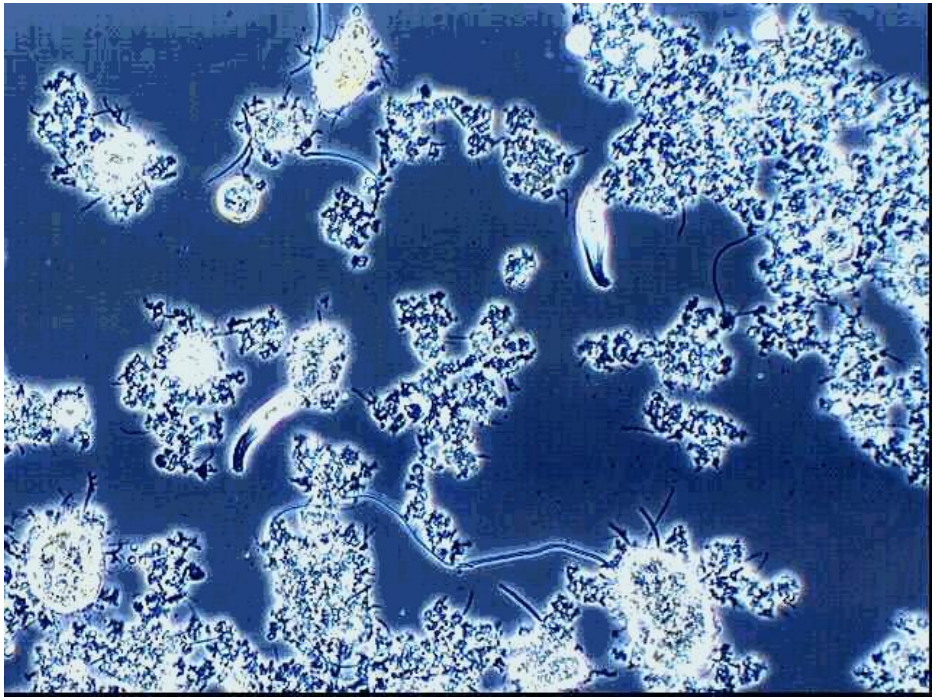


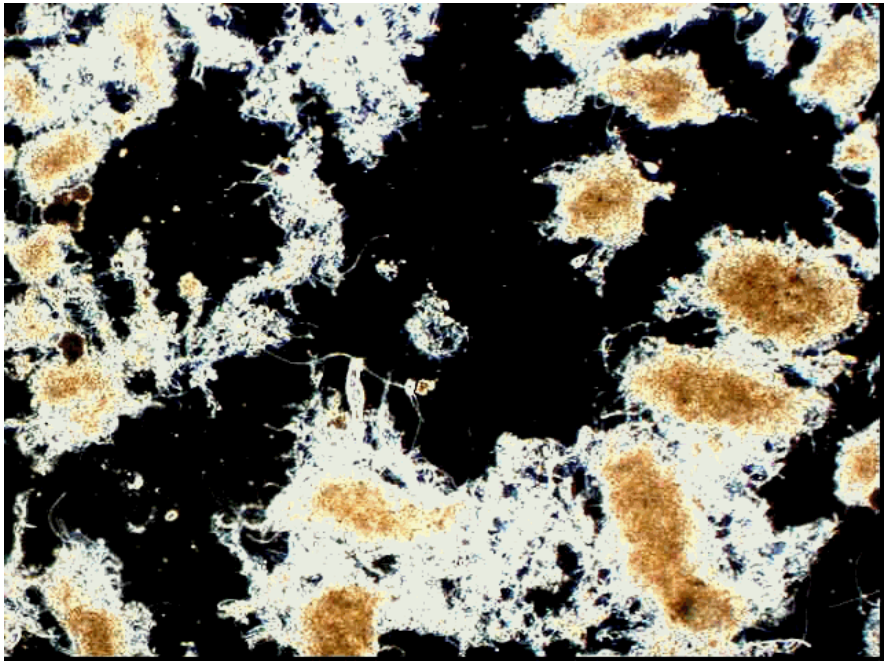


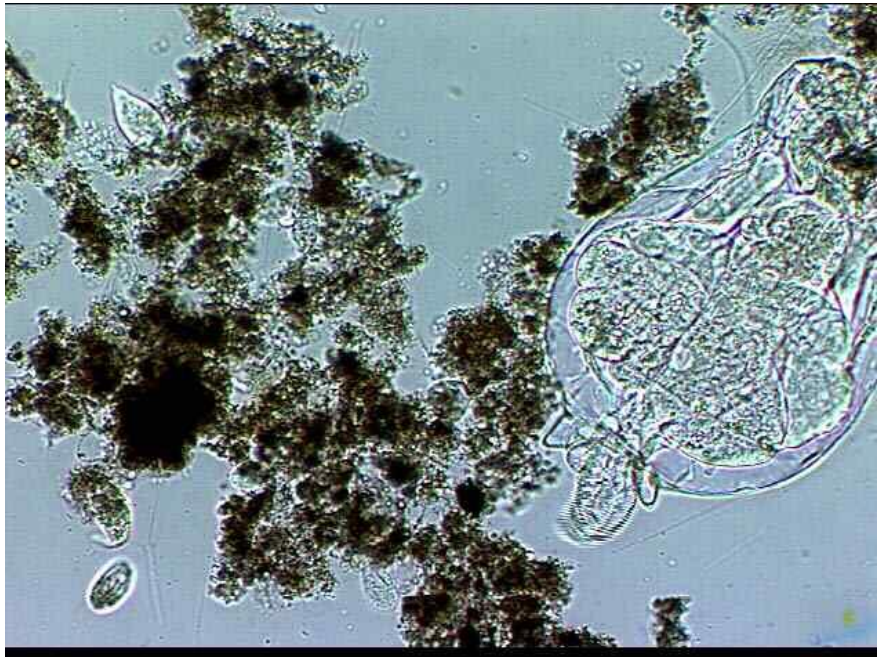
Flocs contain many strains of bacteria with multiple morphologies

Settling and recycle selects for aggregation.

Stable aggregates usual are a mix of types

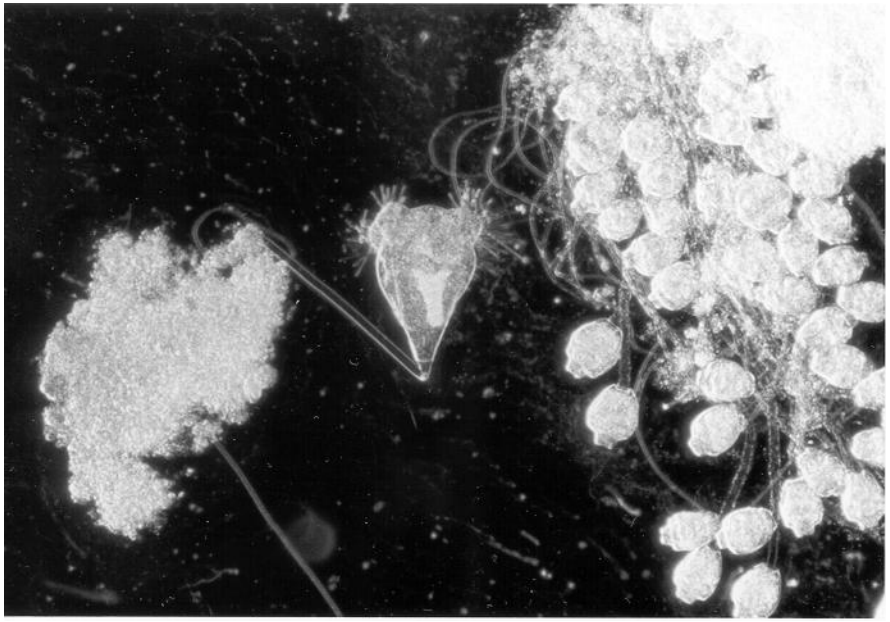


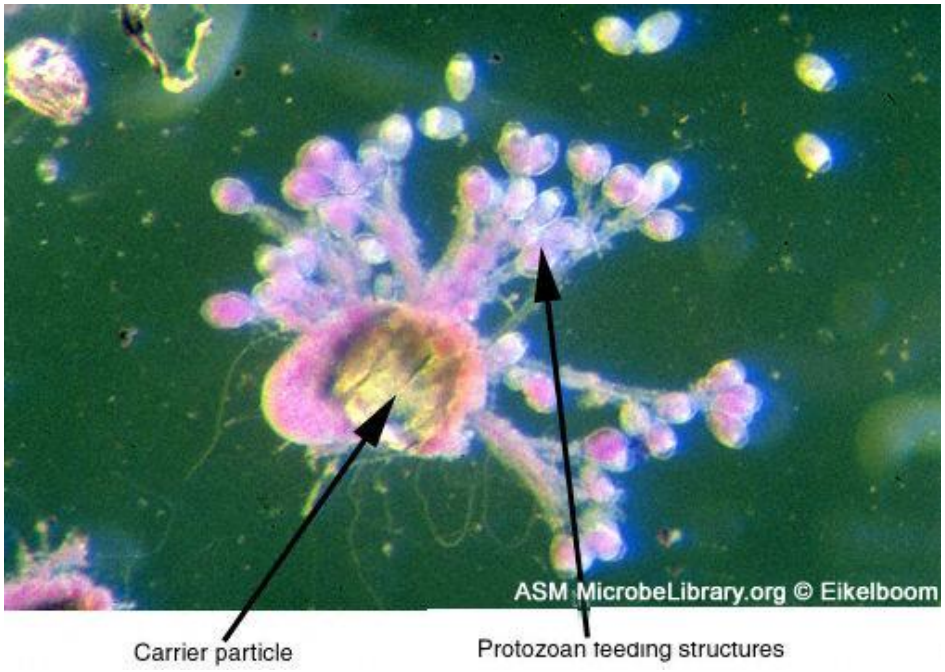


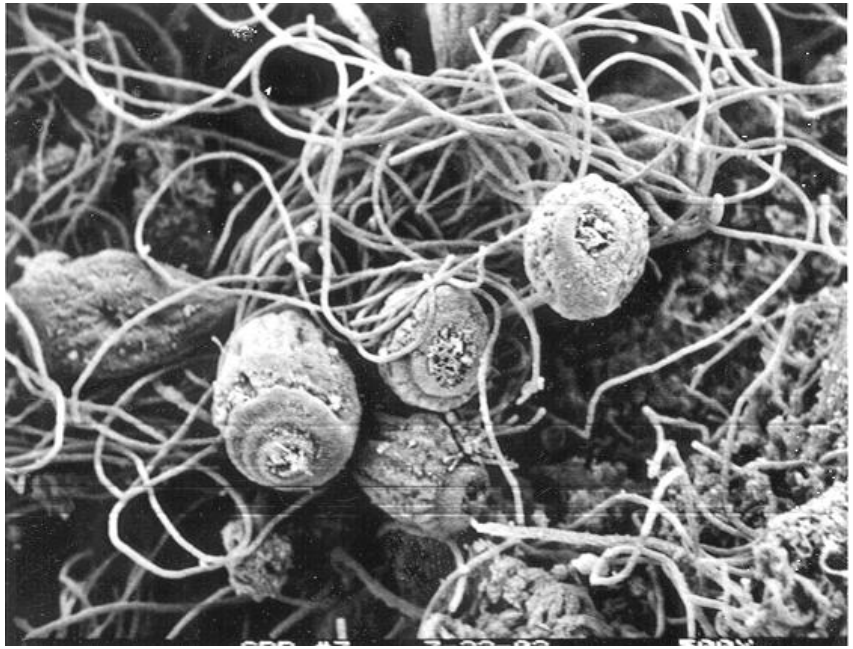


Flocs also contain protozoa (stalked and free-swimming), rotifers, nematodes.

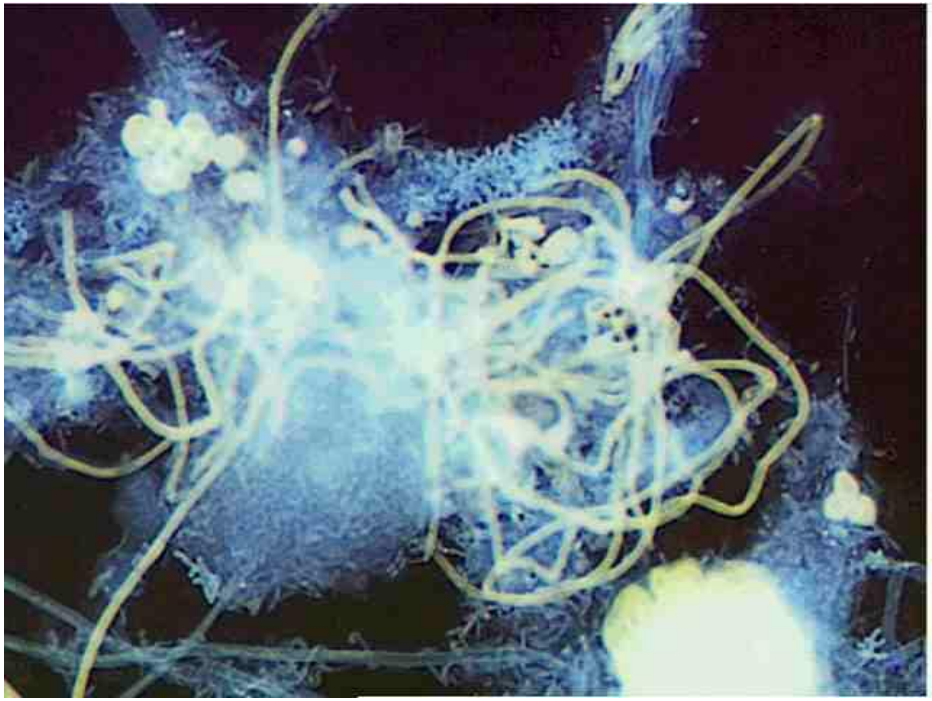
Extracellular polysaccharide binds cells, debris and retains nutrients and metabolites. Can be barrier to O_2 diffusion

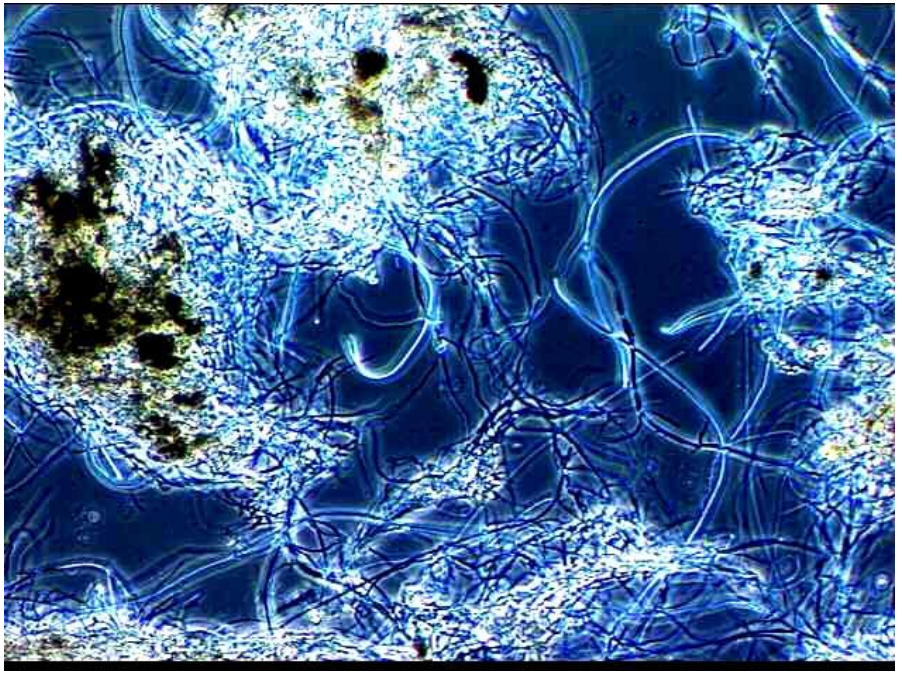


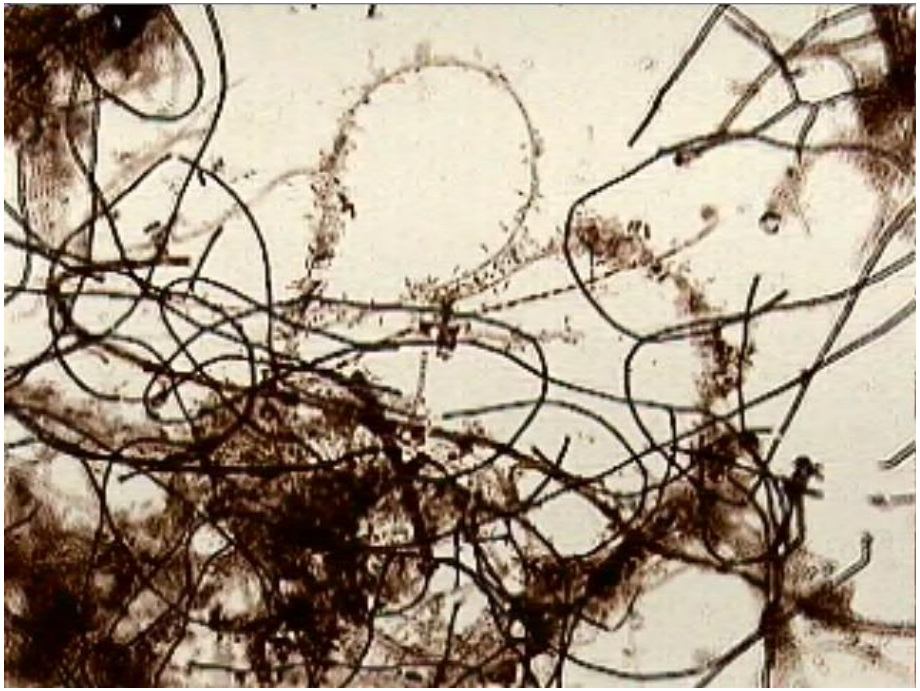




Protozoan grazers are an important component of the floc ecosystem. Indicate oxygen availability, contribute to decay of particulate matter, consumption and recycling of biomass COD.

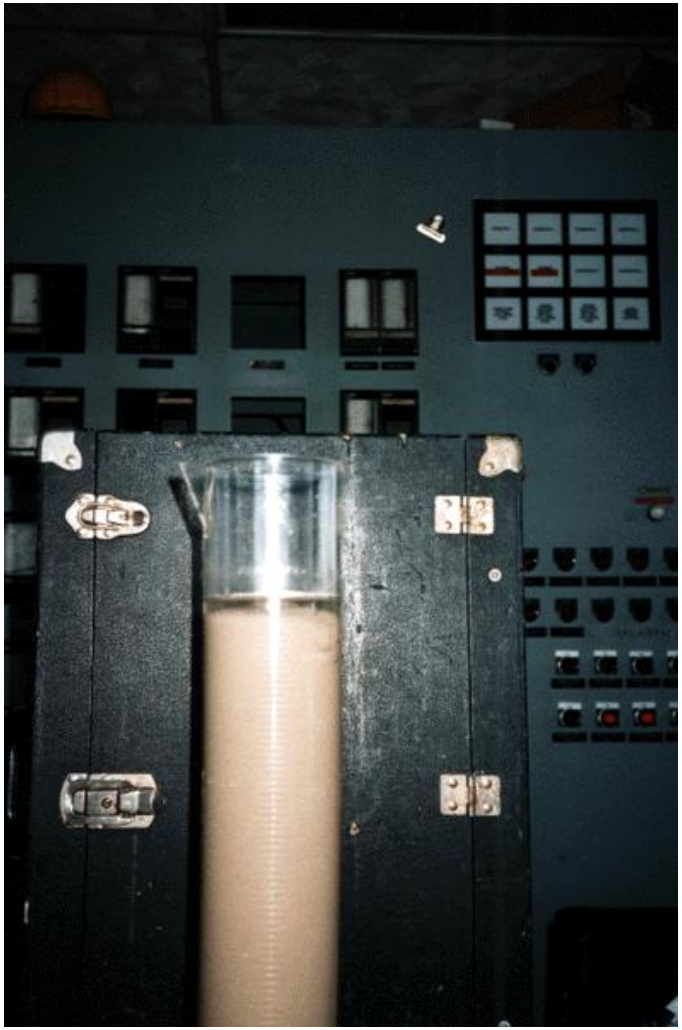






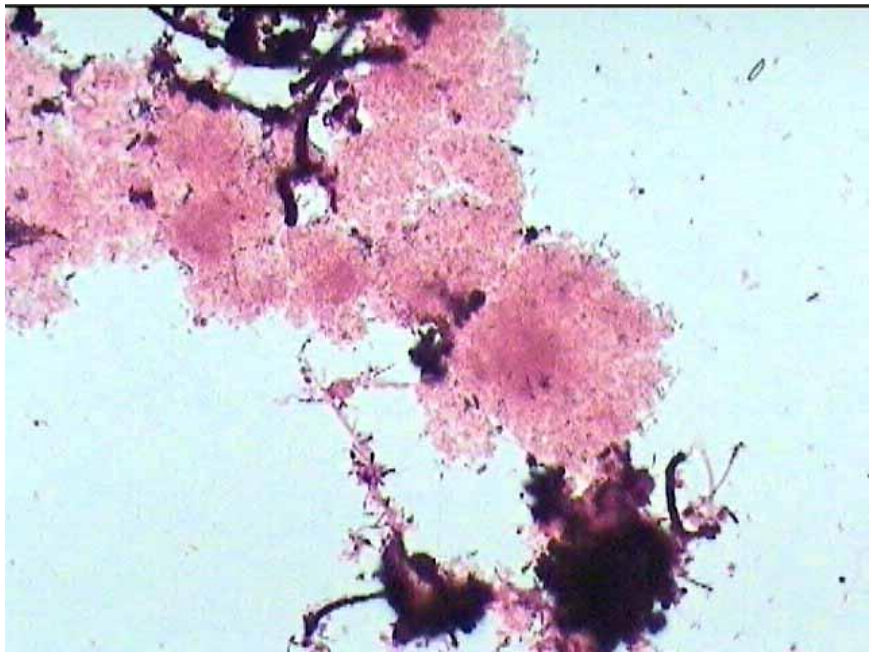
Changes in bacteria population and floc morphology produce process upsets.

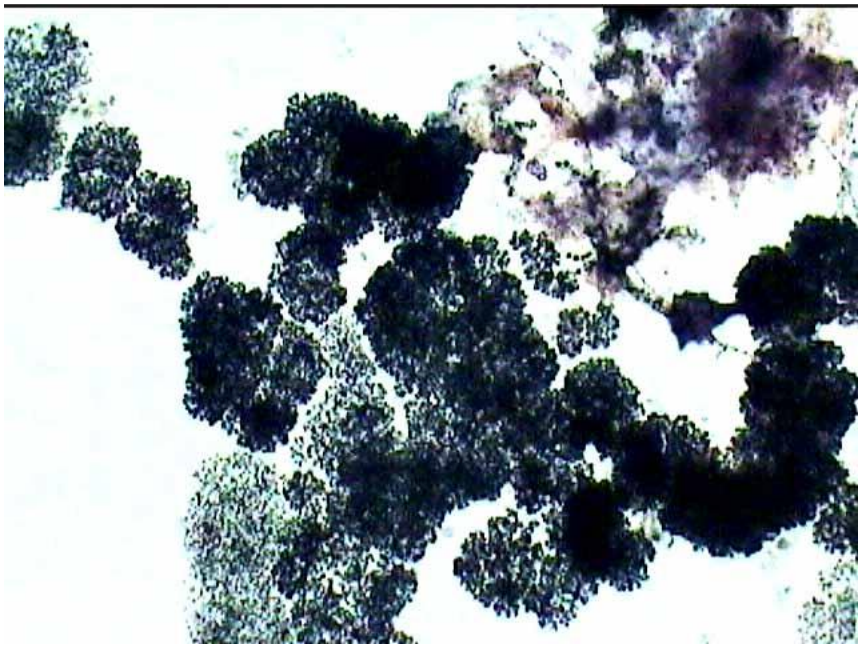
Proliferation of filamentous bacteria results in bulking sludge.

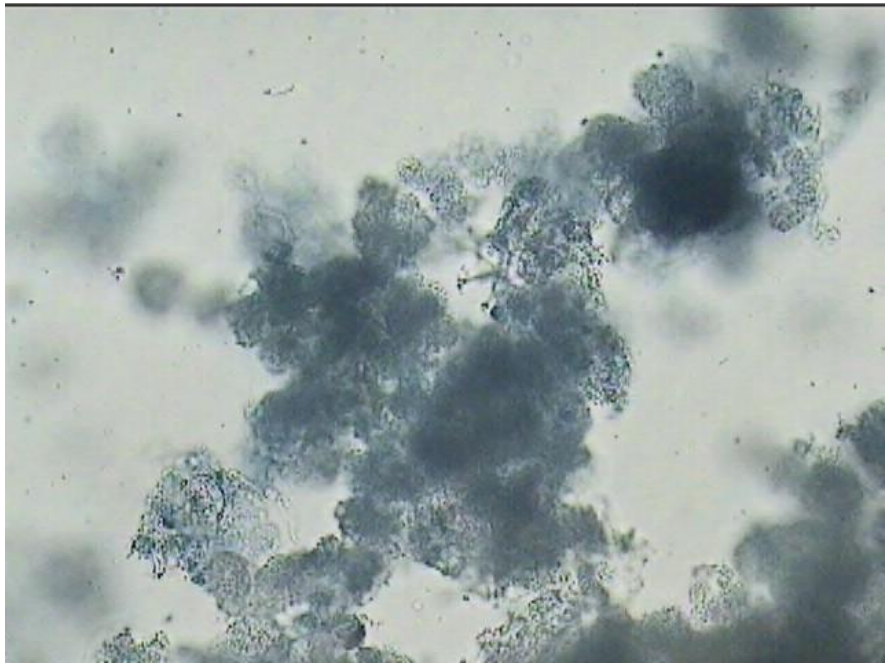


←Filamentous biomass after 30 minutes settling

After treatment with NaOCl, filaments killed selectively →

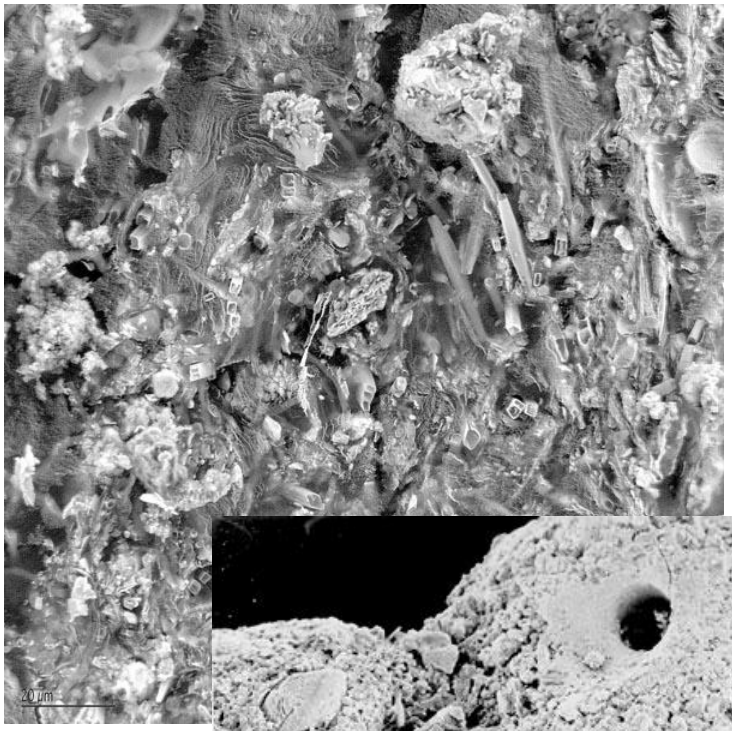




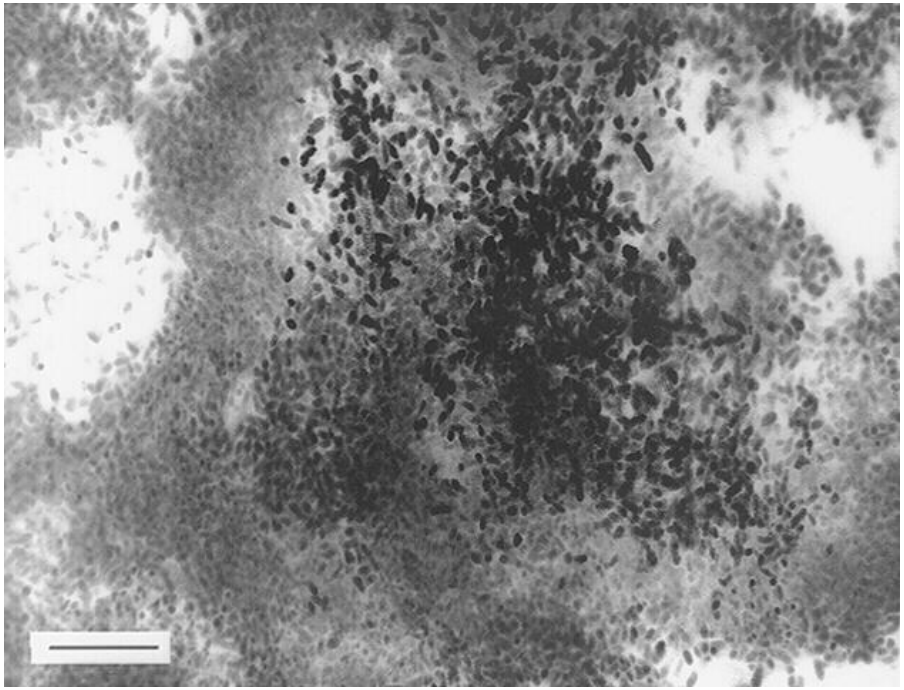


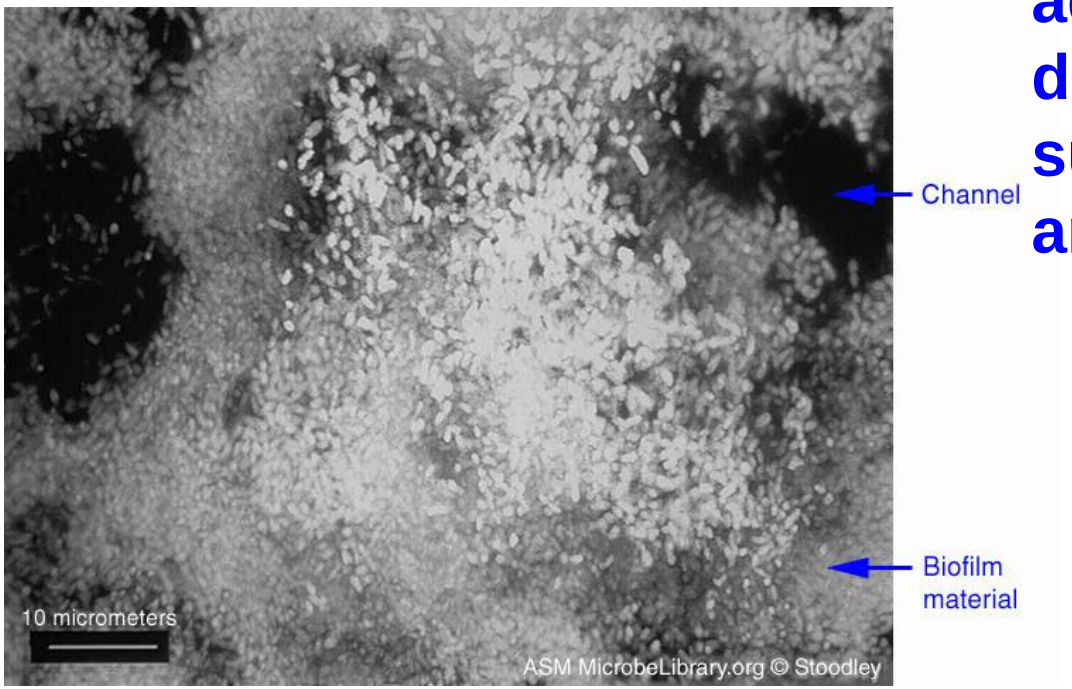
Flocs dominated by polymer producing bacteria (*Zooglea*), *Nocardia*, and *Thiothrix* also can cause process upsets such as foaming when aerated.

Foaming can top aeration tanks and interfere with uniform processing. Foam in the final clarifier is carried over weirs causing excess solids in discharged water.



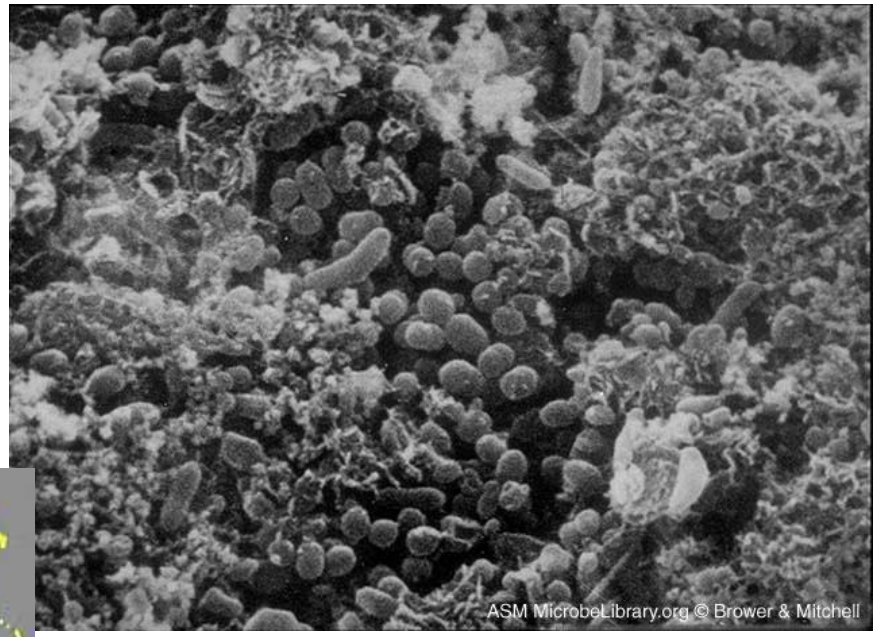
Biofilms are aggregates of bacteria and other microorganisms attached to an inert surface. Appear to be a mat in micrographs. But…..

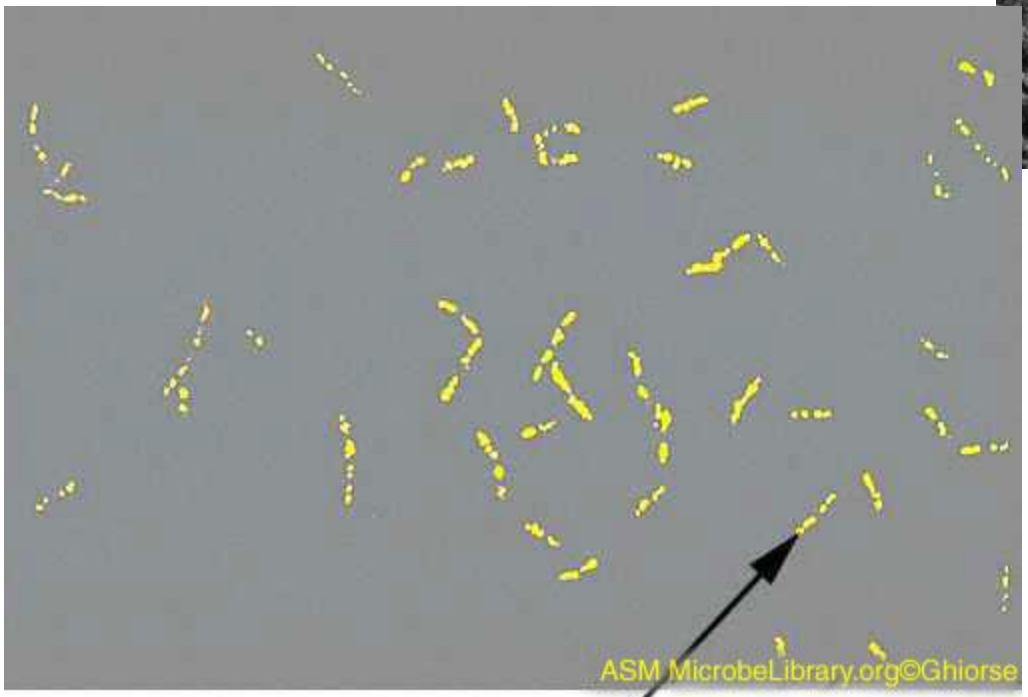




Biofilms are actually quite 3-dimensional with pores of varying size up to large channels that allow advective as well as diffusive transport of substrate and nutrients and particles.

TCE-degrading consortia → growing attached to iron sulfide particle. Consortia are more resistant to shocks and facilitate product utilization





This image shows a number of *Pseudomonas* cells stained with Nile Blue A, a fluorescent stain that binds to PHB. Under these conditions, the PHB can be easily seen as bright yellow granules.

← **Certain growth conditions ("feast-famine") result in bacteria storage of polymers (PHB) for use when no external substrate available. Metabolism used in biological PO_4 removal.**