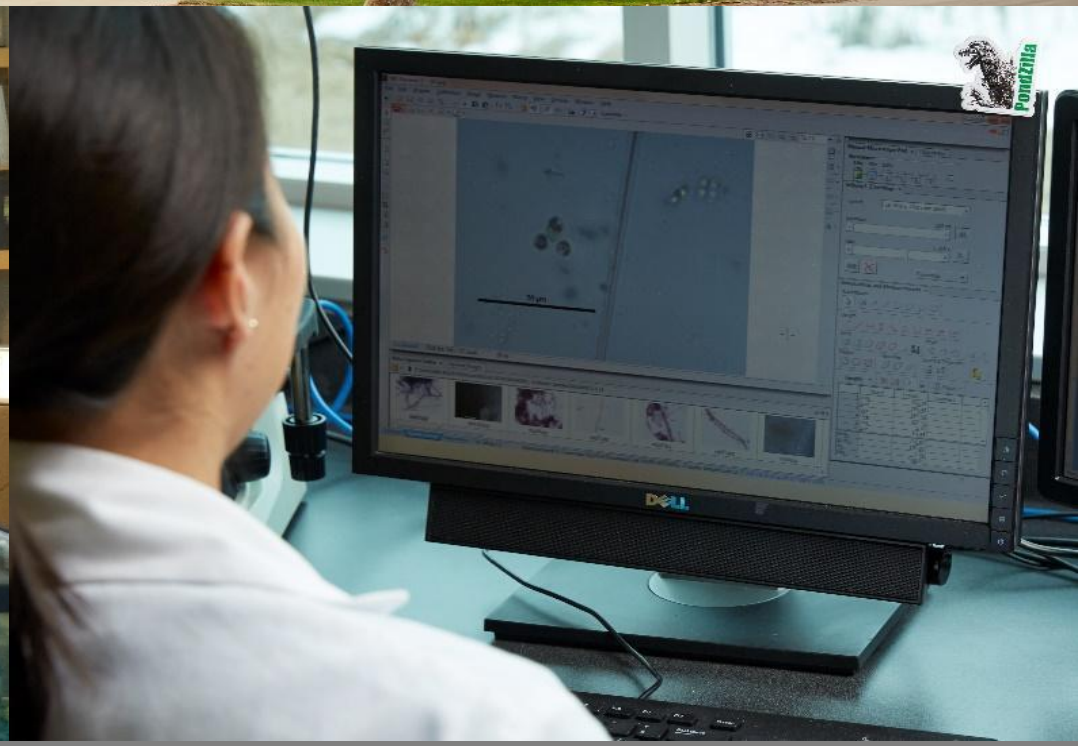
Foaming Filament Control

JOHN DINNEEN

TECHNICAL SERVICE MANAGER

AQUAFIX Inc.

Aquafix Laboratories – Biological Solutions



Identifying the Culprit

- New Bacterial Growth
- Surfactants
- Over Aeration/Mixing
- Grease Slug
- Filaments

Surfactant Based Foam

Nocardia

Lab ID:

- True Branching structure
- Gram positive staining

Field ID:

- Dense Stable Foam
- Tan to Brown Color
- Up to Several Feet Thick
- Excellent BOD Removal

Nocardia

Nocardia

Microthrix

Lab ID:

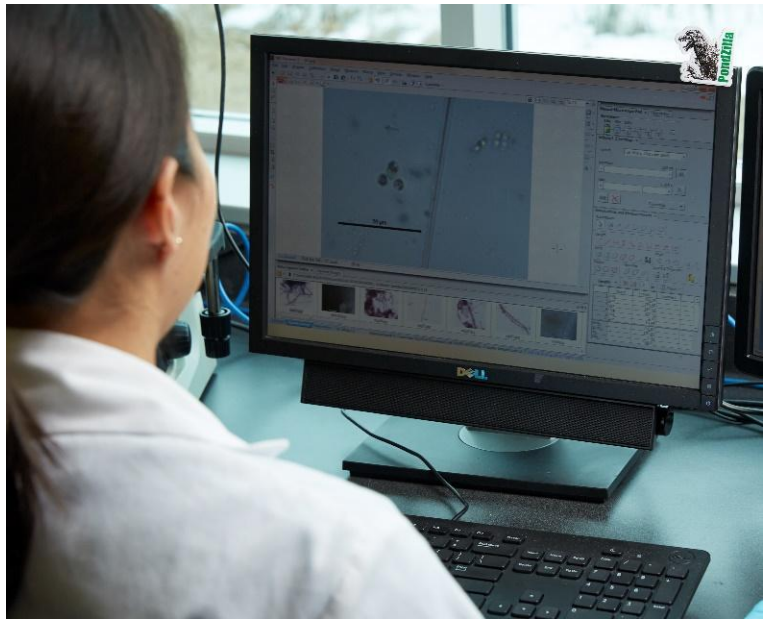
- Spaghetti like tangles
- No Branching
- Gram positive staining

Field ID:

- Dense Foam
- Dark Brown
- Around 6” Thick

Microthrix

Filament Origins Testing



- Filament ID, Causes
- Sludge Age
- Floc Structure
- Oxygen Penetration
- EPS Sliming
- Other
- $425

Fill sample bottles 3/4 Full

Place bottles upright in provided resealable bag, expel excess air

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Identifying the Culprit- Lab Testing

Microscopic Observations SBR Foam

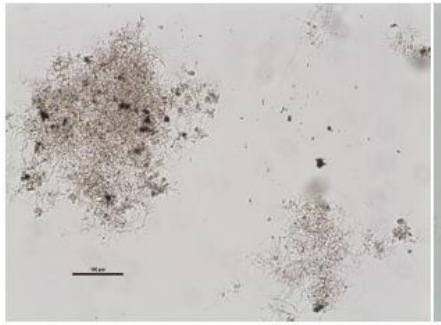

Figure 13-SBR 1 Foam unstained and viewed with 100X magnification showing clumps of branched filaments and trapped fine particles including septic particles.

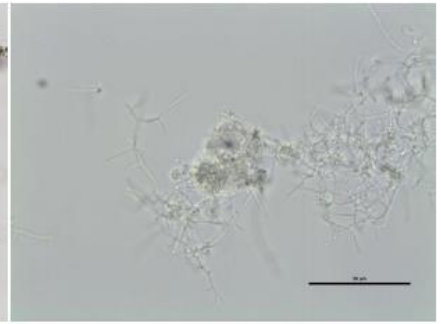

Figure 14-SBR 1 Foam unstained and viewed with 400X magnification showing clusters of branched filaments making a raft-like structure.

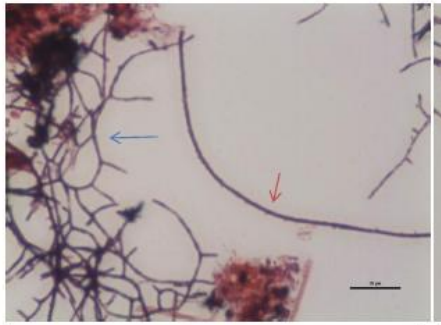

Figure 15-SBR 1 Foam Gram stained and viewed with 1000X magnification showing Nocardioforms (blue arrow) and *M. parvicella* (red arrow).

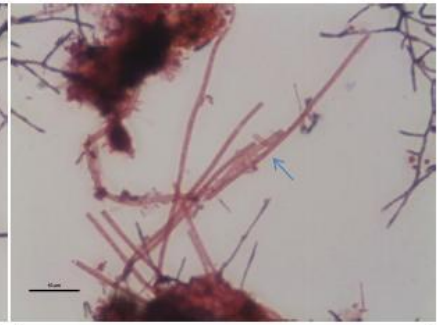

Figure 16-SBR 2 Foam Gram stained and viewed with 1000X magnification showing Type 0092 (arrow).

Figure 11-SBR 2 ML Gram stained and viewed with 1000X magnification showing Gram positive, unbranched filaments of *Microthrix parvicella* (purple filaments in center).

Figure 12-SBR 1 ML Neisser stained and viewed with 1000X magnification showing Neisser positive granules in *M. parvicella* filaments (arrow).

Summary:

- SBR 1 ML and SBR 2 ML were similar in composition. Both SBR's contained medium amounts of stalked ciliates and crawling ciliates with low amounts of rotifers. The presence of these types of ciliates should lead to a clear effluent and the presence of rotifers indicates that there are no toxins in these SBRs. The floc were about 200-300um in diameter and consisted of condensed areas with black spots as well as very open areas due to filamentous microorganisms extending from inside the floc structure. These floc may be breaking apart due to filament extension. The flocs were white in color with black spots when observed under phase contrast. This indicates that most of the floc is getting adequate dissolved oxygen but there are areas that are getting no oxygen. These areas may be particles of magnetite from the magnetite system getting into the return. Although the floc showed only low amounts of exopolysaccharides (EPS), much of the EPS was observed easily pulled off the floc structure and into the bulk liquid. This indicates that they structure of the floc EPS may be too weak to hold the floc together. This is sometimes caused by some form of nutrient deficiency.
- The SBR ML sample contained high amounts of filaments observed both inside and outside of the floc.

Rank	Filament	Abundance	Cause
1	Type 0092	High	Low F:M, high simple organic acids.
2	Nocardioforms	High	FOG, long MCRT
3	*Microthrix*	Medium	FOG, cold temperature
4	Type 0675/0041	Low	Low F:M

When is Filament Foam Most Common?

- High Fats, Oils, Grease
- Cold Weather
- Stressed Floc Forming Bacteria
- Old Sludge Age
- Low F:M Ratio

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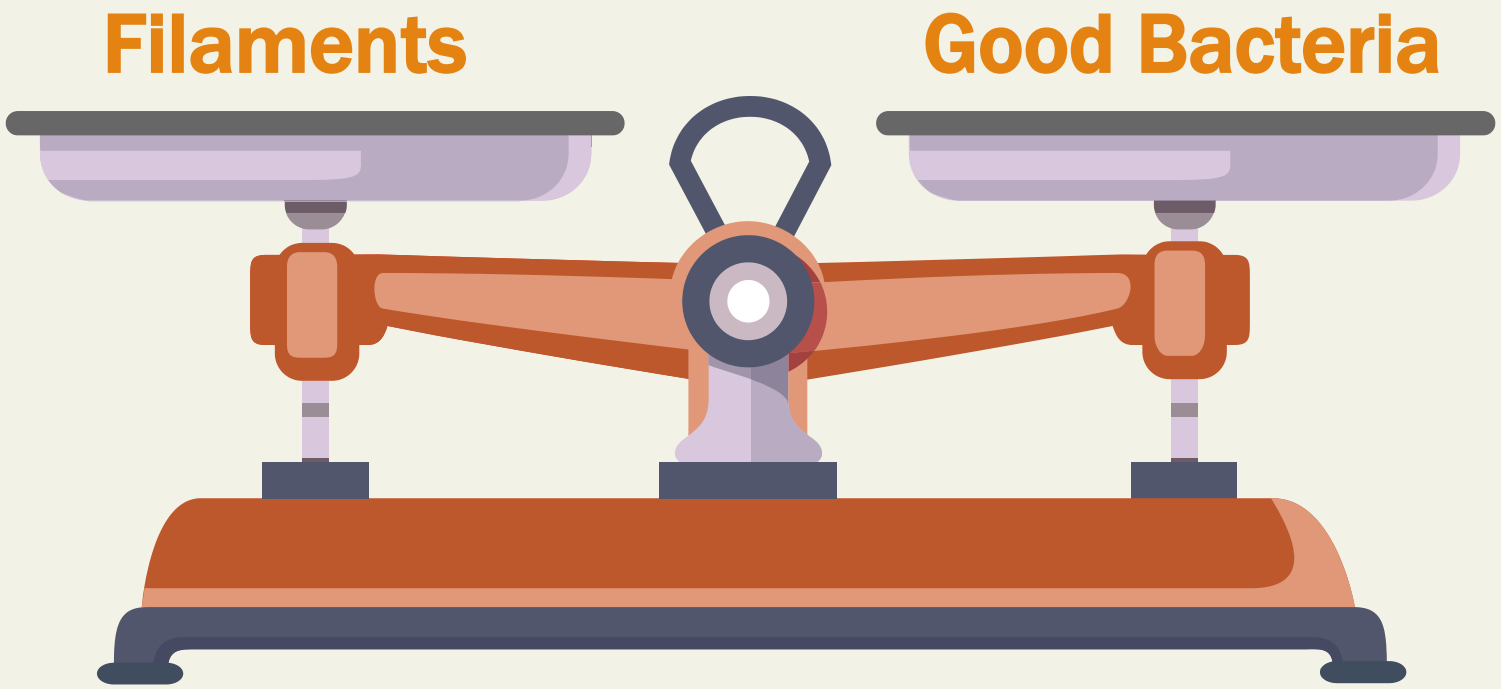
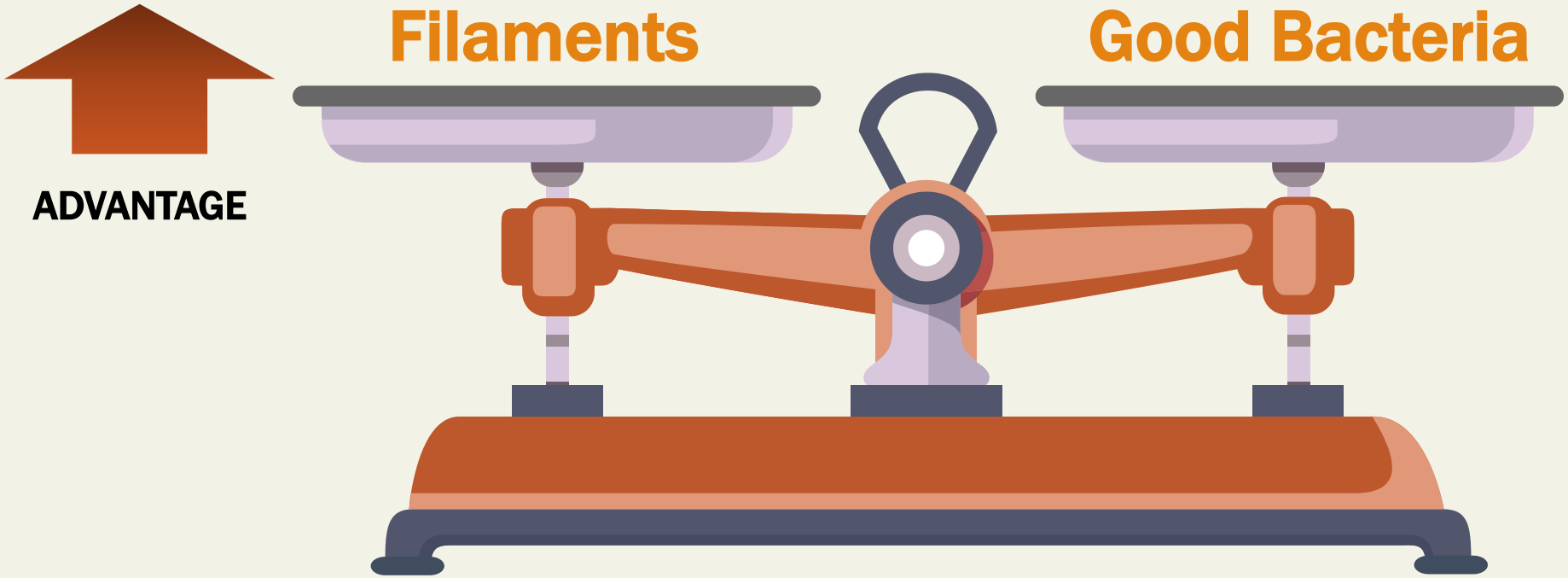
Competitive Balance

- Most Plants Have Filaments, and Floc Forming Bacteria
  - Competing for Resources
- Fixed Amount of Food Entering the System
- Filaments Exploit Certain Advantages to Gain Edge



Competitive Balance

Fixed Amount of Food Entering the System



Efficient Grease Digesters

Slow to Digest Grease

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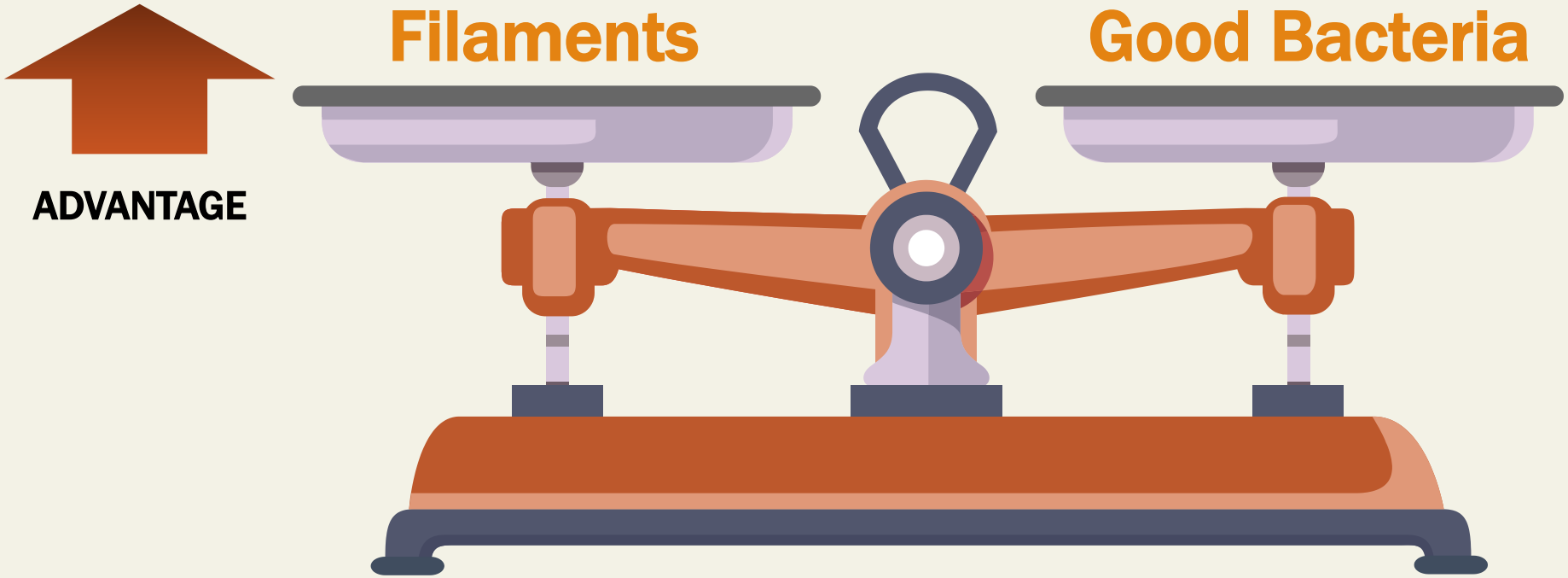
Competitive Balance

Fixed Amount of Food Entering the System



Thrive in Cold Weather

Less Active in Cold

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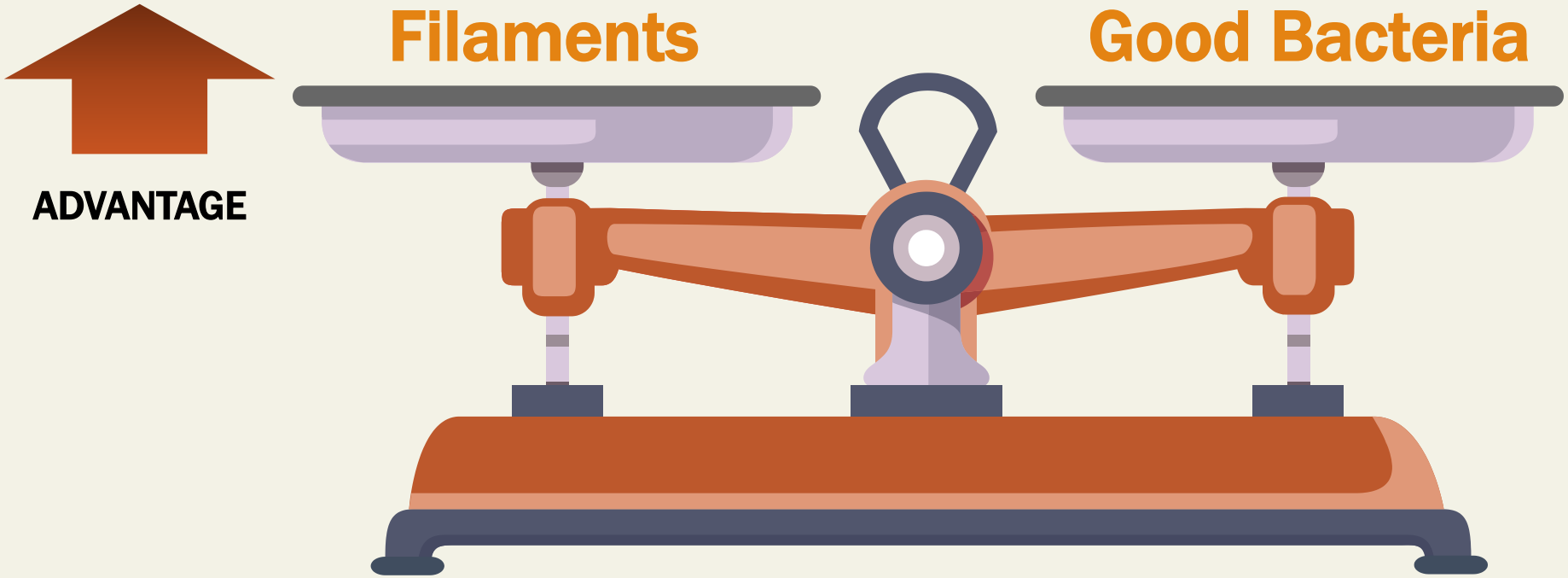
Competitive Balance

Fixed Amount of Food Entering the System



Low F:M Tolerant

Weakened by Low F:M

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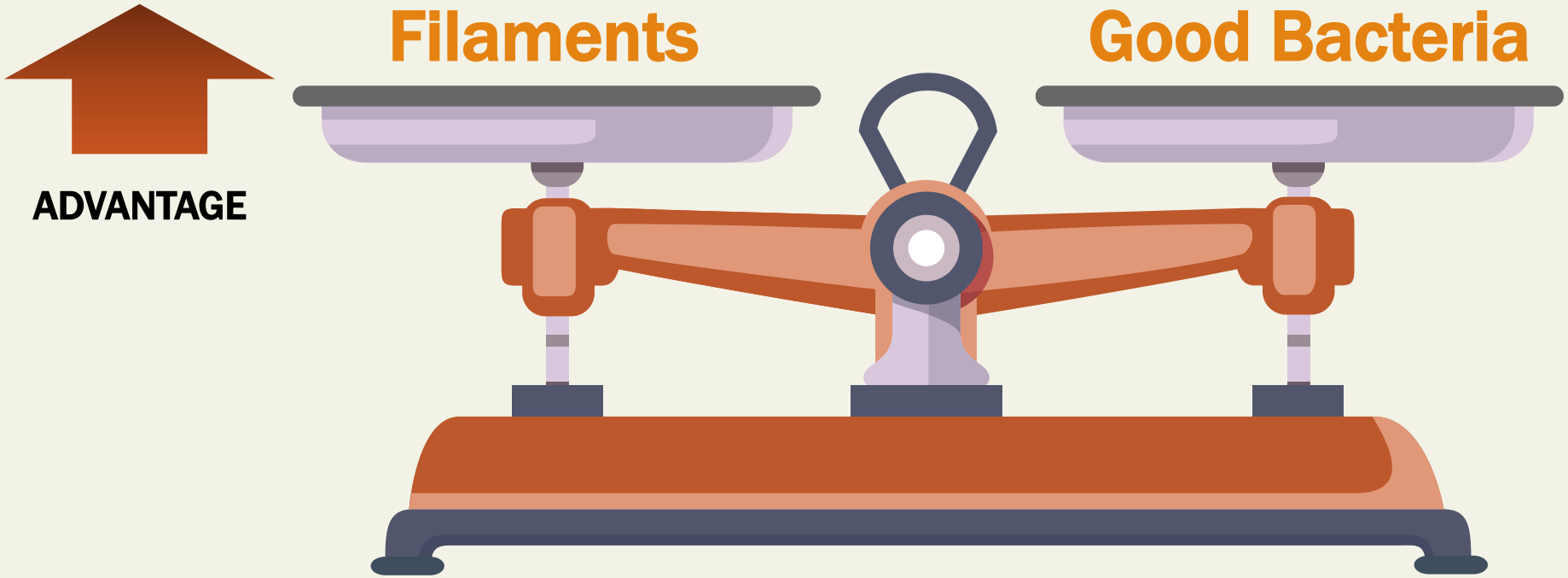
Competitive Balance

Fixed Amount of Food Entering the System



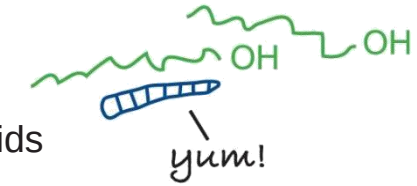
Lots of Surface Area

Less Surface Area

Mechanism of foam: *Microthrix parvicella foam cycle*

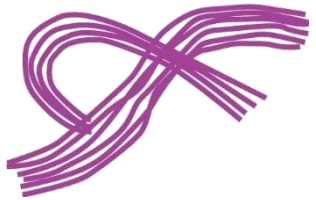
Early stage
SRT<5.7d
Hydrophobic cells
(like fat & oil)

Consume
OleicAcid
volatile fatty acids

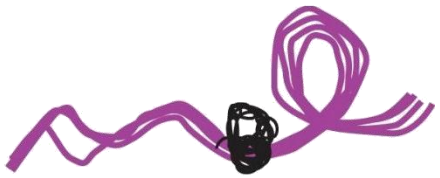


Temperature
changes

Filaments Proliferate

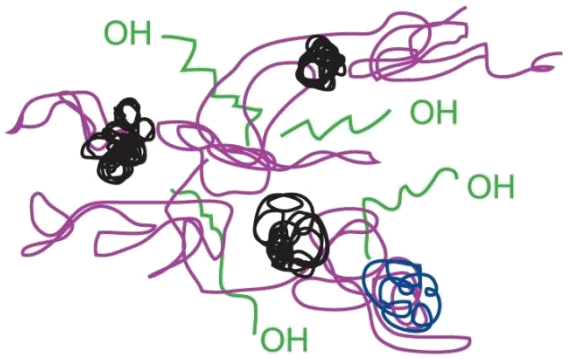


Filaments Outcompete
Floc Forming Bacteria



Chlorination
Fragments
Filaments

Filaments form inter-floe
bridges, rise to surface



Forms net that traps gases,
oils, grease, fat and floats

Brown matty foam
(Operator observes in dismay)

Recirculate mixed liquor

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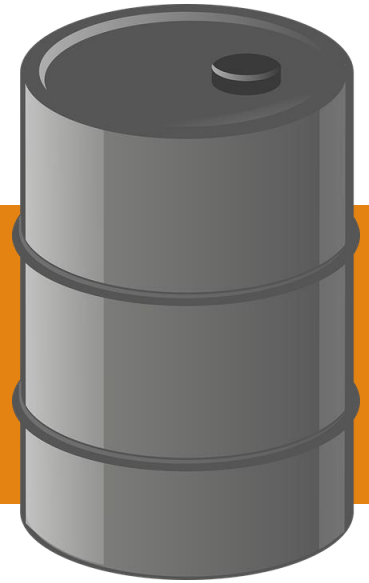
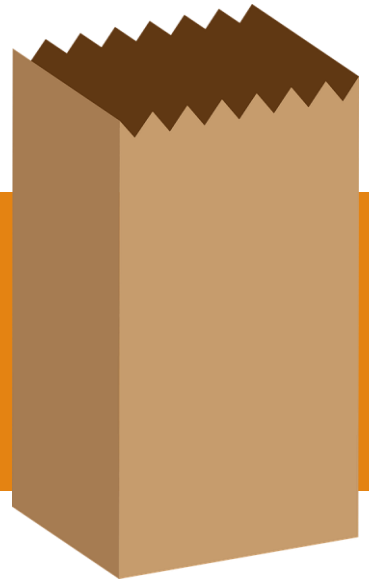
Covering Up the Symptoms



Defoamer

- Silicone Based- Hard on Biology
- Temporary Foam Relief
- Doesn’t Address Settling
- Doesn’t Get Rid of Filament
- Oil Based Defoamers - OK



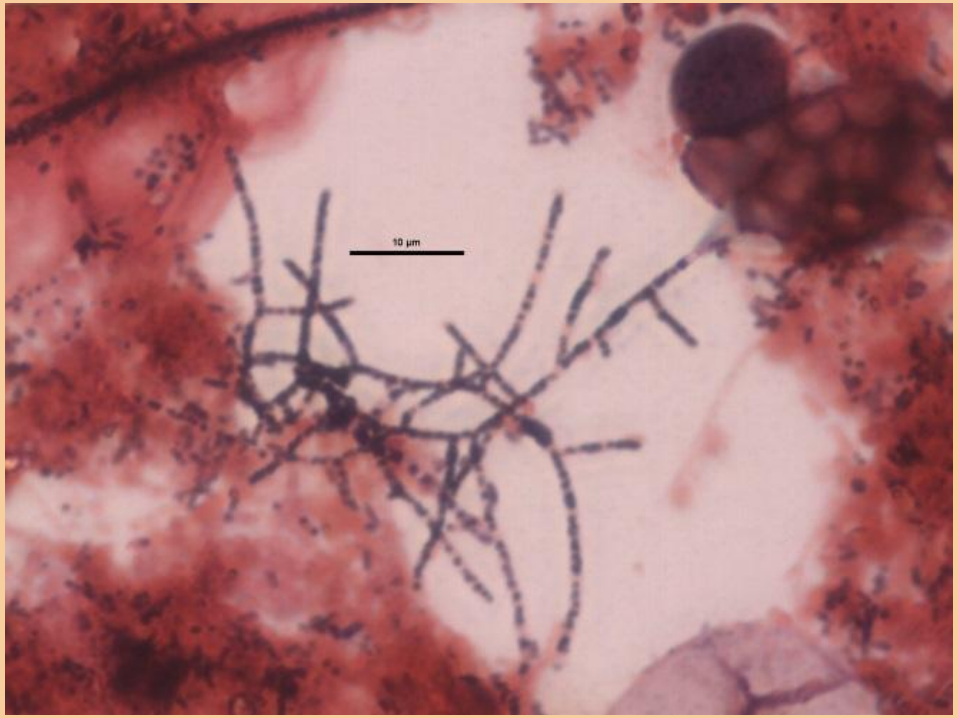
$Al_n (OH)_m CL_{(3n-m)}$

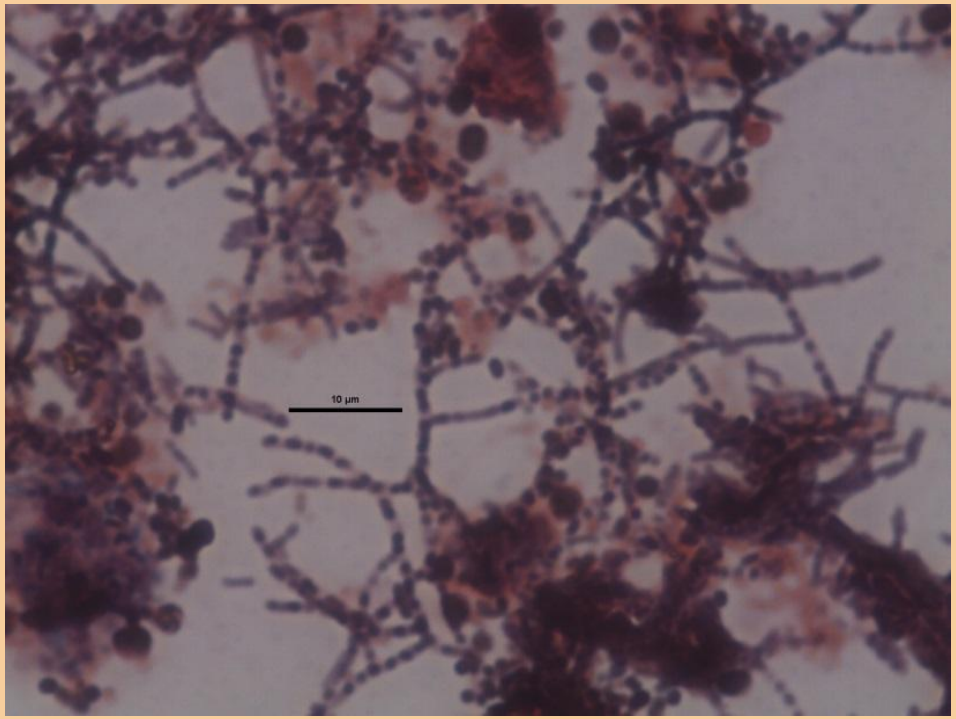
Poly Aluminum Chloride

- Improves Settling
- Doesn’t Address Foaming
- Doesn’t get rid of the filament
- Becomes Expensive Quickly

Chlorinating

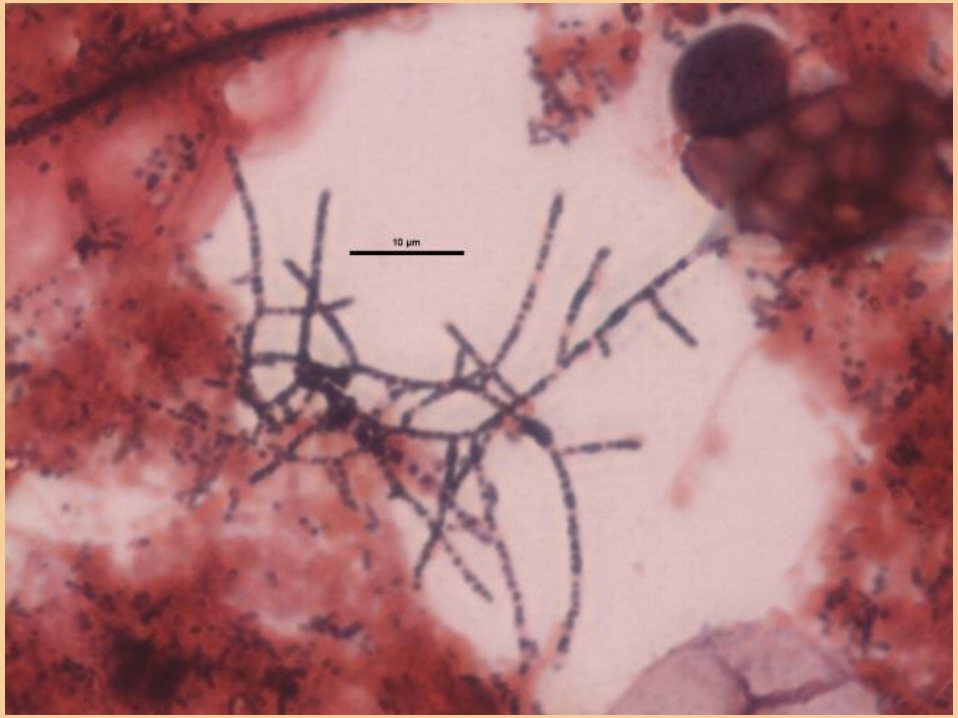
- Low Dose = fragments filaments, short term relief
- High dose = killed filaments, loss of nitrifiying bacteria
- Filaments and floc formers very similar susceptibility

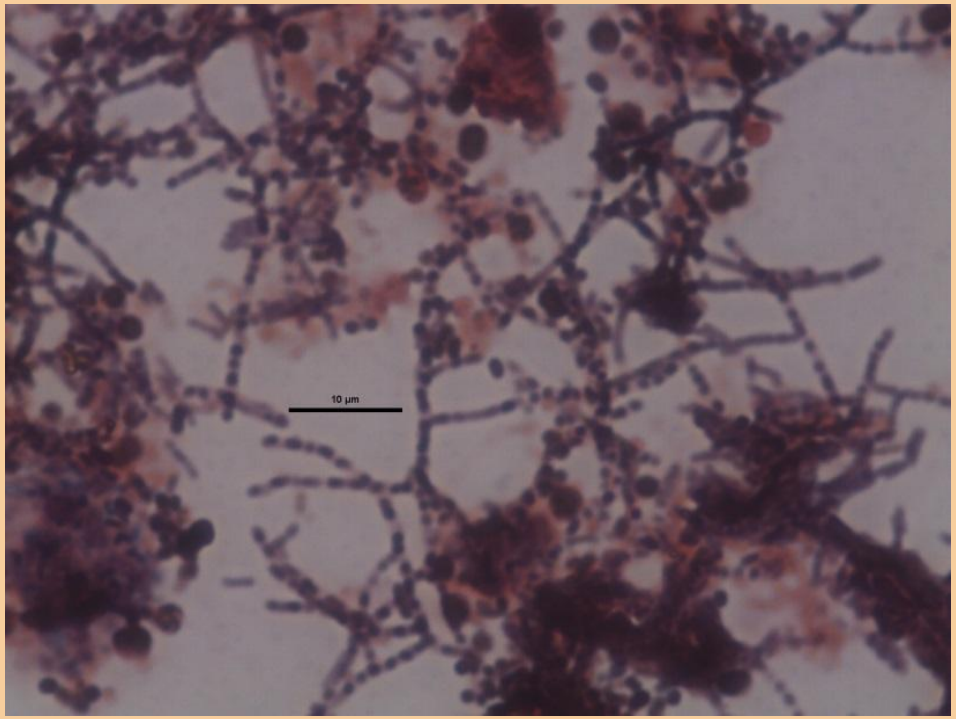




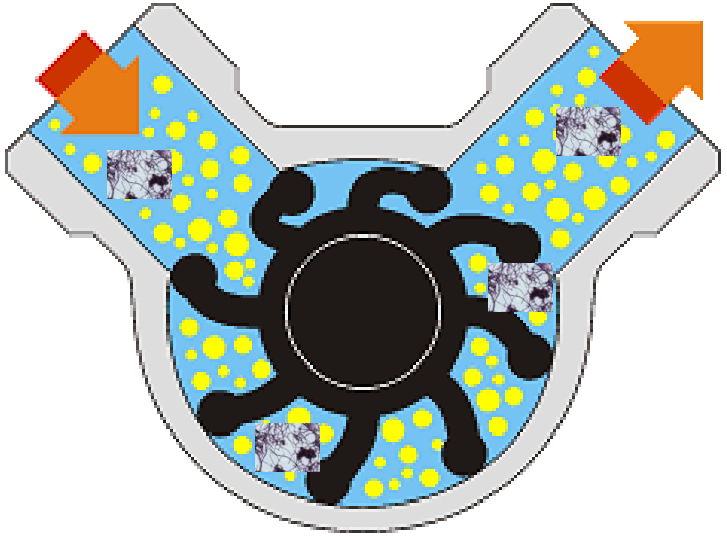
How to Monitor Chlorinating

- 1-10 pounds chlorine/1000 pounds MLVSS inventory/day
- Start Low, add to RAS
- At least once per day, 3+ times per day is better
- Monitor Effluent - Ammonia, Milky, TSS
- Watch the Microscopic Progression





Physical Removal



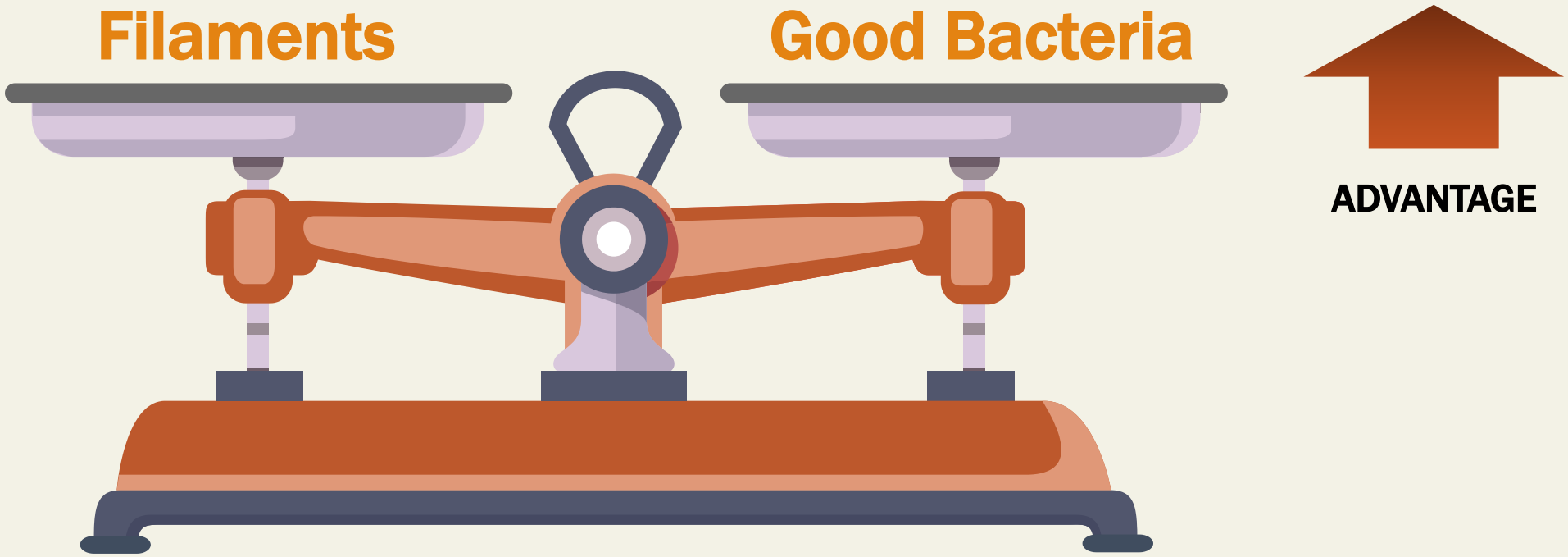
WASTING

- Removes Filament
- Lowers Sludge Age
- Relocates Filaments

FOAM REMOVAL

- Filament Concentrates in Foam
- Fastest Removal
- Drying Bed Disposal is best

Competitive Balance



Starve the Filament

Boost Floc Forming Bacteria

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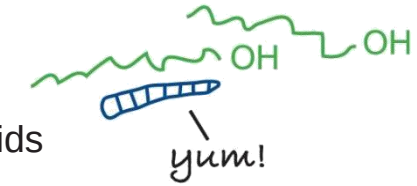
Mechanism of foam: *Microthrix parvicella foam cycle*

Early stage
SRT<5.7d
Hydrophobic cells
(like fat & oil)

Consume
OleicAcid
volatile fatty acids



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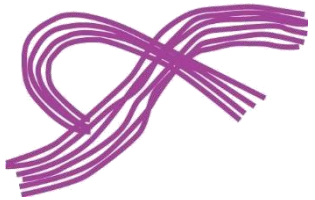
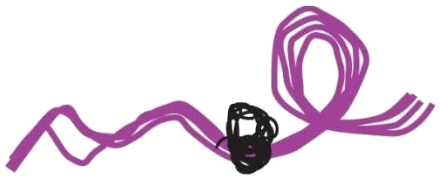


Filaments Outcompete
Floc Forming Bacteria



Chlorination
Fragments
Filaments

Filaments form inter-floe
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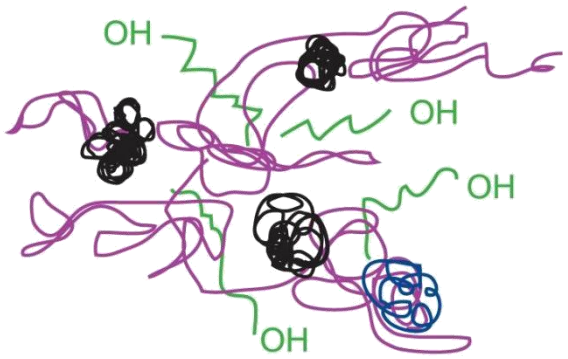

Forms net that traps gases,
oils, grease, fat and floats

Brown matty foam
(Operator observes in dismay)

Recirculate mixed liquor

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Grease Control

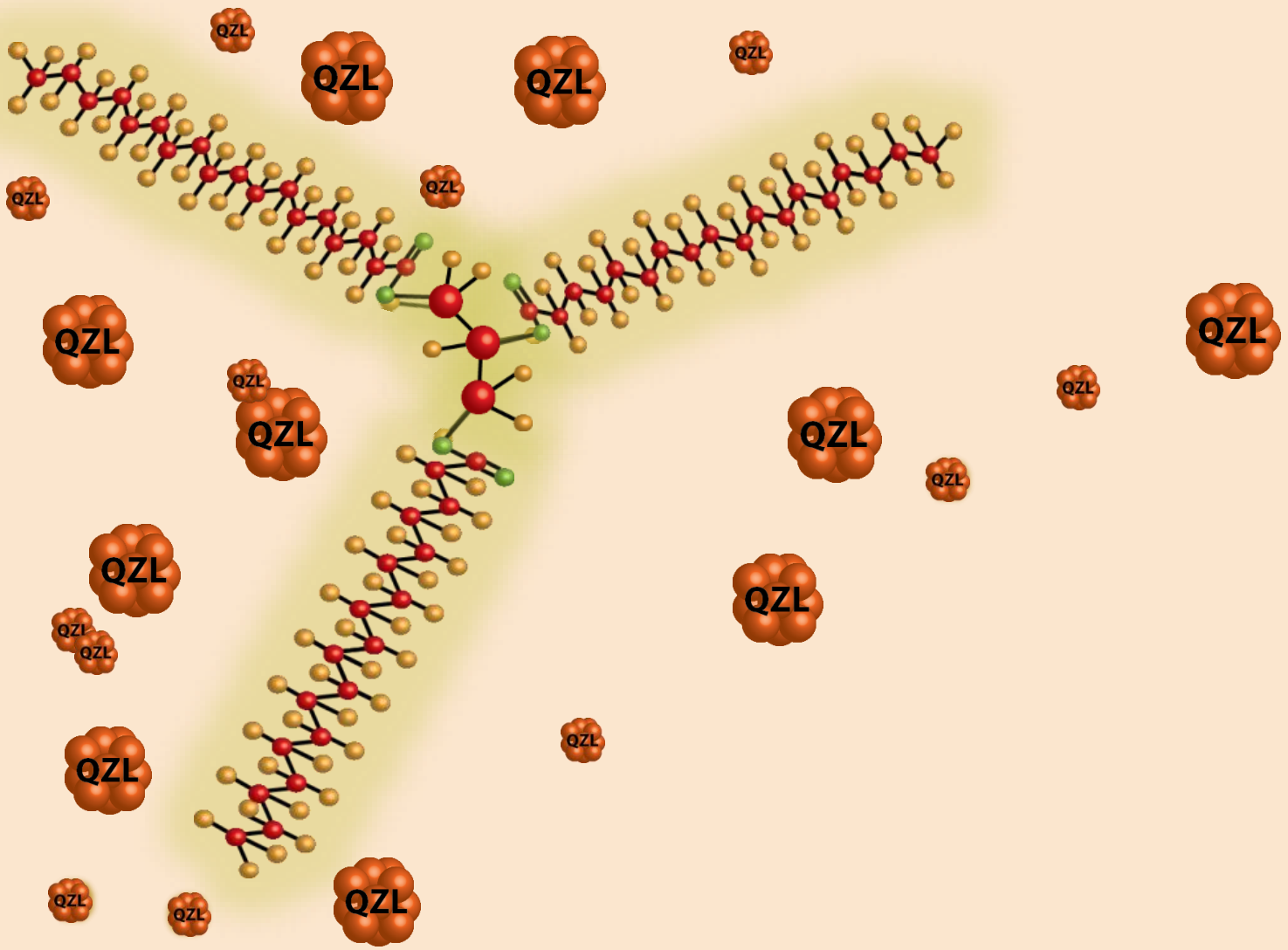
- Grease Traps
- Primary Clarifiers
- DAF Units
- Other

Lift Station Grease Control

- Used In Collection System
- Lowers Incoming Grease
- Best for Preventing Future Filament Issues

WWTP Grease Control

- Liquid Biocatalysts
- Used in Aeration Basin
- Rapidly Accelerates FOG Digestion
- Works With Existing Bacteria Population



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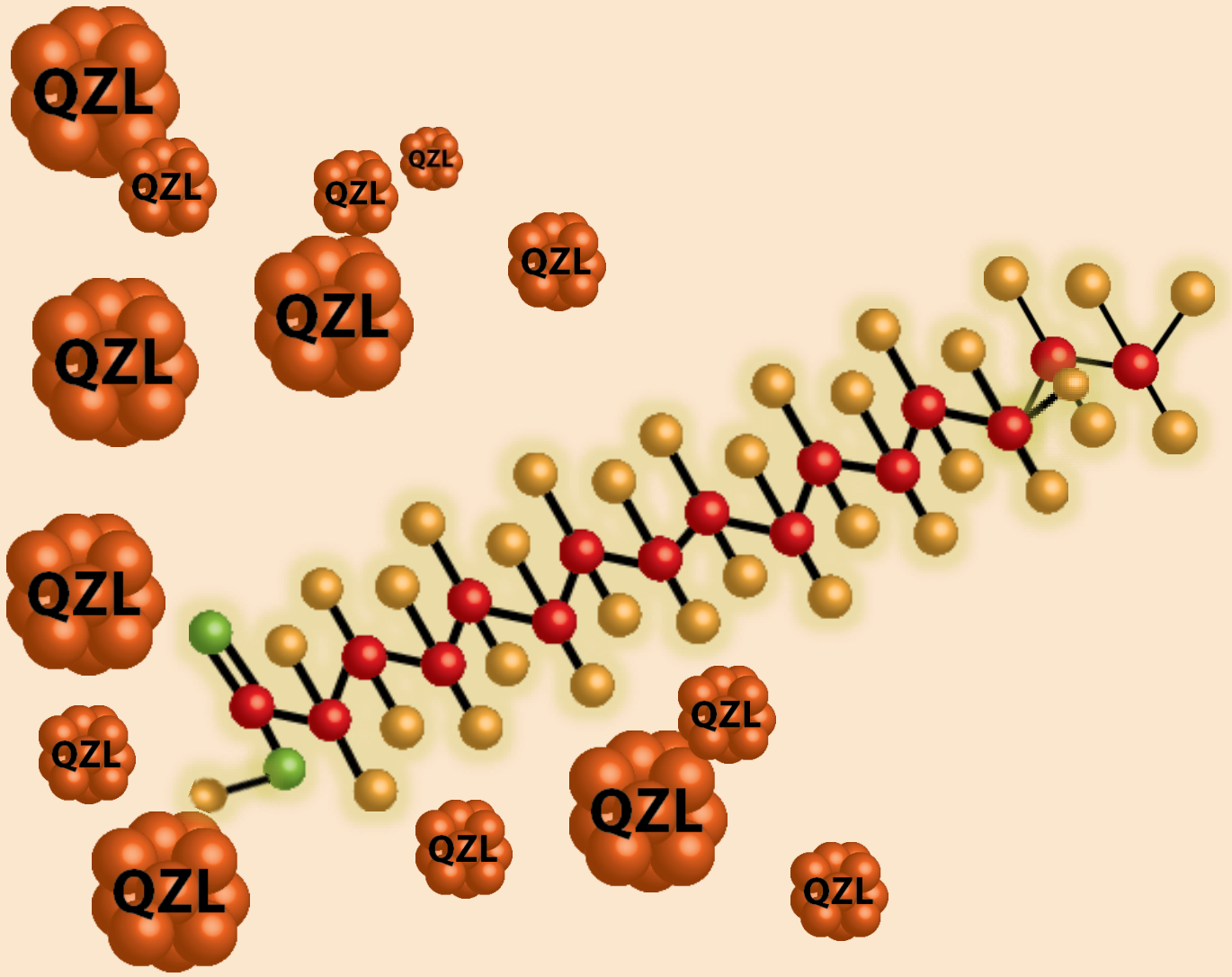

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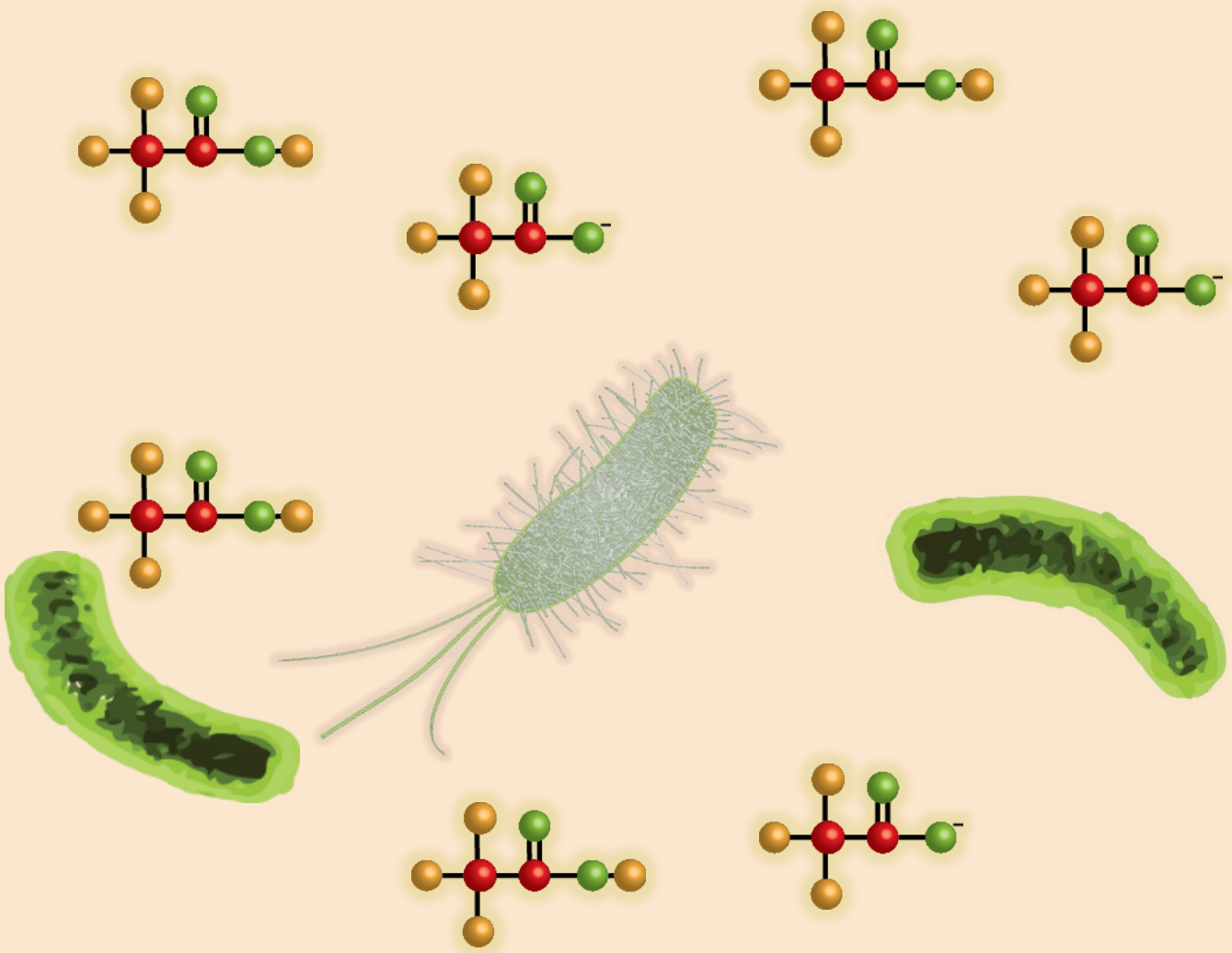
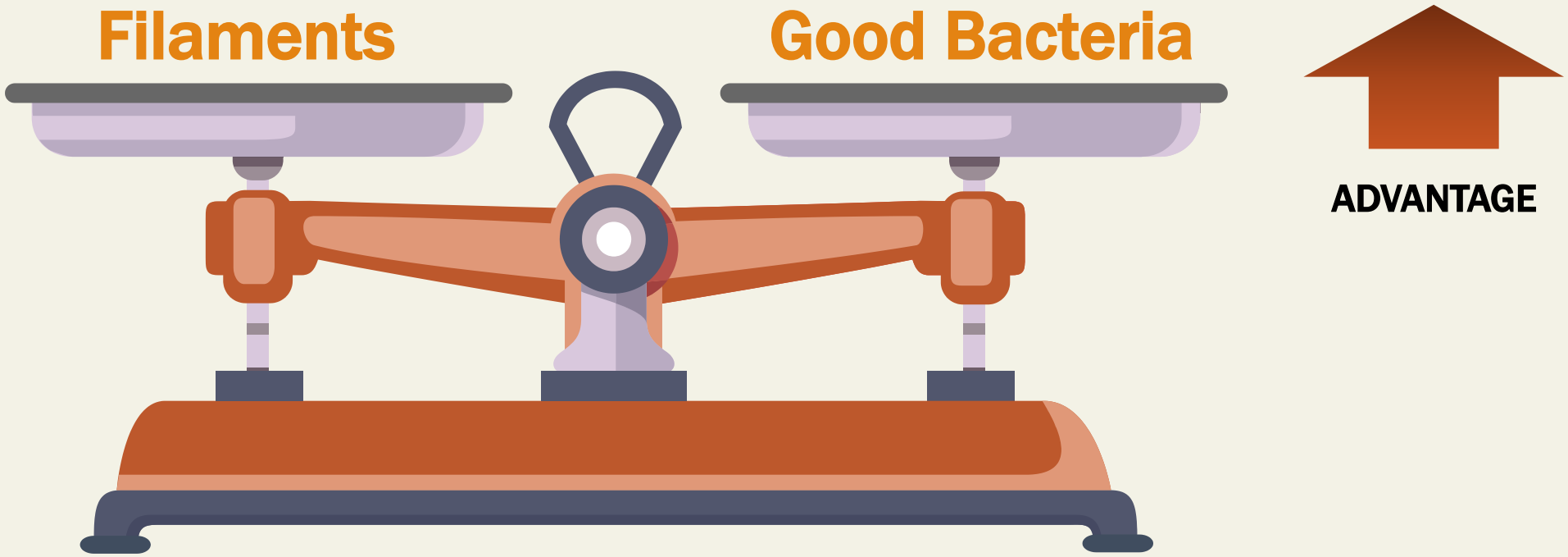


Competitive Balance



Starve the Filament

Boost Floc Forming Bacteria

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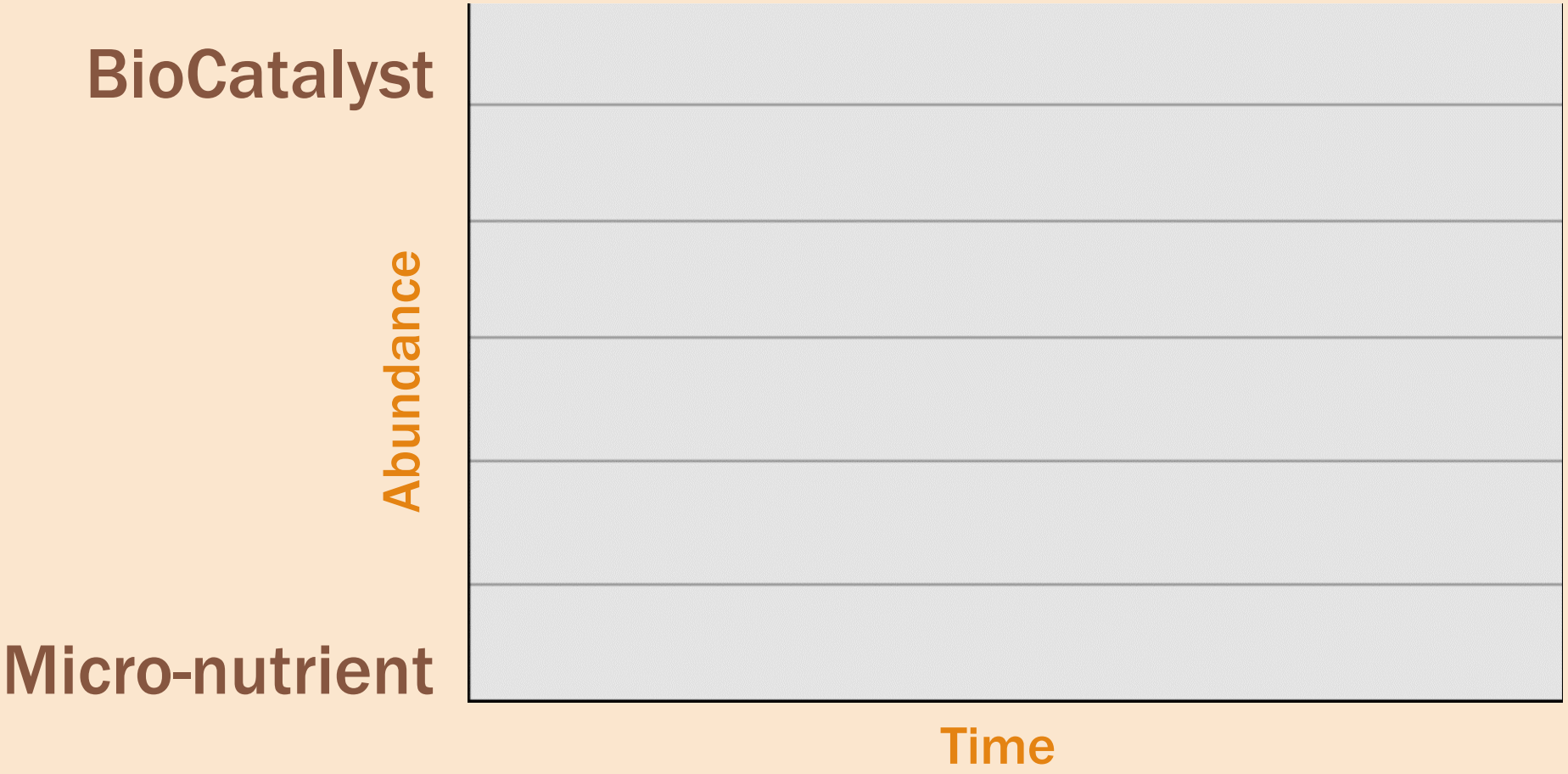
Build Floc Formers

- Micronutrient Blend
- Floc Formers Compete Better
- Helps Floc Digest Fatty Acids

Foam Buster: Foam Under 12" – 60 Day Treatment		
Flow Rate	**Initial Dose 30 Days**	**Maintenance Dose 30 Days**
10,000 GPD	0.25# per day	0.25# every other day
50,000 GPD	0.5# per day	0.25# per day
100,000 GPD+	1# per day	0.5# per day
500,000 GPD+	2# per day	1# per day
1 MGD	3# per day	1.5# per day
For faster results go up to 4x this amount. Works best when regular wasting.		

Qwik-Zyme L for Foam Microthrix Parvicella or under 12" AND WWTP Grease		
Flow Rate	**Initial Dose per day for 30 days**	**Maintenance Dose per day for 30 days**
10 TGD	4 ounces	2 ounces
50 TGD	1 pint	0.5 pint
100 TGD	1 quart	1 pint
200 TGD	2 quart	1 quart
300 TGD	3 quart	1.5 quart
400 TGD	4 quart	2 quart
500 TGD	5 quart	2.5 quart
1 MGD	2.5 gal	5 quart

Competitive Balance



Summary

- Address Incoming Grease
- Keep Sludge Age Down
- Remove Existing Filaments
- Digest Fats
- Boost Floc Formers

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2018 WEBINAR EVENTS

JANUARY 24TH	RESTORING NITRIFICATION
FEBRUARY 28TH	GETTING RID OF LAGOON SLUDGE
MARCH 28TH	TOXICITY IN YOUR WASTEWATER PLANT
APRIL 25TH	OVERCOMING LOW FOOD AND LOW F:M
MAY 30TH	KEYS TO ANAEROBIC DIGESTER STABILITY
JUNE 28TH	CAUSES OF AND SOLUTIONS TO
JULY 25TH	LAGOON ALGAE
SEPTEMBER 26TH	ELIMINATING RED WORMS & MIDGE FLIES
DECEMBER 5TH	TURNING GREASE INTO HELPFUL

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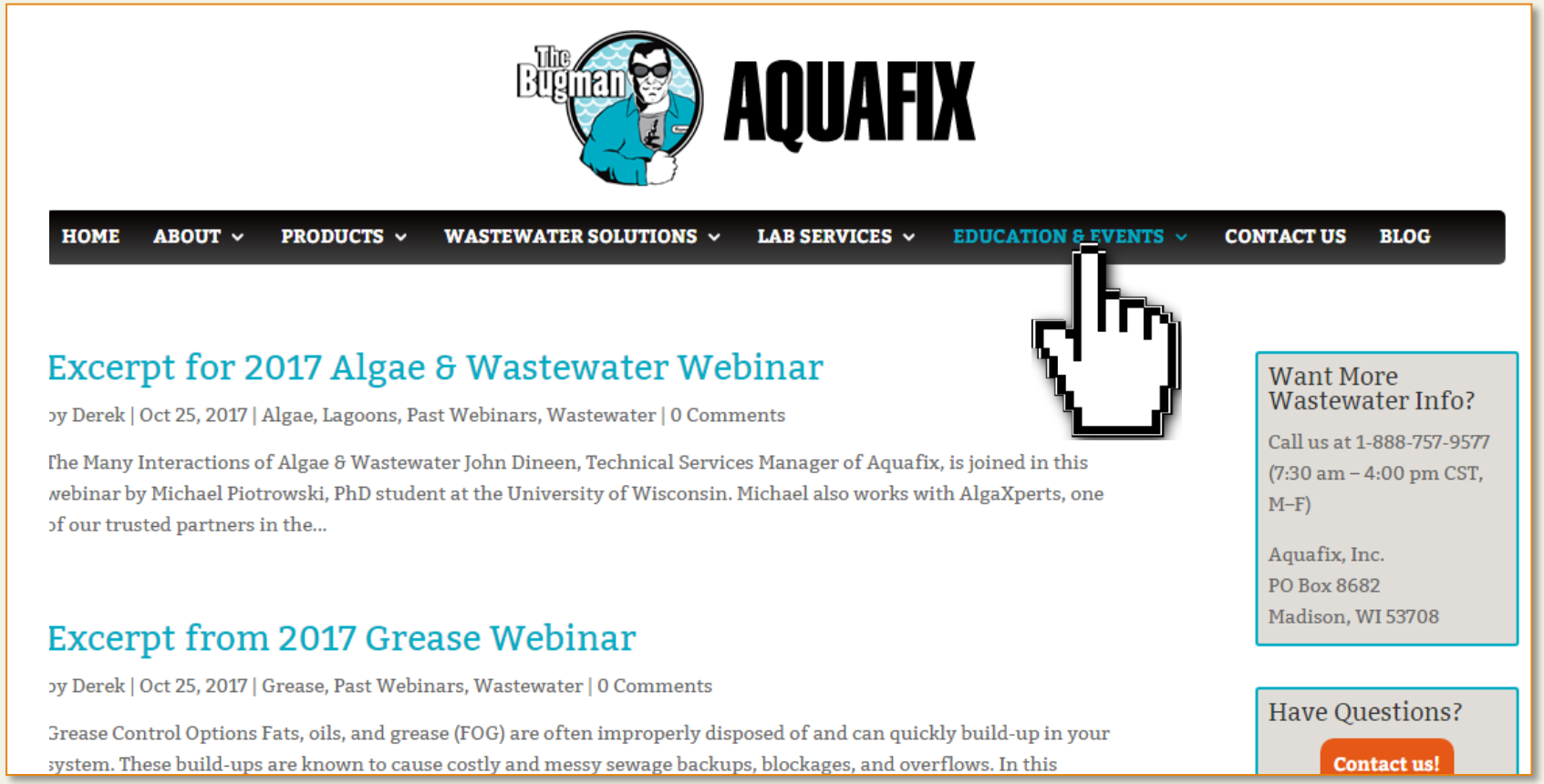

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