I. Low Dissolved Oxygen

*Sphaerotilus natans* (S.natans)

A) S. natans - False branching, 40X Phase contrast; B) 100X Oil immersion, Phase contrast; C) Sausage-shaped cells, 100X Oil immersion, Phase contrast; D) 100X Oil immersion, Brightfield, Gram negative sheathed filament. S. natans is favored in low DO conditions particularly when there is not enough oxygen for the applied organic loading. It is also often seen in systems that are organically overloaded (an organic overload will deplete the available oxygen). This filament is easily identified by its false branching.
**Type 1701**

Filament type 1701 is also favored in low DO conditions. The filament is most often seen with attached growth. The filament is small, with a tight fitting sheath and sausage-shaped cells; Gram negative 40X Phase contrast.

**Haliscomenobacter hydrossis (H. hydrossis)**

H. hydrossis is favored in low DO conditions. The filament is small and straight, has a sheath which is difficult to see due to its small size; Gram negative; 40X Phase contrast.
II. Septic wastes/sulfides; Low F/M (low organic loading); 
Nitrogen deficiency; organic acids

Filament Type 021N

Filament type 021N is easily identified by its discoid to barrel shaped cells. This filament can also grow on reduced sulfur compounds and will store sulfur granules inside the cell (C). The filament is Gram negative (B). A; C; D 100X Oil immersion; B 100X Oil immersion, Brightfield.
Thiothrix I & II both have a sheath with rectangular to barrel-shaped cells. Both have the ability to store sulfur granules. Thiothrix I (A) is larger than II (B). The filament is Gram negative (D). Apical gonidia and rosettes (C) are often seen. A, B, C 100X Oil immersion, Phase contrast; D 100X Brightfield.
Beggiatoa

Beggiatoa is also most often seen with intracellular sulfur granules. This filament is easily distinguished as it is the only filament that glides slowly through the water [Video B-1]. A) 100X immersion, Phase contrast; B) 40X Phase contrast.

Type 0914

Type 0914 is another sulfur oxidizing filament. The filament is Gram negative and is often seen with rectangular to square shaped sulfur granules; 100X Oil immersion, Phase contrast.
Filament type 0041 is often seen with heavy attached growth (A,B). The filament stains Gram variable. 100X Oil immersion; Phase contrast (A,B); 100X Oil immersion, Brightfield (C,D).
Filament type 0675 is very similar to type 0041 both are often seen with attached growth (B), and have square shaped cells. However type is larger. The filament stains Gram variable. 100X Oil immersion; Brightfield (A); 100X Oil immersion, Phase contrast (B).

Filament type 1851 is often sparse attached growth (A,B). The filament stains Gram variable (B). 100X Oil immersion; Phase contrast (A); 100X Oil immersion, Brightfield (B).
IV. Low F/M; Low organic loading; High grease, Oils fats

Type 1863

In addition to low F/M and excess grease, fats and oils, filament type 1863 is favored when there is a decline and aeration basin pH. The filament is Gram negative and is often seen in small clumps (C,D). This filament can cause foaming in the aeration basin. 100X Oil immersion; Phase contrast (A,B,D); 100X Oil immersion, Brightfield (C).
Nocardia

In addition to low F/M and excess grease, fats and oils, Nocardia is favored in warmer temperatures and longer MCRT’s. The filament is easily identified by its strong Gram positive reaction and short branched structure. Nocardia does not cause bulking but can cause severe foaming in the aeration basin, clarifiers and wet wells. 100X Oil immersion; Phase contrast (A); 100X Oil immersion, Brightfield (B,C,D).
In addition to low F/M Microthrix parvicella, favor animal and vegetable greases oils and fats and colder temperatures. This filament is easily identified using the Gram stain. It is strongly Gram positive. This filament can cause both bulking and foaming in the treatment system.

V. Miscellaneous Types of Filamentous Bacteria

Type 0961

This filament has a unique almost transparent structure. It is favored in treatment systems with very low soluble BOD.