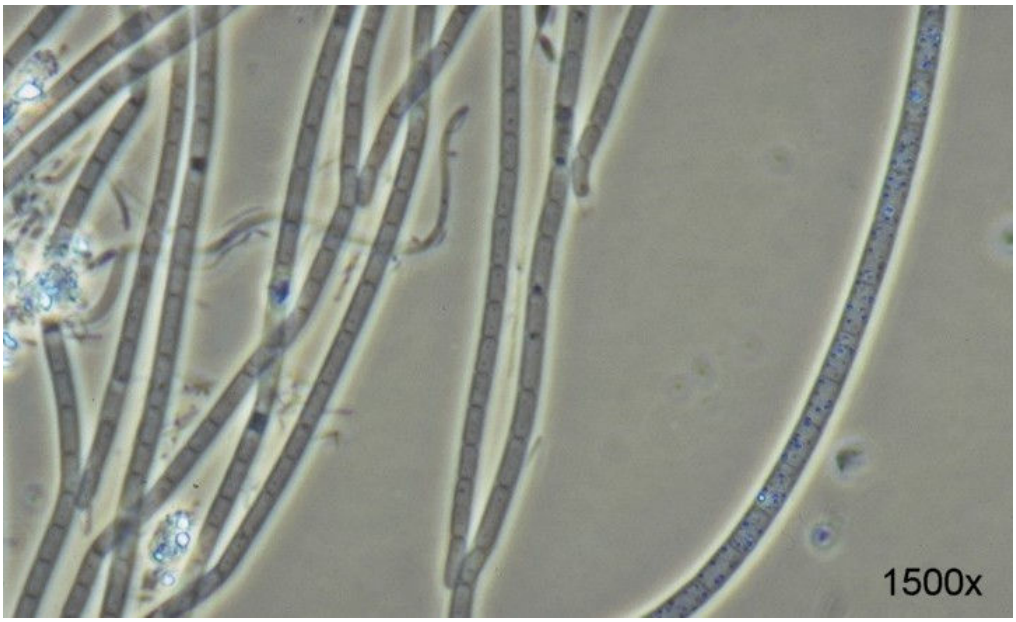
Sphaerotilus natans

Resembles: see remarks
Probes: Group specific : BET-42a [4]; species specific: SNA [6]
Frequency occurrence (200 samples; 175 WTPs):

- observed with a FI ≥ 1 in 8 samples
- observed with a FI ≥ 3 in 1 sample



***S. natans* plus a *Thiothrix*-4 filament**

Characteristics

- straight or bent filaments, occasionally in bundles;
- short filaments or single cells inside the floc, larger filaments protruding from the flocs or free in the liquid between the flocs;
- filament length variable, but frequently > 200 μm;
- filaments often falsely branched;
- not motile;
- cell diameter ca. 1.0 – 1.3 μm;
- sheath present;
- attached growth might be present;
- septa clearly visible;
- rectangular or rod shaped cells;
- no sulphur storage, but other granules might be present;
- Gram negative;
- Neisser negative.

Remarks

Sphaerotilus natans and *Leptothrix discophora* belong to the Betaproteobacteria. They share an almost identical morphology, which means that probes are indispensable to distinguish these species from each other in activated sludge.

If branching is absent, *S. natans* can be mistaken for Type 0041 (Gram positive, shorter cells), Type *Thiothrix*-021N (shorter cells, no attached growth, no sheath), *Thiothrix*-4 (S-storage) or with Type 0961 (cells longer and distinctly transparent).

Physiology
S. natans does not have special nutritional requirements, which means that it can use a broad spectrum of compounds for its growth. Additional energy can be derived from the oxidation of iron compounds. Lack of oxygen, nitrogen or phosphorus favours its growth. Due to its aerobic metabolism, *S. natans* cannot grow, however, in zones where molecular oxygen is missing.

Occurrence in activated sludge
S. natans was observed in WTPs treating wastewater from food, pulp & paper, dairy, brewery and chemical industries. Thus, it is not possible to correlate this species with a specific wastewater.

Growth of *S. natans* is stimulated by a high sludge load (> ca. 0.2 kg BOD/kg MLSS.day).

Control options
The common possibilities aimed at solving a bulking problem are listed below (1-7). Growth of *S. natans* can be controlled by the application of selectors as well as through a two step configuration. It is always recommended to start with a pilot scale experiment before a selected control method is applied on a full scale.
References for further reading about process control: 1, 2, 3 and 5.

1. Good "House-keeping"
2. Remove deficiencies: O_2 > 2 mg/l and BOD:N:P =100:5:1.
3. Two step configuration (aerobic/aerobic or anaerobic/aerobic), in order to remove most of the easily degradable influent fraction before this enters the aeration tank.
4. Aerobic selector.
5. Anoxic zone if sufficient nitrite/nitrate is available for removal of the dissolved fraction from the influent through denitrification.
6. Anaerobic zone if a combination with a Bio-P process is an option.
7. Controlling symptoms, viz. applying physical or chemical methods aimed at destroying the filaments or at improving the settling velocity of the flocs by increasing their weight.

References
1. Eikelboom, D. H. (2000) *Process control of activated sludge plants by microscopic investigation*. IWA Publishing, London, UK.
2. Jenkins, D., M. G. Richard and G. T. Daigger (2004) *Manual on the causes and control of activated sludge bulking, foaming and other solids separation problems.* IWA Publishing, London, UK.
3. Lemmer, H und G. Lind (2000) *Blähschlamm, Schaum und Schwimmschlamm – Mikrobiologie und Gegenmassnahmen.* F. Hirthammer Verlag, München, Germany.
4. Manz, W., R. Amann, W. Ludwig, M. Wagner and K. H. Schleifer (1992) Phylogenetic oligodeoxynucleotide probes for the major subclasses of Proteobacteria: problems and solutions. *Sys. Appl. Microbiol*., **15**, 593-600.
5. Tandoi, V., D. Jenkins and J. Wanner (2005) *Activated sludge separation problems – Theory, Control Measures, Practical Experiences.* IWA Publishing, London, UK.
6. Wagner, M., P. Amann, P. Kämpfer, B. Assmus, A. Hartmann, P. Hultzler, N. Springer and K. Schleifer (1994) Identification and *in situ* detection of Gram-negative filamentous bacteria in activated sludge. System. *Appl. Microbiol*. **17**, 405-417.

Slide show images
- 1-4: morphology at a low magnification: frequently false branching and occasional bundles of filaments
- 5-12: morphology at a high magnification showing false branching and rod shaped or rectangular cells
    - 11: plus *Thiothrix*-4 filament
- 13: FISH image with probe SNA