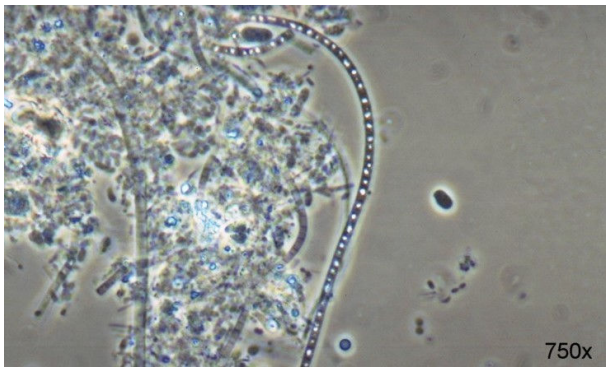
Type 0803/0914

Resembles: see remarks
Probes: not available, see remarks
Frequency occurrence (200 samples; 175 WTPs):

- observed with a FI ≥ 1 in 31 samples
- observed with a FI ≥ 3 in 4 samples

Type 0803



Type 0914

Characteristics

- short (<50 µm) straight, or longer (100-300 µm) bent filaments;
- filaments protruding from the flocs as well as free in the water phase between the flocs;
- filaments sometimes attached by a so-called holdfast to inorganic particles;
- filaments may stick together in bundles;
- filaments not branched, but rosettes of filaments, due to attachment of filaments at their basis to each other or to inorganic particles, are occasionally observed;
- not motile;
- filament length variable;
- cell diameter 0.8 - 1.1 µm;
- sheath absent;
- attached growth absent;
- septa clearly visible;
- square or (rarely) rectangular cells;
- if sulphur is stored, Type 0803 changes into Type 0914. Stored sulphur can be removed by bringing a droplet of ethanol to one side of the cover glass and filter paper to the opposite side. The ethanol will flow through the slide causing the sulphur granules to dissolve and Type 0914 changes into Type 0803;
- Gram variable, but usually Gram negative
- occasionally Neisser positive (grey-violet filaments)

Remarks

The Types 0803 and 0914 were considered as different filamentous species in the past [2]. However, as they sometimes occur together and intermediate morphotypes can be observed, it seems likely that both morphotypes represent one species. A second possibility could be that Morphotype 0803 includes two species: one of them may change into Type 0914 while the other does not.

Filaments resembling Type 0803 do have their general appearance in common (almost square cells with a diameter < 1.2 µm), but may differ from each other as the size of the filaments, the ability to store sulphur, the presence or absence of a holdfast, the staining results and the occurrence of bundles of filaments are considered. Thus, it is a heterogeneously composed group and each morphologically based classification into subgroups is rather arbitrary. However, although it is known that intermediate

forms exist and might cause confusion, it is the only possible method as genetic probes are largely missing so far. The Type 0803 resembling filaments are classified as follows on this CD-ROM:

- Type 0803/0914: straight or bent filaments; diameter: 0.8 – 1.1 µm. Type 0803 does not contain stored sulphur granules and stains usually Gram negative. Type 0914 is characterized by sulphur inclusions and stains always Gram positive. As Type 0803 may change into Type 0914, intermediate forms are sometimes observed.
- Type IF-9: much longer, bent or curled Gram negative filaments, occasionally tangled.
- Type IF-42: hybridises with probe EU17-648. It is the only Type 0803 resembling morphotype that can be identified by applying FISH.
- Type IF-57: long, bent filaments with a diameter of ca. 0.7 µm. Always Gram positive, but sulphur storage was never observed.
- Type IF-67: short filaments with a diameter of about 0.6 µm. Gram negative, no sulphur storage and neither bundles of filaments nor attachment through a holdfast to inorganic particles.
- Type IF-70: almost idem Type IF-67, but Neisser positive.

A Type 0803 resembling pure culture has been classified as a member of the *Rubrivivax* subgroup of the Betaproteobacteria [1]. A probe targeting this species is not yet available.

Physiology
Reliable data are not available

Occurrence in activated sludge
Larger Type 0803/0914 populations were observed in WTPs treating wastewater originating from various industrial branches: potato, rendering, chemical, gelatine, brewery and fish industries and in WTPs for treatment of manure. Thus, it is not possible to correlate these morphotypes to a specific wastewater. Considering that sulphur is stored by Type 0914, it seems likely that a 'stale sewage' or wastewater rich in reduced sulphur compounds favours Type 0803/0914.

Control options
The common possibilities aimed at solving a bulking problem are listed below (1-7). Full scale experience with controlling this filamentous morphotype is not available.
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: 3, 4, 5 and 6.

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 largely 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. Bradford, D., P. Hugenholtz, E.M. Seviour, M.A. Cunningham, H.M. Stratton, R.J.Seviour and L.L. Blackall (1996) 16S rRNA analysis obtained from gram negative, filamentous bacteria micro-manipulated from activated sludge. *Syst. Appl. Microbiol*. **19**, 334-343.
2. Eikelboom, D. H. (1975) Filamentous organisms observed in activated sludge. *Water Research* **9**, 365-388.
3. Eikelboom, D. H. (2000) *Process control of activated sludge plants by microscopic investigation*. IWA Publishing, London, UK.

4. Jenkins, D., M.G. Richard and G.T. Daigger, G.T. (2004) *Manual on the causes and control of activated sludge bulking, foaming and other solids separation problems*. IWA Publishing, London, UK.
5. Lemmer, H und G. Lind (2000) *Blähschlamm, Schaum und Schwimmschlamm – Mikrobiologie und Gegenmassnahmen.* F. Hirthammer Verlag, München, Germany.
6. Tandoi, V., D. Jenkins and J. Wanner (2005) *Activated sludge separation problems – Theory, Control Measures, Practical Experiences*. IWA Publishing, London, UK.

Slide show images

- 1-2: morphology at a lower magnification; rosettes are only rarely present
- 3-5: short, usually straight, Type 0803 filaments
- 6-8: longer, bent, Type 0803 filaments
- 9-10 : attachment by an holdfast to inorganic particles
- 11: occasionally bundles of filaments
- 12-15: rarely formation of rosettes
- 16: filaments start to store sulphur → Type 0803 changes into Type 0914
- 17: Type 0914
- 18: Type 0914 + Type 0803
- 19-20: more tiny, Type 0803/0914 resembling filaments
- 21: Gram negative Type 0803 filaments
- 22: Gram positive Type 0803 filaments
- 23: Bundle of Gram positive Type 0803/0914 filaments
- 24: Occasionally Neisser positive