Type 0092

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

- observed with a FI ≥ 1 in 13 samples
- observed with a FI ≥ 3 in 6 samples

Characteristics

- straight or bent filaments, usually protruding from the flocs;
- not motile;
- not branched;
- filament length often < 200 µm;
- cell diameter ca. 0.6 µm;
- no sheath;
- attached growth absent;
- septa hardly visible;
- no sulphur storage;
- Gram negative;
- Neisser positive (grey-violet filaments).

Remarks

Although it is stated in the literature that Type 0092 belongs to the *Cytophaga-Flexibacter* group within *Bacteroidetes* [1,7], Type 0092 resembling morphotypes present in industrial sludges did not hybridise with the group specific probe CF-319a. Other published probes targeting the *Cytophaga-Flexibacter* group [5] were not applied during Dynafilm.

The following morphotypes have in common that they form thin, straight or bent filaments in which the cell septa are not clearly visible:

1. *H. hydrossis*: Gram and Neisser negative; usually protruding from the flocs.
2. Type IF-33: very short filaments, mainly inside the flocs.
3. Type IF-45: Neisser positive (granules).
4. Type IF-46: Gram and Neisser positive (granules).
5. Type IF-47: filaments free in the water phase.
6. Type IF-53: compared with *H. hydrossis* more robust filaments, occasionally tangled.

7. Type 0092: compared with *H. hydrossis* more robust filaments, which stain entirely grey-violet with Neisser.

Physiology
Hardly any reliable data available

Occurrence in activated sludge
Type 0092 is a common low F/M species in domestic WTPs, especially if nutrient removal conditions are applied. The population size shows a seasonal rhythm in Dutch treatment plants. The population increases during summer and decreases again at lower winter temperatures, a development more or less complementary to the size of the *M. parvicella* population.

Large populations of Type 0092 were observed in industrial plants receiving wastewater from rendering, chemical, sugar and fish industries. Thus, it is not possible to correlate this filamentous bacterium with a specific wastewater.

Control strategies
The common possibilities aimed at solving a bulking problem are listed below (1-7). Full scale experience with controlling Type 0092 by applying selectors is hardly available and the published results are not very consistent.
It is always recommended to start with a pilot scale experiment before a selected control method is applied on full scale.
References for further reading: 2, 3, 4 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
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2. Eikelboom, D. H. (2000) *Process control of activated sludge plants by microscopic investigation*. IWA Publishing, London, UK.
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4. Lemmer, H und G. Lind (2000) *Blähschlamm, Schaum und Schwimmschlamm – Mikrobiologie und Gegenmassnahmen.* F. Hirthammer Verlag, München, Germany.
5. O'Sullivan, L. A. and A.J. Weightman (2002) New degenerate *Cytophaga-Flexibacter-Bacteroides*-specific 16S ribosomal DNA-targeted oligonucleotide probes reveal high bacterial diversity in river Taff epilithon. *Appl. Environ. Microbiol.* **68**, (1), 201-210.
6. Tandoi, V., D. Jenkins and J. Wanner (2005) *Activated sludge separation problems – Theory, Control Measures, Practical Experiences.* IWA Publishing, London, UK.
7. 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 high magnification

- 5: Gram stained
- 6-8: Neisser stained