Protozoa as Bio-indicators of...

Polysaprobic

(a)

Amoeba

(b)

Bodo caudatus

(c)

Euglypha

(d)

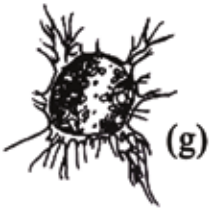
Peranema trichophorum

(e)

Tetrahymena pyriformis

(f)

Trepomonas agilis



(g)

Vampyrella

alpha-polysaprobic

(h)

Chilodonella unicinata

(i)

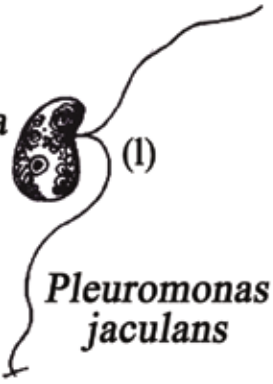
Difflugia

(j)

Hexamitus fissus

(k)

Litonotus fasciola



(l)

Pleuromonas jaculans

(m)

Podophrya fixa

(n)

Vorticella convallaria

Mixed Liquor Saprobic Conditions

beta-mesosaprobic

(o)

Arcella

(p)

Apsidisca costata

(q)

Euplotes affinis

(r)

Opercularia microdiscum

(s)

Tokophyra quadripartite

(t)

Trachelophyllum pusillum

(u)

Vorticella alba

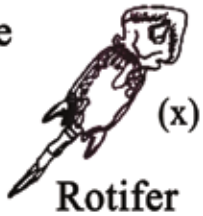
Oligosaprobic

(v)

Epistylis rotans

(w)

Nematode



(x)

Rotifer

(y)

Stylonchia pustulata

(z)

Vorticella nebulifera

(aa)

Vorticella striata

By Brittany Lytle and Michael H. Gerardi

(Continued on page 34)

Protozoa as Bio-indicators of Mixed Liquor Saprobic Conditions

(Continued from page 33)

Brittany Lytle and Michael H. Gerardi

Although dominant protozoan groups can be used as bio-indicators of the health of the mixed liquor and quality of the mixed liquor effluent as illustrated in the poster 'Protozoan Groups as "Bio-indicators" of the "Health" of the Activated Sludge Process,' (*The Keystone Tap*, Fall 2011) there are exceptions to the use of dominant groups. These exceptions occur because some species in protozoan groups become dominant under conditions that are atypical for that group. These species have generation times and tolerance limits to operational conditions that differ significantly from most species in their groups. The dominance of specific protozoa is due to the following:

- Rapid flow rates favor organisms with short generation times and a small diversity of life-forms (small flagellates and small ciliates).
- Slow flow rates favor organisms with short and long generation times and a large diversity of life-forms (crawling ciliates, stalked ciliates, rotifers, and free-living nematodes).
- High organic loadings produce low dissolved oxygen concentrations that favor protozoa that can survive anaerobic conditions (amoebae, flagellates, and small ciliates).
- Low organic loadings produce high dissolved oxygen concentrations that favor organisms that are strict aerobes (crawling ciliates, stalked ciliates, suctoria, rotifers, and free-living nematodes).
- Low organic loadings and high dissolved oxygen concentrations favor a large diversity of life-forms. The use of specific species of protozoa as bio-indicators of water quality or mixed liquor quality is based on the saprobic index and illustrated in the poster 'Protozoa as "Bio-indicators" of Mixed Liquor Saprobic Conditions' in this issue of *The Keystone Tap*. The index uses indicator species including protozoa based upon their pollution tolerance.

The saprobic system classifies the stages or conditions of deterioration and recovery of communities of organisms – bacteria, algae, protozoa, rotifers, benthic invertebrates and fish – in response to organic enrichment or pollution. The system splits a river downstream of a source of pollution into four categories based on a description of the specific organisms present. These categories include the following indices from most polluted to least polluted:

- Polysaprobic = most polluted
- Alpha-polysaprobic
- Beta-mesosaprobic
- Oligosaprobic = least polluted

The indices are developed by the natural cleansing processes of the river as the pollutants are degraded over distance travelled in the river. The activated sludge process does not use the nature cleansing processes of the bacteria and protozoa in the mixed liquor over distance but rather over time (HRT and MCRT) with a concentrated population of bacteria and protozoa.

Protozoa in large numbers that are commonly associated with a polysaprobic condition – a severely overloaded operational condition – include the naked amoebae *Amoeba* (a) and *Vampyrella* (g), the testate amoeba *Euglypha*, the flagellates *Bodo caudatus* (b), *Peranema trichophorum* (d) and *Trepomonas agilis* (e) and the free-swimming ciliate *Tetrahymena pyriformis* (e).

Protozoa in large numbers that are commonly associated with an alpha-polysaprobic condition – an overloaded organic condition – include the testate amoebae *Difflugia* (i), the flagellates *Hexamitus fissus* (j) and *Pleuromonas jaculans* (l), the free-swimming ciliates *Chilodonella uncinata* (h) and *Litonotus fasciola* (k), the stalk ciliate *Vorticella convallaria* (n), and the suctorian *Podophrya fixa* (m).

Protozoa in large numbers that are commonly associated a beta-mesosaprobic condition – high organic loading condition – include the testate amoeba *Arcella* (o), the free-swimming ciliate *Trachelophyllum pusillum* (t), the crawling ciliates *Aspidisca costata* (p) and *Euplotes affinis* (q), the stalk ciliates *Opercularia microdiscum* and *Vorticella alba* (u), and the suctorian *Tokophrya quadripartite* (s).

Organisms in large numbers that are commonly associated with an oligosaprobic condition – a low organic loading condition – include the crawling ciliate *Stylonchia pustulata* (y), the stalk ciliates *Epistylis rotans* (v), *Vorticella nebulifera* (z), and *Vorticella striata* (aa), the free-living nematode (w), and the rotifer (x).