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THE importance of Protozoa in determining the condition of the sludge has been reported by a number of workers and, more recently, the special significance of Vorticella has been emphasized by Pillai[1, 2] and Reynoldson[3]. Further detailed study has revealed the special role of the genus Epistylis, of which not less than six species have been found to be actively associated with the installations in India. These forms flourish in the aeration chambers, forming fluffy masses attached to the sides of the aeration tanks.

During aeration, the Epistylis, which number at least 16,000 per ml., get largely dispersed and thus come into direct contact with the colloids of the sewage which they collect and carry down in the form of flocs. Experiments with isolated forms have shown that, in this action, the Epistylis are at least twice as efficient as the Vorticella and many times more so than all the other forms put together.

The exact mechanism of flocculation is still somewhat obscure. The Protozoa carry a negative charge which is of the same sign as that of the colloids of sewage; they do not secrete any enzyme possessing any marked clotting action excepting on milk. They have, nevertheless, a direct action on sewage colloids in a manner resembling, but more efficient than, that of chemical flocculents.

Parallel studies with activated sludge as well as the equivalent suspension of mixed Epistylis (with the associated bacteria) have shown that the latter accounts for more than 70 per cent of the reduction in 4 hr. oxygen absorption, albuminoid and ammonia nitrogen observed in the former. About 80 per cent of the total nitrification also takes place in presence of Epistylis. Besides concentrating nitrogen in the sludge, the Epistylis cells themselves are quite rich in nitrogen, containing more than 8 per cent dry weight.

Other observations may be summarized as follows:

Prolonged aeration, especially without any inflow of raw sewage, leads to the steady disruption of the protozoan cells and even their ultimate disappearance. This condition, which is associated with the black or 'burnt out' sludge, shows that steady inflow of raw sewage is necessary for the development and active functioning of Protozoa.

With reduced air supply, the protozoan cells tend to diminish in numbers. The little sludge that is left is not reactive and does not settle readily. It gets filled with gases formed by bacterial action and eventually floats up. The phenomenon of 'bulking' which is often noticed under such conditions can thus be explained.

The reversion of the sludge observed either on prolonged standing or during sludge digestion is a drastic form of the above phenomenon, the protozoan cells first floating up, then getting disrupted and finally digested by the bacteria.

Even under conditions of adequate aeration, the presence of certain other forms of life interferes with functioning of the Protozoa and hence the purification. An outstanding example of this is the invasion of the Chironomus larvæ[4], which, under certain conditions, enter the tank in large numbers. These attack the Protozoa, especially those of the Epistylis sp., using the slimy colonies for the formation of their characteristic protective tubes and for their food. As the result of this, the functioning of the process is completely paralysed; and until the larvæ are completely destroyed and the plant re-started, there is no purification to be seen.

Some preliminary studies on the origin of the Epistylis sp. have shown that they are derived from the soil and that, though originally present in very small numbers, they multiply rapidly on aeration. Once established in the tank, they stay on and continue to function until they are destroyed by one or other of the agencies mentioned above.

It would thus appear that the start as well as the efficient functioning of the activated sludge process is mostly dependent on Protozoa which are responsible, directly or otherwise, for not only sludge formation but also the attendant oxidation changes.

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