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SOME ASPECTS OF THE MICROBIOLOGICAL ACTIVITY OF THE MANGERE OXIDATION PONDS.

by

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CONTENTS

SUMMARY

1. A general introduction to the theory, operation and biological activity of oxidation ponds has been given as well as specific introductions to the two areas of research studied, namely the role of fungi and some aspects of the nitrogen cycle in the Mangere oxidation ponds.

2. The enumeration and identification of fungi present in the bottom layers of the pond showed that the numbers were not sufficiently large to make a valuable contribution to the degradation of organic material in that particular environment. The dominant fungi present were species of the genera Penicillium, Mucor, Trichoderma and Geotrichum.

3. Isolates of some of the fungi most frequently isolated from these lower regions were grown under conditions of low redox potential. It was found that although the fungi did grow over the one month test period, they did not show great metabolic activity.

4. Direct examination of pond water containing a whitish glassy scum showed only the presence of clumps of heterogeneous biomass but no dominant microorganism. Filamentous yeasts isolated from these scum samples formed a surface layer when grown in liquid medium. When inoculated into pond water it appeared that these filamentous yeasts formed a matrix to which the biomass adhered producing a condition similar to that seen in the original samples.

5. Use of ultra thin layers of cetyl alchol prevented scum formation by these filamentous yeasts but not growth in the medium underneath. Larger scale trials would be required to determine if this method is feasible for reducing scum formation in oxidation ponds.

6. Investigation of the proteolytic activity of pond sludge showed that the part of the nitrogen cycle which concerns the degradation of protein was present and active in the oxidation ponds. Proteolytic activity was found to increase with increasing depth of pond water up to the maximum (220 cm) tested. This suggests that increasing the depth of the ponds to approximately 185 cm (6 ft.) would improve pond efficiency in relation to degradation of protein.

7. The bacteria responsible for nitrification in the oxidation pond surface water were isolated and identified. Nitrosomonas was responsible for the oxidation of ammonia to nitrite and Nitrobacter for the oxidation of nitrite to nitrate. A twelve month survey of these bacteria showed that their numbers increased or decreased in relation to seasonal changes. Nitrite accumulated only when large numbers of Nitrosomonas were present. Statistical analysis of the data obtained indicated that populations of these bacteria were influenced by pH, alkalinity and ammonia.

8. Enumeration of denitrifying bacteria at different pond depths showed that greatest numbers were present in the sludge and interface although they were well distributed through the aqueous phase.

9. Identification of the isolated denitrifying bacteria showed that they were strains of Pseudomonas denitrificans, Micrococcus denitrificans and Bacillus licheniformis. Their identity was confirmed by comparison with standard cultures.

10. The denitrifying properties of these bacteria were studied to compare their ability to remove nitrate, as well as their reaction to additives. All three bacteria were able to remove low levels of nitrate but high nitrate concentrations were shown to be inhibitory. The use of additives to promote denitrification appeared to depend on the additive and the bacterium and not on the carbon nitrogen ratio. Of the materials tested glucose was the most satisfactory and methanol the most inhibitory. Further work is necessary to clarify the role of methanol because in small scale studies with sewage effluents in other laboratories it has been found to be most efficient in promoting denitrification.

11. Continuous measurements of the redox potential interface of sludge, and pond top liquid (10-15 cm. from the surface) revealed that the electronegative potential of the sludge remained remarkably steady. When the electrode was at either the interface or near the surface it recorded a distinct diurnal pattern. In pond top liquid the length of the positive potential period was dependent on day length. A change from the normal redox potential pattern of pond top liquid preceded deterioration of pond stability. The pattern returned to normal after a change in environmental conditions. It appears that continuous redox potential measurements could be valuable in showing changes in pond performance before they can be detected by other methods.