Chapter 7

CONCLUSIONS

The microbiology of cooling water systems has been extensively researched and thus our understanding of the microorganisms and processess involved has expanded. However, this study clearly showed that there are still numerous problems that face the industrial microbiologist.

Microbiological surveys were carried out on the recirculating cooling waters and corresponding raw water supplies at 12 power stations. Microbiological analyses of the water samples revealed that total aerobic and anaerobic bacteria, anaerobic acid producing bacteria, *Thiobacillus, Nitrobacter*, SRB and algae were present in all the recirculating cooling waters and raw water supplies with the exception of two potable raw water supplies. Although in 75% of the systems the numbers of SRB were higher in the recirculating cooling waters than in the raw water supplies, no correlation between SRB numbers and sulphate concentration could be distinguished. In addition no correlation between the percentage increase in the numbers of total aerobic bacteria and cycles of concentration was evident. The raw water supplies predominantly contained green algae and diatoms whereas in the recirculating cooling water systems algae deposits consisted primarily of blue green algae.

Variations exist between the environmental conditions, water quality and composition in the raw water supply and recirculating cooling water at a power station (Mc Coy, 1980). These changes in environmental and system conditions appeared to have a significant influence on the extent of microbiological contamination in any given system. Thus each system was found to be unique, and the need for the monitoring of each individual system was highlighted.

The individuality of cooling water systems was also highlighted when biodispersant/biocide treatment programmes were monitored at four power stations. Biodispersants resulted in increases in numbers of planktonic bacteria ranging from 22592% to 654%, and biocides in percentage kills of between 83.2 to 100%. Decreases in the numbers of sessile aerobic bacteria always occured when a biodispersant was added to the system and in 80% of the cases when a biocide was added. System inspections revealed that removal of sessile microorganisms and inorganic deposits occured. Although the combinations of biodispersnats and biocides were effective in controlling microbiological growth, they had varied effects in different systems and therefore have to be evaluated for each individual system.

The monitoring of cooling water systems is problematic. Although general trends can be distinguished, the wide variety of environmental conditions in any one cooling water system,

constrain the accuracy of any monitoring device. Monitoring devices using both direct (bacterial numbers) and indirect (effect of bacterial activity or MIC) were evaluated in this study. Four monitoring devices using direct techniques were evaluated at a power station. The devices were the Robbins device, modified Robbins device, Pedersen Device and the Barry's Device. The Pedersen device was discared after one week as it could not simulate system conditions. Statistically significant differences were found between the numbers of bacteria recovered from the sampling surfaces of the remaining three monitoring devices. The numbers of bacteria recovered from the modified Robbin's device were consistently higher than the numbers recovered from the Robbin's device and Barry's device. This was thought to be due to the modification made to the Robbin's device which was to countersink the stud into a stud holder and to increase the surface area by a factor of 10. The indirect technique evaluated was a corrosion monitor using the linear polarisation technique. Bacterial attachment occured uniformly on the electrodes of the device, indicating that this technique can be used to monitor the corrosive effects of sessile bacteria. The corrosion monitor was also evaluated in four pilot rigs. After the addition of a biocide to two of the rigs, a statistically significant decrease occured in the corrosion rate in these two rigs when compared to the untreated control. Thus it was concluded that this technique can be utilised to monitor sessile microbiological activity as well as biocide efficacy.

Due to increasing industrialisation and recurring droughts, the demand for water in South Africa will increase and the quality of water will deteriorate in the future. Thus, there is a need for intensified research into the practical implementation of methods of monitoring and mitigating the effects of microorganisms in cooling water systems.