The thesis deals with the studies conducted to understand biofouling and microbially influenced corrosion (MIC) of structural materials used in cooling water systems. Since severe corrosion problems were encountered in the carbon steel piping of the cooling water system of the Fast Breeder Test Reactor (FBTR) at Kalpakkam, emphasis has been given to the study of carbon steel. However, condenser tube materials such as stainless steel, brass, admiralty brass and titanium alloys were also included in the study.

Since subsoil water (Palar water), collected from Palar river basin and stored in an open reservoir, is used for cooling purposes in FBTR, the changes in the quality of this water on storage and the seasonal variations in the water quality of the open reservoir were studied for one year. The short-term and long-term effects of seasonal changes in water quality on the corrosion rates of carbon steel (CS) and biofouling of stainless steel (SS), brass, admiralty brass and titanium were also investigated. The water quality parameters such as total dissolved solids, conductivity and more especially nitrates and phosphate showed a decrease whereas pH, dissolved oxygen content and total viable counts of bacteria showed an increase on storage of the water in the open reservoir. The main reason for the above changes in water quality on storage in the open reservoir is the excessive growth of microalgae and macrophytes in the reservoir. The corrosion rates of CS determined during different months were found to vary with the microbial density on the coupons. As to be expected, both titanium and stainless steel showed high biofouling when compared to copper-base alloys such as brass and admiralty brass.

The influence of dissolved oxygen content, microbial density and flow rates on the tuberculation of CS was studied in tap water in the laboratory as well as in the open reservoir water. No tuberculation was observed in raw water under static conditions or in 'sterile' water under dynamic conditions. Both nucleation and growth of tubercles were found to increase with increase in the flow rate of tap water up to a maximum flow rate of 120 L/h. These observations tend to indicate a possible mechanism involving formation of oxygen concentration cell for the growth of tubercles. Calcium carbonate precipitation possibly mediated by algal photosynthesis on coupons exposed to reservoir...
water under normal day/night conditions was found to inhibit tuberculation. X-ray diffraction studies of corrosion products formed on carbon steel showed that the ferrihydrite formed in the presence of iron-oxidizing bacteria is poorly crystalline and hence has a tendency to form aggregates facilitating tuberculation.

In order to understand the influence of biofilms formed by microorganisms on the corrosion behaviour of SS in fresh water, electrochemical techniques such as cyclic potentiodynamic polarization and open circuit potential (OCP) monitoring were used. The OCP monitoring studies showed an ennoblement (about 200 mV) in OCP in raw water after exposure for 30 days. However, the coupons exposed in 'sterile' reservoir water did not show any ennoblement. Cyclic potentiodynamic polarization studies were carried out using coupons with biofilms developed in open reservoir water under normal day and night conditions as well as under continuous dark conditions. In addition, in order to study the effect of biofilms formed by individual species of microorganisms on the polarization behaviour, SS specimens with biofilms of *Pseudomonas* sp. (aerobic bacteria), *Desulfovibrio* sp. (anaerobic bacteria), *Oscillatoria* sp. (blue green alga) and *Coelastrum* sp. (green alga), developed by exposing coupons to pure cultures of these microorganisms, in the laboratory, were also tested. Polarization curves of SS with various types of biofilms developed in the natural environment showed that biofilm formed in the open reservoir and exposed to natural day and night cycles showed maximum density of bacteria and algae and the passive current of the SS increased to a stage where a well-defined passive region was absent in the case of coupons with 120-day old biofilm. However, none of the pure-culture biofilms affected the passivity of SS significantly.

Studies were also done to evaluate the efficacy of a non-oxidizing biocide, 2-Bromo-2-nitropropane-1,3-diol (BNPD) (Legocide) in controlling the microbial colonization of metal surfaces. Comparative studies on the biocidal efficacy of legocide on planktonic and sessile bacteria showed that this biocide achieved 90% reduction in bacterial density in water at 20 ppm concentration and on specimens at 40 ppm concentration, after 5h contact time. However, studies on the effectiveness of legocide on developed biofilms on SS specimens exposed to static biocide-treated water showed only less than 50% reduction in total viable counts of bacteria after 24h contact time. Time series studies on the rate of mortality of sessile bacterial cells on coupons compared to that of planktonic cells under 100 ppm legocide concentration showed that legocide achieved 50% cell reduction on coupons only after 4h, as compared with 0.5h in water.