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MONITORING AND CONTROL OF BIOFOULING IN POWER UTILITY OPEN RECIRCULATING COOLING WATER SYSTEMS

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MONITORING AND CONTROL OF BIOFOULING IN POWER UTILITY OPEN RECIRCULATING COOLING WATER SYSTEMS

by

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I certify that the thesis hereby submitted, and the work presented therein, to the University of Pretoria for the degree of M.Sc. has not been previously submitted by myself in respect of a degree at any other University.

Signature .....

Date .....

This thesis is dedicated to my mother, Ruth Poulton

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Summary

Surveys of open recirculating cooling water systems at 12 fossil fired power stations and their corresponding raw water supplies were carried out. It was established that all the raw water supplies and recirculating cooling waters contained aerobic and anaerobic bacteria, anaerobic acid producing bacteria, *Thiobacillus*, *Nitrobacter*, sulphate reducing bacteria and algae, with the exception of two potable water supplies. Analysis of the numbers of microorganisms as well as system inspections revealed that each system was unique and no generalisations in terms of presence or activity of microorganisms could be made. Biodispersant/biocide cooling water treatment programmes were monitored at four fossil fired power stations by means of microbiological analysis of Robbins Device biofouling monitors and bulk water. The use of combinations of biodispersants and biocides effectively controlled microbiological growth in all the cooling water systems, but the treatment products produced different effects in different systems. A Robbins Device, modified Robbins Device, a Pedersen Device and the Barry's Device biofouling monitors were evaluated in an open recirculating cooling water system during three different biodispersant dosing regimes. Statistically significant differences were found in the numbers of bacteria recovered from the devices with the exception of the aerobic bacteria when no biodispersant was added and the H_2S producing bacteria when biodispersant was slug dosed. Consistently higher numbers of bacteria were recovered from the modified Robbins Device. A corrosion monitoring device, using the linear polarisation technique was evaluated to determine its suitability as a technique for the monitoring of sessile microorganisms. Bacterial attachment occurred uniformly on the electrodes of the device and on corrosion coupons. The addition of a biocide to the bulk water of two pilot rigs resulted in a statistically significant decrease in corrosion rate in these two rigs when compared to the untreated controls.

MONITERING EN BEHEER VAN BIOBEVUILING IN OOP HERSIRKULERENDE VERKOELINGSWATERSTELSELS VAN KRAGSTASIES

deur

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Opsomming

Opnames van die hersirkulerende verkoelingswaterstelsels en hul ooreenstemmende rouwater-toevoere is by 12 fossielbrandstof kragstasies uitgevoer. Daar is vasgestel dat, met die uitsondering van twee drinkwatertoevoere, al die verkoelingswater en rouwater aërobiese en anaërobiese bakterieë, anaërobiese suur produserende bakterieë, *Thiobacillus, Nitrobacter*, sulfaatreduserende bakterieë en alge bevat het. Ontledings van die hoeveelhede mikro-organismes, asook inspeksies van die verskeie sisteme, het aangedui dat elke sisteem uniek is en dat geen veralgemening gemaak kan word nie. Biodispergeermiddel/biosied behandelings programme is deur middel van mikrobiologiese ontledings van Robbins biobevuilingsmoni-teringtoestelle en sirkulerende water by vier fossielbrandstof kragstasies gemonitor. Mikro-biologiese groei in al die verkoelingswaterstelsels is effektief deur die gebruik van kombinasies van biodispergeermiddels en biosiedes beheer. Die behandeling het egter verskillende uitwerkings op die verskeie stelsels gehad. 'n Robbins, gewysigde Robbins, Pedersen en Barry biobe- vuilingsmoniteringstoestelle is tydens drie verskillende doseringsregimes van bio-dispergeermiddels in 'n oop hersirkulerende verkoelingswaterstelsel geëvalueer. Statisties beduidende verskille is in die hoeveelheid bakterieë wat van die toestelle herwin is, gevind. Die aantal aërobiese bakterieë in die afwesigheid van 'n dispergeermiddel en H_2S produserende bakterieë tydens eenmalige dosering van die dispergeermiddel was egter uitsonderings. Die hoeveelheid bakterieë wat vanaf die gewysigde Robbin toestel herwin is, was deurlopend meer vergeleke met die ander toestelle. 'n Korrosiemoniteringstoestel wat van 'n lineêr polarisasie tegniek gebruik maak, is geëvalueer om die instrument se toepaslikheid vir die bepaling van sessiel mikro-organismes te bepaal. Bakteriologiese aanhegting het egalig op die elektrodes van die toestel en op die korrosie toetsstukke plaasgevind. Die toediening van 'n biosied tot die water van twee loodsaanlegte het tot 'n beduidende afname in die korrosietempo van hierdie aanlegte vergeleke met 'n onbehandelde aanleg gehad.

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