FOULING OF SURFACES

by

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SYNOPSIS

Three fouling and deposition systems have been studied; paraffin wax in kerosene solutions and silica in geothermal waters at cooled surfaces and particulate magnetite in demineralised water at unheated surfaces. The paraffin wax fouling increased rapidly and asymptotically to an average fouling resistance that fluctuated at random with time due to build-up and break-down processes. The deposition (initial and asymptotic) decreased with flowrate and bulk temperature but increased with concentration and the difference in temperature between the cooled wall and the solution cloud point. The asymptotic fouling resistance was inversely proportional to the flowrate squared.

The magnetite deposition increased asymptotically with time and showed similar characteristics to the paraffin wax system. The deposition was sensitive to suspension bulk temperature (increasing with temperature) and the initial rate of deposition was inversely proportional to the flowrate.

A deposition-release model was developed to describe the behaviour of the paraffin wax and particulate magnetite systems where the initial rate of fouling and the asymptotic fouling resistance are inversely proportional to the friction velocity and friction velocity squared, respectively. The deposit build-up and break-down in the two systems is considered to be adhesion/cohesion controlled. A feature of the model is the inclusion of a strength of deposit term.

The silica fouling increased linearily with time and is apparently controlled by the dehydration of silicic acids. At certain conditions the silica deposits assume a transversely rippled structure and the fouling resistance curve becomes spoon-like in shape. The pressure drop across rippled surfaces is excessive; some magnetite deposits are rippled. It is suggested that rippled deposits are formed due to the phenomena of flow separation and reattachment when the foulant is close to saturation and the depositing material highly adherent.

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FOREWORD

This thesis is divided into six main parts for the convenience of the reader. Each part can stand on its own and includes all the appropriate tables, figures, nomenclature and references.

There is an introduction to the subject and then four parts dealing with the experimental studies. The work is brought together in the last part.

At the end of each of the four parts concerned with the experiments there are several published papers and reports based on the work.

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