Abstract

The Hammarsdale Wastewater Treatment Plant (HWWTP) 5-stage Bardenpho nutrient removal reactors were assessed to determine their decolourising performance and to determine methods of improving this performance. The assessment incorporated both full-scale and laboratory experimentation.

The decolourisation of a C.I. Reactive Red 141, an azo reactive dye, was studied in a series of laboratory experiments. The inoculum used was obtained from the HWWTP return activated sludge pumps. The results demonstrated that the dye would be decolourised by approximately 92 % within 4.5 h if the system was strictly anaerobic. Based on these results and previous research, it was concluded that the oxidation reduction potential (ORP) of the system affected the rate of decolourisation. Measurement of the ORP of the HWWTP sludge showed that decolourisation of C.I. Reactive Red 141 was taking place at a higher ORP than that recommended by other researchers. It was concluded that the discrepancy in the results was due to the difference between the inoculum and feed substrates used in these experiments and those used by other researchers.

The full-scale experiments were required to determine the performance of the HWWTP reactors, in terms of colour removal, at normal operating conditions. It was determined that the majority of the decolourisation of the influent to the reactors was occurring in the anaerobic zone of the Bardenpho reactors and that a layer of scum on the surface of this zone appeared to increase the decolourisation. The ORP of the bulk sludge in the anaerobic zone was determined to be approximately -120 to -140 mV, which was lower than the ORP required for the decolourisation of C.I. Reactive Red 141 as indicated by the laboratory experiments. A residence time distribution (RTD) model of the anaerobic zone was developed to determine the flow characteristics within this zone. The RTD demonstrated that the residence time in the anaerobic zone, approximately 57 min, was insufficient for effective decolourisation of C.I. Reactive Red 141. The RTD model was complimented by a simultaneous computational fluid dynamics (CFD) study which modelled the flow vectors of each inlet fluid.

It was concluded that decolourisation of azo dyes was feasible in the anaerobic zone of the HWWTP reactors, but that the residence time in this zone was insufficient for effective decolourisation.