**ABSTRACT**

Activated Sludge Process (ASP) is a highly complex and non-linear biological system; therefore, traditional mathematical modelling of this treatment process has remained a challenge. To improve treatment efficiency, quality of the effluent released into the receiving water body, find simple and easy model that can help the operator to predict the performance of the plant. Moreover, to take cost-effective and timely remedial actions that would ensure consistent treatment efficiency that meeting discharges consents. Therefore, this work highlights one of the techniques that have proved a great success in many scientific problems and applications. Adaptive Neuro-Fuzzy Inference System (**ANFIS**) has proven to be efficient, reliable and flexible. This work focus on the general concept and characteristics of adaptive neuro fuzzy inference system and its application in nonlinear and dynamic systems. Moreover, this work present MANFIS which is the extended of adaptive neuro fuzzy inference system (ANFIS). The proposed MANFIS is used in this project to make identification of four nonlinear outputs in the ASP: biomass, recycled biomass, dissolved oxygen and substrate. The last part of this work focuses on controller design – ANFIS inverse controller and model predictive control (MPC) that are used to compare the ability of these two techniques in dealing with nonlinear and complex systems and to predict and control the concentration of the two outputs, substrate and dissolved oxygen.