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AUTOMATIC TUNING FOR PROCESS CONTROL

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ABSTRACT

In polymer industries, mixing of chemicals are very common. When two or more chemicals are mixed together, the mixer produces a sudden unpredictable and unmeasurable heat due to a nonlinear exothermal reaction. Resin adhesives are produced through a mixing process between phenol and formaldehyde with certain catalyst. This mixture has to undergo a specific heating process to achieve the required quality of resin. Developing a suitable methodology to control the exothermal heat in producing resin adhesives is the main task of this research effort.

PID control is one of the general solutions often applied in the chemical production line. Due to the inherent time delay of the industrial plant, the experienced operators have to tune the PID gains using a trial and error method. However, this method has been found to be a source of errors that affects the quality of the product. In addition, the PID controller needs a precise mathematical model for on-line temperature control. This has become a problem, as the nonlinear exothermal process is not easy to be modelled due to the plant parameters varying unpredictably.

The main objective of this thesis is to propose a model-free control system, which is precise in temperature control. A computer based temperature control scheme has been developed in this work, which employs fuzzy logic control (FLC) principles. Two types of control methods are suggested, namely predictive fuzzy logic (PFL) and adaptive predictive fuzzy logic (APFL). The developed real time PFL controller has been applied to a specially fabricated pilot process plant for testing its accuracy in controlling and regulating the reactant temperature. The pilot plant has facilities for heating and cooling the mixture.