

UNIVERSITI TEKNOLOGI MARA

**MODEL REFERENCE ADAPTIVE
CONTROL (MRAC) FOR
TEMPERATURE REGULATION OF
GLYCERIN BLEACHING PROCESS**

MOHD HAFIZ BIN A. JALIL @ ZAINUDDIN

Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Electrical Engineering)

Faculty of Electrical Engineering

August 2019

ABSTRACT

Bleaching is a part of the crude glycerin purification process that is used for glycerin colour removal. During bleaching, proper temperature regulation throughout the heating stage is extremely important in order to shorten the heating process period and consequently minimize the batch cycle time whilst preventing product quality degradation. However, temperature regulation of the bleaching process is challenging since this process is executed in batch and may possess nonlinearities that imparted from input constraint, slow dynamic response, and exothermic characteristic. Thus, this study focus on the implementation of Model Reference Adaptive Control (MRAC) based controller for improving the temperature regulation of the glycerin bleaching process. In conjunction with this, various designs of the MRAC structure were evaluated and benchmarked with Proportional Integral Derivative (PID) based controller. In this work, two PID based controller design considered are the standard PID controller and PID with Back Calculation Anti-windup (PIDBCW). For the simulation study, the first order Autoregressive Exogenous Input (ARX) model that is developed based on the open loop step test data is used to represent the heating process of the glycerin bleaching process. The response analysis comparative performance via simulation and real-time study for step test, set point changes test and load disturbances test, clearly indicated that MRACWI is able to improve the process settling time, reduced response overshoot and minimized Mean Square Error (MSE) at the steady state condition. MRACWI gives 56.8% lower MSE as compared to robust MRAC controller while it possesses 52.4% faster settling time, 3.81% lower overshoot and 79.2% lower MSE compared to PID based controller for step test real-time results. With that, this research reveals that MRAC based controller namely MRACWI is one of the nominated controllers that capable to improve the temperature regulation of the bleaching process. Further, this finding is expected to improve the overall glycerin purification process towards realising the desired future glycerin demand.

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim

Alhamdulillah. All praises to Almighty Allah, whom with his willing giving me the opportunity to complete this thesis.

First of all, I would like to express my deepest appreciation to my supervisor Professor Ts. Ir. Dr. Hj Mohd Nasir Taib and my co-supervisor Associate Professor Dr. Mohd Hezri Fazalul Rahiman for their effort, guidance, support and patience throughout completing this research.

My deepest gratitude to my lovely wife, Rohaiza Hamdan and children Muhammad Haziq and Hani Tihani for their support, patience and sacrificing so many cheerful time with me during completing this research. Also to my Father (A. Jalil @ Zainuddin Ali Amran), Mother (Rogayah Kormin), Father in Law (Hamdan Ismail), Mother in Law (Roziyah Khamis), brothers (Abg Aid, Abg Aki and Hasif) and sister (Kak Zura) for their motivation and pray throughout completing this study.

Not forgetting to all of ASP and PICO group member (Dr Laila, Noor Nasriq, Zakariah, Dr Hezri, Dr Nurhani, Dr Zakiah, Dr Zuraidah and others) for being a part of my research journey. To my office members (Zali, Kak Pid, Herda and Wani) that always support me during the critical time.

My gratitude also goes to UTHM, JPA and UiTM for the financial support and gives me a chance for pursuing my study.

Last but not least to all of the panel examiners, Assoc. Prof. Dr Ramli Adnan, Assoc. Prof. Dr. Ir. Herlina Abdul Rahim and Prof. Dr. Carmadi Machub for their very meaningful feedback of my research.

Thank You Very Much. May Allah be merciful and repay all of their kindness.

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