UNIVERSITI TEKNOLOGI MARA CAWANGAN PULAU PINANG

IMPLEMENTATION OF FIRST ORDER MODEL REFERENCE ADAPTIVE CONTROL (MRAC) ON REGULATING TEMPERATURE OF ESSENTIAL OIL EXTRACTION PROCESS

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July 2017

ABSTRACT

This paper presents the performance of proportional-integral-derivative (PID) controller and Model Reference Adaptive Controller (MRAC) on regulating essential oil extraction process. Model of Auto-Regressive with Exogenous Input (ARX) from previous research on real time experiment data was used to represents the system dynamic of heating process. Heating process is important thing in the essential oil extraction and became challenging for industrial to control the temperature at the desired temperature. Besides, quality of essential oil will reduce if the extraction process expose to overheating of temperature. Unsuitable temperature regulation on extraction oil such as overshoot will give a large settling time and affected steady state response. Generally, conventional PID controller that commonly used in control system is not provided a desired output performance. Implementation of MRAC by using Lyapunov approach in the system gives better response than conventional PID controller. Model reference of the system was developed based on first order plus dead time (FOPDT). Parameter gains of PID were tuned automatically by PID tuner based on system performance with varied time response while adaptation gain for MRAC system chosen based on the best system performance by manually inserted into adaptation mechanism in simulation. In addition, adaptation gain ±0.1 is the best selection in adaptation mechanism for MRAC system. Result shows that MRAC controller was able to minimize its overshoot and robust in performance better than conventional PID controller in step test and set point tracking test. In addition, conventional PID controller provided faster time taken in rise time, 1760 second to initially reach the set point compared to MRAC, 2500 second but MRAC takes in short time to settle the response, 4460 second compared to PID, 7220 second. The comparison of output response between both controllers was obtained by using transient analysis and performance indices in MATLAB/Simulink.

ACKNOWLEDGEMENT

Alhamdulillah. First and foremost, I would like to thank Allah S.W.T. for giving me the time, strength and blessing to finish this study. Without His blessings, none of this is possible. Special appreciation goes to my parent for their love, understanding and unconditional support throughout this long and tough journey.

In the course of doing the research and writing up this report, I had encounter many difficulties that might not been possible to overcome without the assistance of so many knowledgeable and experienced personalities. My deep gratitude and thanks to my respected supervisor, Dr Zuraida Binti Muhammad, who constantly giving guidance, valuable advice, support, ideas and assistance for me to complete this final year project.

Lastly, special thanks to my mother and family for the support and encouragement given was a source of encouragement to me. Not forgotten a big thankful to all individuals who have helped and assisted me in carrying and bringing out this project the co-operation and help received from lecturer and friends Department of Electrical Engineering, is gratefully acknowledged.

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CHAPTER 1
INTRODUCTION

1.1   OVERVIEW

This chapter is separated into five parts. The first part covers the introduction of essential oils. Second part presents the problem statement on regulating temperature of essential oils. Third part consists of research objectives while fourth part described the scope of study in this research. At the end of this chapter presents the thesis organization in this report for overall chapters.

1.2   INTRODUCTION

Essential oil is commonly used in many purposes in our daily life. Essential oils has been used for many applications such as medical treatment, perfumes, for flavourings food, beauty product and insect repellent purposes [1–5]. So that, it gives positive impact on our economy because of highly demand due to users. Usually, essential oils can be extracted from plant's leaves, flowers, root, bark, wood and seed [4,6]. There are many type of method that used to extract the essential oils. Essential oils are commonly extracted by several methods such as steam distillation, expression process, solvent extraction, mechanically or cold pressing and absolute oil extraction [3,4,7]. In order to control the extraction process, suitable controller is needed in plant.

Control applications that are used by industrial process mostly are related in dealing with level, flow, pressure and temperature [6,8]. In this research, controlling temperature is important parameter in the extraction process [9]. In the extraction process, temperature regulation is needed to reach and maintain a temperature at certain temperature level to produce best quality of extraction oils. The aromatic and physical colour of essential oils may reduce if essential oils is exposes to high temperature in a long time or faced over heating process [5,8]. So that, ideal type of controller is needed to maintain the heating process due to desired set point [9]. The

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