UNIVERSITI TEKNOLOGI MARA

MODEL PREDICTIVE CONTROL FOR STEAM DISTILLATION ESSENTIAL OIL EXTRACTION PROCESS

NAZURAH BT TAJJUDIN

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of UniversitiTeknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for anydegree or qualification.

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Name of Student	:	NazurahBtTajjudin
Student's ID No.	:	2008713139
Programme	:	Master of Science (EE780)
Faculty	:	Faculty of Electrical Engineering
Thesis Title	:	Model Predictive Control for Steam Distillation Essential Oil Extraction Process.
Signature of Student	:	.....
Date	:	November 2014

ABSTRACT

Steam distillation technique is a common method being used in essential oil productionfrom botanical plants. The process depends on the pressurized steam and temperature that circulates through the materials inside a container. Some of the material is sensitive to high temperature where it could harm or alter the compound of the oil and it will decrease the therapeutic value of the essential oil. A proper temperature control technique is needed in order to maintain the suitable steam temperature to avoid an overheating of the material. This study proposes a Model Predictive Control (MPC) controller for steam distillation essential oil extraction process. MPC is a model based control algorithm which applied a model to predict for the future output over a prediction horizon. An ARX model was estimated based on the input and output data using system identification method as a prediction model for MPC. The PID controller was designed based on the Ziegler-Nichols tuning method for the benchmarking purpose.Both controllers design were restricted with an input voltage boundary and the ideal temperature was set as 90˚C. They were evaluated with noise disturbance test and reference tracking capability. The results illustrated that MPC can provide a better control solution with better step response performance smaller deviation from the set point was recorded in term of IAE and RMSE. Apart from that, MPC shows a good tracking capability with minimal energy consumption compared to PID which required more energy in order to compensate the disturbances.

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