Pengendalian Unit Distilasi Pada Pabrik Base Oil Ester dengan Multivariable Model Predictive Control (MMPC) 4×4 = Dynamic Control of Distillation Unit in the Base Oil Ester Plant Using 4x4 Multivariable Model Predictive Control (MMPC)

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Abstrak

Pelumas merupakan senyawa yang digunakan untuk mengurangi gaya gesek dan keausan antar komponen yang berkontak satu sama lain. Base oil merupakan komponen penting dalam pelumas sehingga pemilihan base oil dapat menentukan sifat dari pelumas tersebut. Kolom distilasi pada proses separasi base oil ester memiliki potensi bahaya yang cukup tinggi sehingga perlu adanya pengendalian pada unit tersebut. Pada penelitian ini, Multivariable Model Predictive Control (MMPC) digunakan sebagai pengendali tingkat lanjut untuk mengendalikan 4 pasangan manipulated variable (MV) dan controlled variable (CV) pada unit distilasi. Penyetelan pengendali dilakukan dengan pemodelan first order plus derivative time (FOPDT) dengan metode Smith, Wade, Lilja, dan Solver yang dilanjutkan dengan penentuan parameter MMPC. Penentuan parameter MMPC dengan metode fine-tuning menghasilkan prediction horizon (P) sebesar 375, control horizon (M) sebesar 245, dan sampling time (T) sebesar 1. Pengendalian dengan MMPC 4×4 hasil fine-tuning mampu mengurangi nilai Integrated Absolute Error (IAE) sebesar 3,31 – 80,40% dan nilai Integrated Squared Error (ISE) sebesar 2,77 – 81,33% dibandingkan hasil pengendalian PI pada pengujian set point tracking. Selain itu, pengendalian MMPC juga dapat mengurangi nilai IAE sebesar 3,17 – 77,48% dan nilai ISE sebesar 23,83 – 88,44% dibandingkan hasil pengendalian PI pada pengujian disturbance rejection.

.....Lubricants are compounds used to reduce friction and wear between components in contact with each other. Base oil is an important component in lubricants so that the selection of base oil can determine the nature of the lubricant. The distillation column in the ester base oil separation process has a high potential hazard, so it is necessary to control the unit. In this study, Multivariable Model Predictive Control (MMPC) is used as an advanced controller to control 4 pairs of manipulated variables (MV) and controlled variables (CV) in the distillation unit. Controller tuning is done by first order plus derivative time (FOPDT) modeling with Smith, Wade, Lilja, and Solver methods followed by MMPC parameter determination. The determination of MMPC parameters with the fine-tuning method results in a prediction horizon (P) of 375, a control horizon (M) of 245, and a sampling time (T) of 1. Control with MMPC fine-tuning results can reduce the Integrated Absolute Error (IAE) value by 3.31 – 80,40% and the Integrated Squared Error (ISE) value by 2.77 – 81,33% compared to the PI control results in the set point tracking test. In addition, MMPC control can also reduce the IAE value by 3.17 – 77,48% and the ISE value by 23.83 – 88,44% compared to the PI control results in the disturbance rejection test.