

Penyetelan Ulang Pengendali PI Untuk Peningkatan Kinerja Pengendalian CO₂ Removal Berbasis Model Linear-SISO = Re-tuning PI Controller to Improve CO₂ Removal Controller with Model Linear-SISO

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Abstrak

Model Predictive Control (MPC)-Single Input Single Output (SISO) digunakan untuk mengoptimalkan parameter pengendalian pada penghilangan CO₂ di lapangan Subang. MPC-SISO digunakan untuk mengendalikan laju aliran amina, laju aliran makeup water, dan tekanan gas umpan untuk mempertahankan konsentrasi CO₂ pada keluaran sweet gas. Model empiris dibuat untuk diterapkan di MPC controller berdasarkan kurva reaksi proses (PRC) dengan menggunakan pendekatan first order plus dead time (FOPDT) berbasis SISO (Single Input-Single Output). Namun, bila terdapat disturbance pada feed gas, seperti perubahan laju air dan konsentrasi CO₂, maka dibutuhkan penyesuaian kembali berupa re-tuning agar produk sweet gas yang dihasilkan tetap terjaga kualitasnya. Metode Ziegler-Nichols, Tyreus-Luyben dengan Bode Diagram, serta fine-tuning digunakan dalam mengamati respons pengendali PIC-1101, FIC-1102, dan FIC-1103 terhadap adanya disturbance. Dengan simulasi dinamik yang dilakukan, maka didapatkan nilai FOPDT berbasis SISO untuk tiap pengendali dengan metode fine-tuning yang terbaik untuk penyetelan SP (PIC-1101 ISE = 721300 dan IAE = 2764, FIC-1102 ISE = 113.1 dan IAE = 701, dan FIC-1103 ISE = 2262000 dan IAE = 19430). Untuk menangani gangguan berupa laju alir dan konsentrasi, metode Ziegler-Nichols merupakan metode yang terbaik untuk pengendali PIC-1101 (ISE = 2.409 dan IAE = 5.723 untuk laju alir dan ISE = 0 dan IAE = 0 untuk konsentrasi CO₂) dan FIC-1102 (ISE = 0.00001392 dan IAE = 0.1663 untuk laju alir dan ISE = 0 dan IAE = 0 untuk konsentrasi CO₂) serta fine-tuning untuk FIC-1103 (ISE = 2.382 dan IAE = 63.41 untuk laju alir dan ISE = 8.693e+04 dan IAE = 8.361e+03 untuk konsentrasi CO₂).

.....Model Predictive Control (MPC) - Single Input Single Output (SISO) is used to optimize the control parameters for CO₂ removal in the Subang field. MPC-SISO is used to control amine flow rate, makeup water flow rate, and feed gas pressure to maintain CO₂ concentrations in sweet gas output. Empirical models are made to be applied in the MPC controller based on the process reaction curve (PRC) using the first order plus dead time (FOPDT) approach based on SISO (Single Input-Single Output). However, if there are any disturbances in the gas feed, such as flow rate and CO₂ concentration, then re-tuning is necessary so that the sweet gas product is maintained in its best quality. The Ziegler-Nichols method, Tyreus-Luyben method with Bode Diagrams, and Fine-Tuning method are used in observing the response of the PIC-1101, FIC-1102, and FIC-1103 controllers to disturbance. With the dynamic simulation carried out, the SISO-based FOPDT values for each controller are obtained with the best fine-tuning method for SP settings (PIC-1101 ISE = 721300 and IAE = 2764, FIC-1102 ISE = 113.1 and IAE = 701, and FIC-1103 ISE = 2262000 and IAE = 19430). To deal with disturbances of flow rate and CO₂ concentration, the Ziegler-Nichols method is the best method for controlling PIC-1101 (ISE = 2.409 and IAE = 5.723 for flow rates and ISE = 0 and IAE = 0 for CO₂ concentration) and FIC-1102 (ISE = 0.00001392 and IAE = 0.1663 for flow rate and ISE = 0 and IAE = 0 for CO₂ concentration) and fine-tuning for FIC-1103 (ISE = 2.382 and IAE = 63.41 for

flow rate and ISE = $8.693e + 04$ and IAE = $8.361e + 03$ for CO₂ concentration).