ANALISIS PENGARUH PENALAAN PENGENDALI DALAM PROSES PERENGKAHAN NAFTA

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INTISARI

Proses perengkahan nafta merupakan salah satu cara yang umum digunakan dalam produksi etilena, propilena, dan senyawa olefin ringan lainnya. Aliran umpan nafta yang memiliki rantai karbon panjang dicampur dengan uap air bertekanan tinggi dan dipanaskan dalam suhu tinggi. Selama proses perengkahan temperatur reaktor perlu dijaga pada nilai optimal agar produksi olefin berjalan efisien yang secara langsung berhubungan dengan jumlah keuntungan. Sehingga diperlukan sebuah sistem kendali agar proses tersebut dapat berjalan sesuai kebutuhan.

Penelitian ini dilakukan untuk mengetahui pengaruh penalaan pengendali dalam proses perengkahan nafta. Pengendalian dilakukan pada pasangan *controlled variable* dan *manipulated variable* berturut-turut temperatur reaktor dan persentase bukaan *fuel valve*. Penalaan dilakukan secara *on-line* menggunakan metode *continuous cycling* untuk memperoleh *ultimate controller gain* K_{CU} dan *ultimate period* P_U. Relasi penalaan Ziegler-Nichols dan Tyreus-Luyben digunakan terhadap nilai tersebut untuk mendapatkan pengaturan pengendali PID berupa *controller gain* K_C, *integral time* atau *reset time* τ_I, dan *derivative time* τ_D.

Hasil simulasi menunjukkan penalaan Tyreus-Luyben PID menghasilkan persentase profit paling tinggi sebesar 372% dibanding Tyreus-Luyben PI, Ziegler-Nichols P, PI dan PID. Tyreus-Luyben PID juga memiliki respon karakteristik paling baik dengan nilai *steady state error* 0,009% dan tidak memiliki *overshoot*. Meskipun nilai *rise time* dan *settling time* paling besar masing-masing 202 menit dan 270 menit, grafik respon Tyreus-Luyben PID menunjukkan perubahan temperator reaktor paling stabil.

Kata kunci: proses perengkahan nafta, sistem kendali, penalaan pengendali, metode *continuous cycling*

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ANALYSIS OF CONTROLLER TUNING EFFECT IN NAPHTHA CRACKING PROCESS

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ABSTRACT

Naphtha cracking process is the most common process used in the production of ethylene, propylene, and many other light olefins. Naphtha feedstock which has long-chained carbon is mixed with high-pressure steam and heated in high-temperature reactor. During the cracking process, the reactor's temperature needs to be maintained at optimal value so that olefin production can run efficiently which in turn yields a higher profit. Therefore it's necessary to build a control system to achieve that goal.

This study aims to analyze the controller tuning effects in the naphtha cracking process. A control system is built on a controlled variable and manipulated variable pair that is reactor's temperature and fuel valve opening percentage. On-line controller tuning was conducted using continuous cycling method based on trial and error procedure to get ultimate controller gain K_{CU} and ultimate period P_U. Ziegler-Nichols and Tyreus-Luyben tuning relation was used to get PID controller settings that is controller gain K_C, integral time or reset time τ_I, and derivative time τ_D.

Simulation results show that Tyreus-Luyben PID tuning achieves the best profit percentage with 372% than other tuning relations such as Tyreus-Luyben PI, Ziegler-Nichols P, PI, and PID. Tyreus-Luyben PID have the best characteristic responds with steady-state error value of 0.009% and wihout an overshoot. Although it has longer rise time of 202 minutes and settling time of 270 minutes, its reactor's temperature change is the most stable.

Keywords: naphtha cracking process, control system, controller tuning, continuous cycling method

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