

INTI SARI

Primary reformer merupakan salah satu alat proses vital di pabrik Amoniak PT Pupuk Kujang 1B yang berfungsi untuk mengubah gas alam menjadi *synthesis gas* (H_2 , CO dan CO_2) melalui reaksi *steam-methane reforming* (SMR). Reaksi SMR bersifat sangat endotermis dimana kebutuhan panas reaksi tersebut disuplai oleh pembakaran *fuel* pada burner. Sejak pabrik didirikan, diketahui bahwa performa *primary reformer* tidak optimum. Hal tersebut ditandai dengan peristiwa *overheat* dan kerusakan katalis pada tiga perempat bagian atas *tube-inner row*. Oleh karena itu, perlu dilakukan penelitian untuk mempelajari variabel-variabel yang berpengaruh terhadap kinerja *Primary Reformer* khususnya pada distribusi suhu zona pembakaran.

Metode yang digunakan dalam penelitian ini adalah metode numerik dengan *software Computational Fluid Dynamics* (CFD) dan MATLAB. Output *software* CFD berupa profil suhu dan konsentrasi spesies diperlukan untuk mengidentifikasi sumber masalah sehingga didapatkan konfigurasi alat yang optimum.

Kesimpulan dari penelitian ini menyatakan bahwa masalah *overheat* disebabkan oleh ketidak seimbangan distribusi *fuel*. Hasil simulasi CFD dan MATLAB pada distribusi suhu tube katalis memiliki nilai eror sebesar 1,92% dan 4,68% terhadap data aktual. Pada ukuran *header* yang sama, porsi *mass flow* terbesar terletak pada ujung header. Hal tersebut juga berlaku pada *process gas header*. Distribusi tersebut dapat menyebabkan sebagian besar tube pada baris ke-2 *process gas header* berpotensi mengalami *overheat*. Penyebab perbedaan nilai distribusi *mass flow* diduga karena momentum fluida yang mengalir searah sumbu aksial sehingga aliran akan semakin besar seiring bertambahnya jarak dengan inlet header utama. Setelah masalah teridentifikasi, konfigurasi valve pada *fuel header* disesuaikan agar suplai panas reaksi masing-masing baris tube katalis seimbang. Dengan konfigurasi baru yang diusulkan, potensi permasalahan *overheat* dapat dihindari.

Kata kunci: *primary reformer*, *overheat*, distribusi panas, *computational fluid dynamics*

ABSTRACT

Primary reformer, one of the vital equipments in Ammonia Plant of PT Pupuk Kujang 1B, has a function to reform natural gas into synthesis gas (H_2 , CO and CO_2) through the steam-methane reforming (SMR) reaction. SMR is a very endothermic reaction, in which the heat of reaction is supplied from *fuel* combustion in the burner. Since the beginning of the plant establishment, the primary reformer have not been on its greatest performance. It was indicated by the overheat problem and catalyst damage over three fourth upper parts of the inner row catalyst bed. Therefore, research is essential to investigate the variables affecting the primary reformer performance especially in overheat zone.

The methods used in this reseach were numerical methods with Computational Fluid Dynamics (CFD) software and MATLAB. The outputs of CFD software were temperature and species concentration profile. It can be used to identify the root of the problem thus the primary reformer's performance can be optimized.

Final investigastion revealed that the overheat problem is caused by the unbalanced *fuel* distribution. The errors of simulation results of CFD and MATLAB software were 1,92% and 4,68% from the actual tube wall temperature distribution. The values of mass flow in the same size of header output was focused at the top, it worked too on the process gas header. Such distribution could lead into overheat problem at a large number of 2nd catalyst row. The fluid momentum in axial direction was suspected as the reason why the portion was bigger as the distance increased from the inlet of manifold. Once the problems were identified, the valve at *fuel header* was configured hence the heat supply of each catalyst tube was balanced. The overheat problem could be avoided with the new proposed configuration.

Keyword: primary reformer, overheat, heat distribution, computational fluid dynamics