Rancang Bangun Sistem Optimisasi Pemakaian Batubara Pada Proses Produksi Feronikel = Development of Optimization System for Coal Usage in Ferronickel Production Process

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Abstrak

Proses produksi feronikel di industri menggunakan teknologi Rotary Kiln Electric Furnace (RKEF) yang sangat intensif energi. Penelitian ini bertujuan mengoptimalkan parameter operasional RKEF untuk meningkatkan efisiensi energi sambil menjaga kualitas produk, menggunakan model prediktif Ridge Regression dan algoritma optimisasi. Dua metode utama, yaitu Sequential Least Squares Programming (SLSQP) dan Genetic Algorithm (GA), diterapkan dan dievaluasi berdasarkan efisiensi energi, kepatuhan constraint, kewajaran solusi, akurasi output, dan waktu komputasi. Hasil menunjukkan SLSQP (Skenario e) unggul dalam kepatuhan constraint (0 pelanggaran) dan efisiensi komputasi (23.8 detik), serta menghasilkan solusi input yang lebih wajar (rata-rata outlier 19). Sementara itu, GA (Skenario d) mencapai efisiensi energi yang lebih tinggi (total efisiensi 1.85 Ton/jam) dan akurasi output lebih baik (rata-rata deviasi 4.69), namun dengan kewajaran input yang lebih rendah (rata-rata outlier 40.27) dan waktu komputasi jauh lebih lama (365.78 detik). Berdasarkan pertimbangan stabilitas operasional dan kecepatan, SLSQP dengan skenario e lebih direkomendasikan untuk implementasi industri.

.....The ferronickel production process in the industry utilizes the highly energy-intensive rotary kiln electric furnace (RKEF) technology. This study aims to optimize the operational parameters of the RKEF to improve energy efficiency while maintaining product quality, using predictive models and optimization algorithms. Two main methods, namely Sequential Least Squares Programming (SLSQP) and Genetic Algorithm (GA), were applied and evaluated based on energy efficiency, constraint compliance, solution reasonableness, output accuracy, and computation time. Results show SLSQP (Scenario e) excels in constraint compliance (0 violations) and computational efficiency (23.8 seconds), and produces more reasonable solutions (average outlier 19). Meanwhile, GA (Scenario d) achieved higher energy efficiency (total efficiency 1.85 Ton/hour) and better output accuracy (mean deviation 4.69), but with lower input reasonableness (mean outlier 40.27) and much longer computation time (365.78 seconds). Based on operational stability and speed considerations, SLSQP with scenario e is more recommended for industrial implementation.