Optimasi sistem pemgkondisian udara untuk top coat booth pada industri otomotif di Indonesia

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Abstrak

Pada penelitian ini dilakukan analisis potensi optimasi pada sistem pengkondisian udara (chiller) untuk mengatur temperatur dan humidity ruang pengecatan mobil (top coat booth) di salah satu industri otomotif terbesar di Indonesia. Analisis optimasi yang dilakukan meliputi analisis penggunaan thermal storage tank (cold water storage), potensi penurunan cooling load pada top coat booth, analisis computional fluid dynamic (CFD) untuk aliran udara dingin pada top coat booth dan optimasi total exergy destruction dari keseluruhan sistem sekaligus total product component and energy cost keseluruhan sistem (multi objective optimization). Dari hasil optimasi didapatkan bahwa sistem chiller dapat berjalan lebih optimal dengan tanpa thermal storage yang berdimensi terlalu besar serta tedapat potensi penghematan energi sebesar 2646.4 kW cooling load. Dengan merubah desain sisi masuk top coat booth bisa juga didapatkan cooling load yang lebih kecil. Dari multi objective optimization didapatkan pula nilai variabel-variabel penting sehingga sistem chiller dapat berjalan lebih optimal secara termodinamika (minimal exergy destruction), optimal secara ekonomi (minimal component and energy cost) dan optimal secara termodinamika sekaligus juga ekonomi. Dari nilai-nilai variabel optimal tersebut didapatkan equivalent cooling cost sebesar 621.02 (Rp/kWh) untuk base case, 588.86 (Rp/kWh) untuk economic optimized, 611.50 (Rp/kWh) untuk thermodynamic optimized dan 595.72 (Rp/kWh) untuk multi objective optimized.
.....The optimization of the air temperature- and humidity conditioning of a top coat booth at one of the biggest automotive industry in Indonesia has been considered. The optimization analysis consists of the thermal storage utilization analysis (cold water storage), the potential of cooling load reduction at top coat booth, the computational fluid dynamic (CFD) analysis for air flow in top coat booth and the multi-objective optimization (optimization of the total exergy destruction of the system simultaneously with the total product component and energy cost of the system) The results have shown that without the large thermal storage tank, the chiller could save 2646.4 kW of cooling capacity. By redesign the inlet- and outlet side of top coat booth, the cooling load could be also significant reduced. Three optimized values of decision variables for a single objective thermodynamic optimized, a single objective economic optimized and a multi objective optimized are also obtained. From the optimized values of decision variables, it could be obtained the equivalent cooling cost of 621.02 (Rp/kWh) for base case, 588.86 (Rp/kWh) for economic optimized, 611.50 (Rp/kWh) for thermodynamic optimized and 595.72 (Rp/kWh) for multi objective optimized.