

139^a DEFESA DE TESE EM ENGENHARIA INDUSTRIAL

PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA INDUSTRIAL - PEI



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Título: OPTIMIZATION STRATEGIES FOR PRESSURE SWING ADSORPTION: AN APPROACH FOR CHARACTERIZING FEASIBLE OPERATION REGIONS

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Resumo:

Pressure Swing Adsorption (PSA) facilitates the separation of complex mixtures, offering an energy-efficient and environmentally friendly approach. Then, optimizing such cyclic adsorption processes is challenging due to their dynamic operational complexity. This work proposes a new approach for single- and multi-objective optimization of PSA units. Additionally, it introduces the concept of Feasible Operation Regions (FORs). The proposed methodology, previously unexplored in literature, integrates a likelihood test and a variant of the Fisher-Snedecor test for solving single-objective or multi-objective problems using a Particle Swarm Optimization technique. The FORs are divided into sub-regions that meet optimization constraints and prioritize a specific objective through clustering. These sub-regions enable the analysis of different possible operating conditions of the PSA unit. Furthermore, this work makes another significant contribution by using a surrogate model to address and simplify the computational demands of optimization processes, developing a multi-objective optimization using deep neural network models, and incorporating an evaluation of the optimality of the Pareto frontier and the feasible operation region. Utilizing these new concepts, a PSA process for syngas purification was optimized. The results show that analyzing the FORs of operational variables is crucial for providing insights into the system's behavior. It was concluded that the proposed methodology uses the map of feasible operation regions and a clustering strategy to explore the outcomes of single-objective and multi-objective optimizations. The methodology allows for assessing the most impactful factors influencing the process behavior. The study offers a practical and enlightening operational map that assists operators in identifying the ideal process location and prioritizing specific operational objectives. Thus, providing more reliable and accurate optimization of PSA units is an important tool for decision-making in the PSA system.

Palavras-chave: Pressure Swing Adsorption, Feasible operation region, Syngas purification, Particle Swarm Optimization.