A DYNAMIC SIMULATOR FOR SUPERCRITICAL FLUID EXTRACTION USING ARTIFICIAL NEURAL NETS

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ABSTRACT

This work presents a methodology to get a model of the supercritical fluid extraction process to be used in the simulator's implementation which can complement experimental data obtained during an extraction; to analyze previously the performance of the process under certain operation conditions or besides to allow that the exhaustive tests can be easily accomplished in the identification of control strategies that increase the extraction, minimize the operation costs and besides improve the quality of the extracted product. The extraction processes that use supercritical fluids as solvents are constituted by stages of compression; heating or condensation; extraction; separation; and regeneration of the solvent. The sum of those stages is denominated of the supercritical fluid cycle. The proposed simulator uses a model that describes the dynamic behavior of the extraction along the time establishing the relationship of cause-effect of the variables involved in the stages of the supercritical cycle through the characterization of the variables interns interactions of the process in accordance with the input signals, initial conditions and parameters of the process. The dynamic model of the supercritical extraction process used in the simulator's implementation involves the differential and algebraic equations obtained of the balance of energy and mass and the characterization of the thermodynamic properties of the carbon dioxide in the stages of its cycle. The methodology used in this work suggests the use of artificial neural nets (ANNs) in the characterization of the thermodynamic properties of the CO_2 with the objective of obtaining the correlation of the experimental data of temperature, pressure and density in a wider strip and with larger precision. The multi-layer perceptron was adopted to characterize the relationship temperature-pressure-density and the training of the neural net was accomplished with base in the Levenberg-Marquardt optimization method of through which the values of weights and bias of ANN are up-to-date in way to minimize a linear combination of the sum squared errors between the presented output pattern and the output of the neural net in training. The training of ANN was

executed in the environment of the software MatLab/Simulink and the simulator was implemented using the software LabVIEW. The developed dynamic simulator provides a level of enough details to give answers of the main process characteristics. The results obtained with the process simulator help in the identification of the CO_2 mass variable as the manipulate variable to maximize the product to be extracted in the supercritical cycle.