NEURAL IDENTIFICATION OF SUPERCRITICAL EXTRACTION PROCESS

Rosana P.O. Soares*, Roberto Limão de Oliveira*, Vladimiro Miranda**
***** Electrical and Computer Engineering Department, Federal University of Pará -UFPA
Campus Universitário do Guamá, CP 8619, CEP: 66075-900, Belém - PA, Brazil
Phone Number: +55 91 3183 1680 Fax: +55 91 3183 1634
******Electrical and Computer Engineering Department, Engineering Faculty of the University of Porto - FEUP
Rua Dr. Roberto Frias, s/n 4200-465 Porto, Portugal.
E-mails: rsoares@ufpa.br, limao@ufpa.br, vmiranda@inescporto.pt

RESUMEN

In this work, an Artificial Neural Network (ANN) is designed to model an extraction process that uses a supercritical fluid as solvent. The models considered can forecast the extraction curves in relation to the solvent mass profile used for an operation point. The obtaining of those models was based on the application of ANNs and in the use of experimental data collected in laboratory during experiments performed in a pilot installation at the Institute of Experimental and Technological Biology located in Portugal, when the extraction of useful compositions for the pharmaceutical industry from residues originating from of the cork production. Due to small amount of experimental data for the ANN training and the high cost involved in the execution of experiments, two different strategies were tested in order to create larger amount of data for an efficient ANN training. The first strategy consists in the interpolation of information collected during each extraction operation to get a bigger number of samples. It is assumed that even though the information has not been registered due to the characteristics of the extraction process, it exists in fact and, therefore, it can be estimated using an interpolation method. The second strategy consists of adding pseudo experiments to the set of training, which had been generated from the real experiments using qualitative characteristics of the process. Its use, besides generating enough data for the training, also allows a priori knowledge inclusion in the ANN through the qualitative information of the process incorporated in the training patterns. The multilayers direct neural networks were used to correlate solvent mass of and raw material with the extracted mass of product. The training of ANN was executed using MATLAB with the optimization algorithm of Levenberg-Marquardt and Bayesian regularization. In general, considering the 37 real experiments used to get the neural model, the results reached with the two strategies presented good precision with non-significant errors between the output of the ANN and the experimental data even in the experiments that were not part of the training set. Although the data interpolation during each experiment has produced satisfactory results for the ANN training and in the simulation of the process, its use does not have a formal justification and, therefore, it is not possible to conclude about its success in other situations or operation conditions. The pseudo experiments were essential in the ANN training making possible a larger number of information, besides allowing to insert characteristics of the process in the training data. The high degree of non linearity of the process and the limited spectrum of the collected data restricted the efficiency of the model obtained with the pseudo experiments turning it too sensitive to great deviations of the mass solvent profile during an extraction. However, in the band of operation considered in this study, it presented good characteristics of precision and generalization capacity becoming very important in the identification of strategies of manipulation of the CO_2 mass in the supercritical cycle to maximize the product to be extracted.