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Development of a Mathematical Model for Apple Juice Compounds Rejection in a Spiral-wound Reverse Osmosis Process

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Abstract

The use of Reverse Osmosis (RO) membrane processes for the clarification and the concentration of apple juice is proposed as an alternative to the conventional concentration technique, which is based on evaporation and freezing. Several models have been published on RO process models relying on different assumptions that predict the permeate flux and aroma compounds rejections for aqueous solutions apple juice. The solution-diffusion model (Lumped model) has been applied for the previous models. The main instrument of this study is the use of the gPROMS software to develop a new distributed steady state model that will relax a number of earlier assumptions.

The model has been validated with an observational data of apple juice filtration derived from the literature by analysing the permeate flux and the performance of membrane rejection at different concentrations, temperatures and pressures for a laboratory scale of spiral-wound RO module. Simulated results corroborate with experimental and model predictions.

***Keywords*:** Apple Juice Concentration; Spiral-wound Reverse Osmosis; One Dimensional Distributed Model; gPROMS software.

1. Introduction

The concentration of fruit juices is achieved by reducing the water content. This has many advantages, including easier and cheaper conservation, storage, transportation and distribution of the extracted juice. Conventional methods of fruit juices concentration are usually conducted using a high temperature multi-stage vacuum evaporation process. This process usually results in significant losses of nutritional compounds, such as vitamin C, as well as associated thermal effects (Pozderovic´ et al. 2006). As a result, RO has become an alternative process to the conventional methods for removing water from fruit juices and other liquid foods (Girard and Fukumoto, 2000). However, one of the main disadvantages of using RO is related to lower concentration of the yield in comparison to the thermal process due to high osmotic pressure limitation. Having said this, the RO process has affirmed its