VEGETABLE OIL PRODUCTIVITY OF A SUPERCRITICAL FLUID EXTRACTION PLANT

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ABSTRACT

There is limited information in the literature on the sizing of supercritical fluid extraction plants for solid substrates, probably because the expertise gathered by plant manufacturers is offered to clients as part of a package including the plant itself. Such multi-vessel plants are characterized by a simulated counter-current contact between the solid substrate in packed beds (loaded extraction vessels) and continuously flowing supercritical CO_2 (SC-CO_2). In this work, we present a map of vegetable oil productivity of prepressed rapeseed pellets extraction plant using SC-CO_2 as the solvent as a function of the plant configurations, process conditions, and solute recovery. For this purpose, we used a previously developed simulation algorithm based on the shrinking core model to represent the mass transfer.

In order to compare the plant productivity for different extraction conditions, we studied the following three cases: (i) a plant with an extraction pressure of 30 MPa; (ii) a plant with an extraction pressure of 70 MPa; and (iii) a plant with an extraction pressure of 70 MPa and the same productivity of the first plant. In all cases, the total plant volume, the extraction vessel diameter, and the extraction temperature were constants (V = 6 m^3, D = 80 cm, and T = 40 °C respectively). We modified some operational parameters to discuss its effect on the oil productivity. These parameters and its ranges are the following: number of extraction vessels (n, 3 or 4), mass flow rate of SC-CO_2 ($10000 < F_{CO2} < 20000$ kg/h) and superficial rate of CO_2 ($6 < U < 12$ mm/s), particle size ($1< d_p, < 8$ mm), and bed porosity ($0.4 < \varepsilon < 0.6$). The results will allow us to estimate the total cost (investment plus 15 year-processing) of the three plants.

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