

Praca dyplomowa inżynierska

Cost Analysis of Supercritical Fluid Technologies



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Introduction

Processes of separation are some of the most commonly used in chemical engineering. Supercritical fluid extraction has many advantages over traditional extraction however one of the main disadvantages is the cost of changing to the new technology due to high initial investment costs of the high pressure equipment. This work is an attempt to provide a procedure for analyzing the cost of applying supercritical technology on an industrial scale and evaluating the profitability of such investments.

Aim of the work

The aim of the thesis is to develop a procedure for calculating the investment cost of operating a supercritical fluid extraction plant.

The work is divided into three main parts.

1. Overview of available literature regarding methods of cost estimation in supercritical fluid technology.
2. A proposed procedure for cost estimation, developed on the grounds of selected methods described in part one.
3. Validation of the proposed procedure. Costs calculated using the procedure are compared with actual costs of selected industrial applications of supercritical technology.

Cost estimation in Supercritical Technology

The theses focuses in detail on the estimation of costs directly related to the supercritical technology applied in the project under evaluation. The largest portion of the cost of operating a production facility which uses supercritical technology for the manufacturing process comprises three major parts. The main contributors to the overall cost of investment are the fixed cost of equipment, the cost of raw materials for production and utilities.

Procedure for cost estimation

For the purpose of initial cost estimation penny accuracy is not required. An order of magnitude valuation of the project may be enough to make a choice between different production technologies considered for the manufacturing process.

The proposed procedure is as follows:

1. Establish the product, manufacturing process and production rate
2. Calculate the energy requirements for the thermodynamic cycle
3. Calculate equipment cost
4. Direct production costs:
 - a. Calculate cost of raw material
 - b. Calculate cost of utilities
 - c. Calculate cost of labour
5. Calculate final cost

Practical examples and verification

For the purpose of verification, the proposed procedure was applied to recalculate the cost of several example installations. The results obtained using the procedure were then compared with the known costs of investment of the existing plants.

Three examples were considered:

1. Cost of manufacturing of clove extracts
2. Supercritical extraction from agro-food raw materials
3. Decaffeination of coffee

Most of the cost can be attributed to three factors. Cost of investment, cost of raw material and cost of utilities. Depending on the process each of these might be an order of magnitude larger than the rest. The cost of investment can actually be considered to equal the cost of purchased equipment. The other two major factors are considered variable cost and depend on the rate of production.

Conclusions

The procedure proposed in this work allows for quick estimation of the cost of production using supercritical extraction technology. Analysis using the proposed procedure presented in this work shows that applying supercritical technology in production processes at an industrial scale can be not only economically viable but also profitable.