СЕКЦІЯ 5. МОДЕЛЮВАННЯ РОБОЧИХ ПРОЦЕСІВ В ТЕПЛОТЕХНОЛОГІЧНОМУ, ЕНЕРГЕТИЧНОМУ ОБЛАДНАННІ ТА ПРОБЛЕМИ ЕНЕРГОЗБЕРЕЖЕННЯ

FILM EVAPORATORS TO BE USED WITH CRYSTALLIZED SOLUTIONS

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Evaporation processes are widely used in technological processes of metallurgical, chemical, pharmacological, food industries, etc. The type of evaporator depends on the area of its application and the initial characteristics of the evaporated product, while the thermophysical properties of the evaporated solution, its tendency to crystallization, sensitivity to high temperatures, available temperature difference and the heat transfer surface are taken into account.

The type of evaporation equipment also determines the energy costs of production and affects the quality of the finished product. This is especially true for crystallizing and scale-forming solutions, which are often subjected to the evaporation process. A significant part of the evaporated solutions contain salts that crystallize during processing. Evaporation of such solutions poses a number of problems and its implementation causes many difficulties. One of the main problems is the saline deposits on the internal surfaces of the apparatus. Saline deposits inside the heat exchanger tubes are especially harmful, as this can reduce the performance of the evaporator due to the necessity to switch it to the washing mode or to stop it for cleaning.

Typically, evaporators with natural or forced circulation and remote boiling zone are used for the treatment of liquids with a high viscosity, containing a crystallizing component or prone to inlaid heat transfer surfaces. Their use minimizes contamination of the heating surfaces due to the deposition of the crystallizing component.

At the same time, film evaporators are quite efficient because of shorter duration of the evaporation process and smaller dimensions and specific amount of metal. Its high efficiency can also be obtained through the use of a mechanical or thermal secondary steam compressor. This allows making the best use of the minimum temperature difference and the possibility of multi-stage evaporation. However, application of film evaporators for the salts containing solutions is now limited.

Nevertheless, various studies show the possibilities of expanding the area of applicability for film evaporators. Partial cleaning of the heating surfaces and a decrease in the rate of scale formation can be achieved by introducing in the initial solution particles of the solid phase, which, in addition to the cleaning function, also improve heat transfer. After passing through one evaporation cycle, a small amount of the crystallizing phase returns to the initial solution supplied to the evaporator. Thus, the working period of the evaporator increases due to the continuous circulation of the solid phase.

The implementation of these possibilities for film evaporators should be investigated further taking into account multiphase liquids evaporation and the mutual influence of boiling, vaporization and crystallization processes.