

EXERGY CHARACTERISTICS OF SUGAR PRODUCTION
ЕКСЕРГЕТИЧНІ ХАРАКТЕРИСТИКИ ВИРОБНИЦТВА ЦУКРУ
ЭКСЕРГЕТИЧЕСКИЕ ХАРАКТЕРИСТИКИ САХАРНОГО ПРОИЗВОДСТВА

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Abstract: A typical technological scheme of sugar production with a capacity of 3000 tons/day was considered and the corresponding exergy characteristics were determined. The loss of exergy and the degree of thermodynamic perfection for the typical processes of sugar production were evaluated: preparation of raw materials, heating of syrups, evaporation, collection of syrups, filtration. As calculations have shown, for the system of sugar production as a whole, the greatest exergy losses (more than 70%) fall on evaporation processes, therefore, the most attention should be paid to these processes.

Keywords: sugar production, exergy losses, degree of thermodynamic perfection

Анотація: Була розглянута типова технологічна схема виробництва цукру продуктивністю 3000 т/добу та визначено відповідні ексергетичної характеристики. Окремо були оцінені втрати ексергії і ступеня термодинамічної досконалості для основних процесів цукрового виробництва, а саме: підготовки сировини, підігріву сиропів, випарювання, збору сиропів, фільтрації. Як показали розрахунки, для системи виробництва цукру в цілому найбільші ексергетичної втрат (понад 70%) припадають на процеси випарювання, тому цим процесам повинно бути приділено найбільшу увагу.

Ключові слова: виробництво цукру, втрати ексергії, ступінь термодинамічної

досконалості.

Аннотация: Была рассмотрена типовая технологическая схема производства сахара производительностью 3000 т/сутки и определены соответствующие эксергетические характеристики. Отдельно были оценены потери эксергии и степени термодинамического совершенства для основных процессов сахарного производства, а именно: подготовки сырья, подогрева сиропов, выпарки, сбора сиропов, фильтрации. Как показали расчеты, для системы производства сахара в целом наибольшие эксергетические потери (более 70 %) приходятся на процессы выпарки, поэтому этим процессам должно быть уделено наибольшее внимание.

Ключевые слова: производство сахара, потери эксергии, степень термодинамического совершенства.

It was considered a typical technological scheme of a sugar production factory with a capacity of 3000 tons/day, and determined the corresponding exergy characteristics.

In the initial preparing of product, the greatest loss of exergy (187 kW) falls on the process of obtaining affinity sugar with a minimum value of the degree of thermodynamic perfection 0.5. This is due to dissipative losses of centrifugation processes, mechanical separation and grinding, diffusion, in which energy is used on the equipment drives.

In the processes of syrups heating the exergy losses caused to heat transfer irreversibility at sufficiently high temperature differences, and the dissipative losses of the product transportation process in the subsequent processing steps. The largest losses of exergy (93 kW) fall on the process of heating the syrup of affinity sugar at a low value of the degree of thermodynamic perfection 0.77.

For syrup evaporation the greatest exergy loss (kW 1451) occur in the process of primary refined (as well as a low value of 0.55 degree thermodynamic perfection), which results to a large heat flows and an irreversibly of heat transfer processes at high temperature differences.

In the processes of collecting syrups, loss of exergy caused by dissipation in transportation of the product from several locations with subsequent mixing and direct losses of a heat to the environment from the equipment due to imperfect thermal isolation. The largest losses of exergy (10 kW) fall on the process of collecting the syrup 2 product at a sufficiently high value of the degree of thermodynamic perfection 0.92.

During filtration, the greatest loss of exergy (30 kW) falls on the process of filtering the syrup before sulphation at a sufficiently high value of the degree of thermodynamic perfection 0.89.

This is due to the dissipative processes during filtration and the low quality of filtration material.

As follows from the consideration of the results for system of sugar production as a whole, the greatest exergetic losses are observed during the process of syrup evaporation (more than 70 % of the exergetic losses of the whole process of sugar production). These processes are also characterized by the lowest degree of thermodynamic perfection from all the processes under consideration (0.54), therefore, for these processes have been given the most attention.