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DEVELOPMENT OF A SYSTEM OF OPTIMAL CONTROL OF PROCESSES OF OIL TREATING TERMOCHEMICAL PLANTS

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Oil treating termochemical plant (OTTP) is one of the main units of oil production and taking into account that oil industry of Azerbaijan develops intensively the problem of creation of a system of optimal control (OC) of OTTP processes is very urgent. The proposed report is devoted to solving of this problem.

OTTP consists of two successive blocks: dehydration (DhB) and desalting block (DsB). In the first place, a problem of optimization with the following definition is to be solved for creation of OC system:

$$\min_{U\in\Omega U}(X_2 Ц_T + 10^{-6} Z_1 \rho_{нэ} Ц_p Ц_1 + 10^{-2} X_1 Ц_в Ц_з) \qquad (1)$$

with the following limitations

$$Y_3(Y_1, X_1, U_3) \le A_3 \qquad (2)$$

$$Y_4(Y_i, X_1, U_3) \le A_4, \quad i = \overline{1,3} \qquad (3)$$

$$13 \le U_1 \le 35 \qquad (4)$$

$$50 \le U_2 \le 65 \qquad (5)$$

$$2 \le U_3 \le 7 \qquad (6)$$

where $Y_1 = f(Z_1, Z_2, Z_3, U_1, U_2)$ and $Y_2 = f(Z_1, Z_2, Z_3, Z_4, U_1, Y_2, Y_1)$ are content of water and salt in oil respectively at DhB outlet; Z_1, Z_2, Z_3, Z_4 are flow rate and temperature of oil emulsion (OE) (m^3/hour) and water (%) and mineral salts (mg/l) content in it respectively at DhB inlet; Y_3, Y_4 are water and salts content in oil at DsB outlet; $Ц_т, Ц_р, Ц_в$ are prices of separator oil (AZN/t), chemical agent (AZN/t) and water (AZN/thousands m^3); U_1, U_2, U_3 are consumption of chemical agent (g/t), temperature (^oC) and consumption of fresh water (m^3/hour).

Dependence ОУ (U_q) of ВФ (Z_s) should be determined in order to avoid the problem of optimization in case of change of values of perturbing factors (PF).

Considering the linear dependence between $U_q^{opt}, q = \overline{1,3}$ and $Z_s, s = \overline{1,3}$ was found inadequate it was decided to increase of polynomial degree, i.e.:

$$U_q^{opt} = a_{oq} + \sum_{s=1}^{4} a_{sq} Z_s + \sum_{\substack{sj=1 \\ s<j}}^{4} a_{sjq} Z_s Z_J + \sum_{s} a_{ssq} Z_s^2 \qquad (7)$$

In the result of solving of the problem of optimization using planning of experiment at all values of perturbing factors algorithms of optimal control of OTTP processes were derived (equation 7).

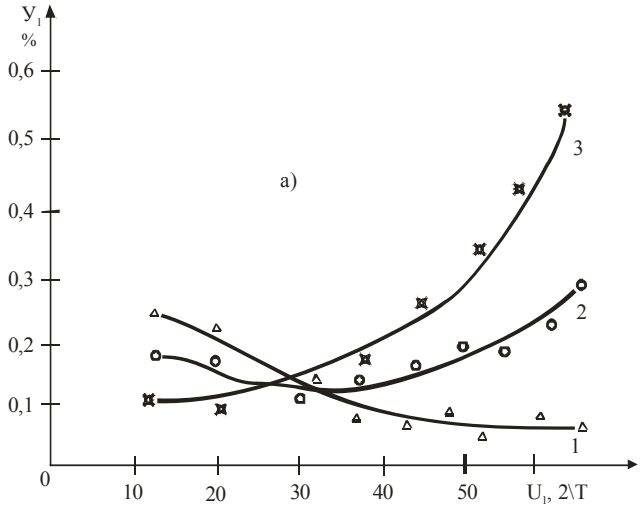
A two-level system of OC of OTTP processes is applied in this work for realization of derived algorithms (Figure 2).

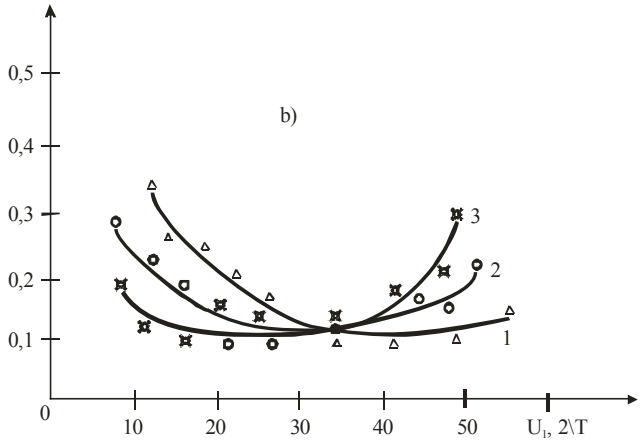
The first stage of hierarchical structure (HS) of the system includes local systems of regulation of separate parameters [1-3] and the second stage of HS includes UVK (Figure 2).

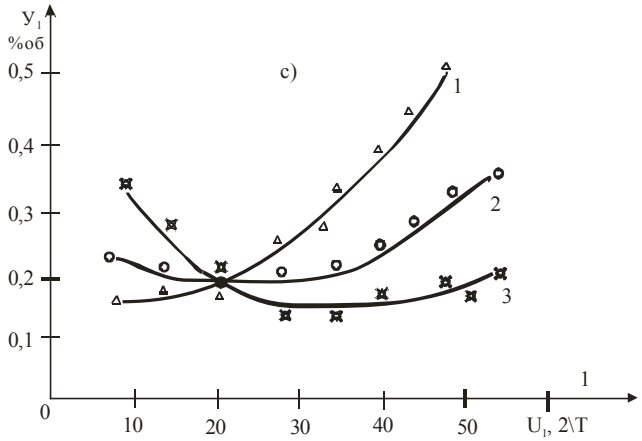
The system works in the following way:

Information about changes of values Z_1, Z_2, Z_3, Z_4 enters UVK through the first stage of HS. On basis of obtained information and algorithm (7) an optimal value of control actions U_1, U_2, U_3 is determined and sets of relevant regulators are changed. Subject to considerable change of situations (quality of OE entering the plant, quality of chemical agent) models (2), (3) are

defined more exactly. Problems of optimization (1)-(6) are solved again for all possible variants of change of Zs and factors of equation (7).







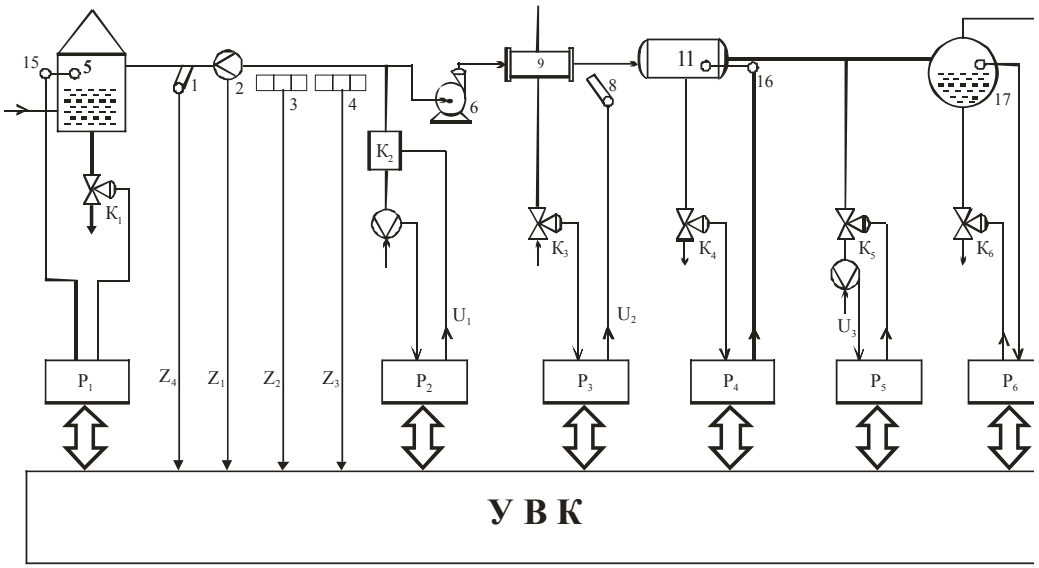


Figure 2. Basic diagram of the system of OC of OTTP
5,11,14 – dehydration boxes; 9 – heat exchanger; 6 – pump;
1,2,3,4,8,11,12,13,14,15 – sensors; K_1-K_6 – actuators;
P_1-P_6 regulators

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