

## PRACTICAL 7

### **THEME : Calculation of consumption of auxiliary products: calculation of the amount of circulating gasoline and consumption of process water and steam.**

5) The amount of gasoline extracted from the extractor with the meal per day is calculated as follows.

$$B_g = B_c - III_p = 286,5 - 200,52 = 85,98 t / day$$

6) Total amount of gasoline consumed per day

$$B_0 = B_m - B_g = 64,8 + 85,98 = 150,78 t / day = 6,3 t / hour$$

Volume amount as follows:

$$\frac{B_0}{\rho} = \frac{6,3}{0,68} = 9,3 m^3 / hour$$

$\rho = 0,68 m / m^3$  density of gasoline

### **Calculation of water consumption.**

**3.1.** Calculation of water consumption for technological needs:

**3.1.1.** Water consumption required to moisten 100 tons of grain with initial moisture to the requirements of technological regulations:

$$B_0 = 9,5\%$$

$$B_T = 11\%$$

$$B_1 = \frac{G * (B_T - B_0)}{100 - B_0} = \frac{100 * (11 - 9,5)}{100 - 9,5} = 1,1 t$$

**3.1.2.** Grinding in a humidifying-evaporating screw

$B_{\text{яш}} = 9\%$  from  $B' = 12,5\%$  to Water consumption for humidification:

$$B_2 = \frac{C_{\text{яич}} * B' - B_{\text{яи}}}{100 - B_{\text{яи}}} = \frac{62,37 * 12,5 - 9}{100 - 9} = 2,4m$$

3.1.3. Water consumption for cooling the forpress and extraction oil from 100°C to 35°C in the refrigerator:

Initial temperature of water  $t_s = 20^\circ C$  till  $t_f = 30^\circ C$

$$B_3 = \frac{(\Phi_M + \mathcal{E}_M) * C_M (t_{ini} - t)}{C_g * (t_f - t_{\text{оош}})} = \frac{11,851 + 6,617 * 2,1(100 - 35)}{4,19 * (30 - 20)} = 60,2m$$

Here:  $C_M - 2,1 \text{кдж} / \text{кг} * ^\circ C$  heat capacity of oil

$C_g - 4,19 \text{кдж} / \text{кг} * ^\circ C$  heat capacity of water

3.1.4. According to the technological regulations, the water consumption used in condensers and coolers in the extraction shop is taken as 22m<sup>3</sup> to obtain 1 ton of extraction oil.

$$B_4 = \mathcal{E}_M * 22 = 6,617 * 22 = 145,6M^3$$

3.1.5. Total water consumption for technological needs:

$$B_m = B_1 + B_2 + B_3 + B_4 = 1,1 + 2,4 + 60,2 + 145,6 = 209,3m$$

3.2. Calculation of water consumption for household needs.

3.2.1. For washing, according to the norm, per worker  $W = 50 \text{litre}$

water is consumed.

$$B_5 = \frac{W * n * 1,4}{1000} = \frac{50 * 24 * 1,4}{1000} = 1,68M^3$$

Where: n=24 - number of technical staff

1.4 - coefficient of shower usage by workers.

3.2.2. The amount of water consumed for household needs (excluding showering) per worker.  $W_2 = 35 \text{ litre}$

$$B_6 = \frac{W_2 * n * 1,4}{1000} = \frac{35 * 24 * 1,4}{1000} = 1,18 \text{ m}^3$$

3.2.3. The amount of water consumed for washing floors and equipment according to sanitary and technological standards is 1.5 liters per 1 m<sup>2</sup> of surface.

$$B_7 = \frac{F * 1,5}{1000} = \frac{1 * 1,5}{1000} = 1,5 \text{ m}^3$$

Where: F- total surface area to be washed, m<sup>2</sup>. Determined from the graphic part of the project.

3.2.4. Total amount of water consumed for household needs.

$$B_{general} = B_5 + B_6 + B_7 = 1,68 + 1,18 + 1,5 = 4,36 \text{ m}^3$$

3.3. General consumption of water

$$B_{total} = B_m + B_{general} = 209,3 + 4,36 = 213,66 \text{ m}^3$$

3.4. Total water consumption for the production of 1 ton of crude oil:

$$B_{oil} = \frac{B_{total}}{Q_{oil}} = \frac{213,66}{131,66} = 1,62 \text{ m}^3 / \text{m}$$

## 4. Calculation of steam consumption

4.1. Determination of steam consumption for technological needs.

4.1.1. Determination of steam consumption for heating the feedstock in the steam-humidifying screw.

$$\Pi_1 = \frac{G_{cr} * C_{cr}(t_f - t_s)}{J_n} = \frac{62,37 * 1,35(105 - 25)}{2100} = 3,2 \text{ tonn}$$

Here: G<sub>cr</sub> – 62.37 t (taken from the material account);

C<sub>cr</sub> – 1.35 kJ/kg\*°C, heat capacity of the fuel

J<sub>n</sub> – 2100 kJ/kg – useful heat output of the heating steam

$t_{ox}$  – 1050C final temperature of the fuel

$t_{bosh}$  – 250C initial temperature of the fuel

4.1.2. According to the technological regulations for distillation of micelles and removal of solvent from the meal in the extraction workshop, the steam consumption is 1.67 tons per 1 ton of extracted oil.

$$\Pi_2 = \frac{B_2 * C_{cyb} * (t_{ox} - t_{bosh})}{J_0} = \frac{3,2 * 4,19 * (1050 - 250)}{2100} = 11,1 \text{ tonn}$$

4.1.3. The total amount of steam consumed for technological needs, taking into account the loss of 10% of heat to the environment:

$$\Pi_{general} = (\Pi_1 + \Pi_2) * 1,1 = (3,2 + 11,1) * 1,1 = 15,73 \text{ tonn}$$

## 4.2. Determining the consumption for household needs.

4.2.1. We determine the steam consumption for heating the water used in the shower as follows:

$$\Pi_3 = \frac{B_5 * C_{cyb} * (t_{oxp} - t_{oou})}{J_0} = \frac{1,68 * 4,19 * (60 - 20)}{2100} = 0,14 \text{ tonn}$$

**Here:**

**C<sub>water</sub> = 4.19 kJ/kg·°C** — specific heat capacity of water.

**c<sub>b</sub> = 2100 kJ/kg** — specific heat capacity of steam.

4.2.2. When calculating the amount of steam required for heating a room, the following is taken into account:

To increase the temperature of **1 m<sup>3</sup> of air in the room by 1°C**, an amount of heat **Q = 1.5–2.5 kJ/h** is required.

For the subsequent calculations, we assume

$$\Pi_4 = \frac{V * Q * 24 * (t_2 - t_1)}{J_0} = \frac{1200 * 2 * 24 * (20 - 4)}{2100} = 439 \text{ kJ} = 0,44 \text{ tonn}$$

**Here: B** - the volume of the premises used in the enterprise, m<sup>3</sup>.

For the calculation, we take 1200 m<sup>3</sup>.

**t<sub>2</sub> – 20°C** - the average temperature in the room

**t<sub>1</sub> = 4°C** - the average temperature of the outside air.

**4.2.3.** The total amount of steam consumed for household needs:

$$\Pi_{total} = \Pi_3 + \Pi_4 = 0,14 + 0,44 = 0,58 \text{ tonn}$$

**4.2.4. General consumption of steam:**

$$\Pi_{generalsteam} = \Pi_g + \Pi_{total} = 15,73 + 0,58 = 16,31 \text{ tonn}$$

**4.2.5. Steam consumption for 1 ton of crude oil:**

$$\Pi_{oil} = \frac{\Pi_{g.s}}{\Phi_m + \mathcal{E}_m} = \frac{16,31}{11,851 + 6,617} = 0,88 \text{ tonn}$$