USING AN AUTOMATIC PROCESS CONTROL SYSTEM AT A WATER TREATMENT PLANT

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Abstract: The results of research on the development of control and automated control systems for technological processes of TashTPP water treatment plants are presented.

Keyword: coagulant dispenser, specific electrical conductivity, regeneration, clarifier

From 2019 to the present, the TashTPP water treatment plant (VTP) has been working to create automated systems for managing and monitoring water treatment processes. In 2019, an automated system for regeneration of H-cationite filters of stage I and II was put into pilot operation, as well as the process of regeneration of H–cationite filters using the developed sulfuric acid dispenser was automated (H_2SO_4).[1]

Conduct metric sensors that measure the concentration of sulfuric acid are installed on the supply pipelines of the regeneration solution for H-I and H-II cationic filters. Inside the sensor, tantalum electrodes with a diameter of 3 mm are used, placed in a photo-layer housing. Electrical conductivity is measured by measuring the amplitude of an alternating current, through a sensor at a constant voltage on it. For temperature compensation, the signal from the sensor together with the signal from the diode is used in the universal liquid dispenser JU-1-2 [2].

It is known that the h –cationic filters of the first stage are fed with a step-by-step mode of regeneration solution with a concentration of 0.3%, 0.6% and 1.0% at the VTP of Tashtpp. All this automated system provides the supply of regeneration solution, which prevents the cationite grains from being plastered.

A multi-channel system for collecting conduct metric information from universal conduct metric sensors provides a real-time control mode at the TashTPP VPU. These sensors are installed at the inputs and outputs of all ion exchange filters [3].

The conduct metric sensor has one short and two long tantalum electrodes. Tantalum eliminates wear and passivation of electrodes due to electrochemical processes and contact with acid and alkaline regeneration solutions.

All information from universal conduct metric sensors is sent to the multi-channel digital conduct meter developed by the authors (KMC-1).

The KMC-1 conduct meter provides measurement of specific electrical conductivity with 32 universal sensors. All these sensors are installed at the entrances and exits of ion exchange filters and on the supply lines of regenerative solutions.

Universal sensors are installed at the inlet and outlet of filters of all existing sampling lines. This type of sensor connection eliminates the possible negative impact of the sensor on the filter operation, and also allows you to repair the sensor without disturbing the filter operation mode. To cover the range of specific electrical conductivity $0{,}4$ from to the $105\ {mkSm}/{sm}$ microcontroller KMC-1 selects the necessary pair of electrodes and the gain in the line. For low electrical conductivity, a pair of long electrodes and two consecutive amplifiers is used. For regenerative solutions, a short one with a long electrode without amplifiers is used. Information received from universal sensors is processed in the PC, recorded and displayed on the PC monitor in the form of tables and histograms.

The On-line values of the reduced electrical conductivity of the treated water in filtration mode, as well as the values of regeneration solutions and washing water at the inlet and outlet of the regenerated filter, are displayed on histograms.

The UEP values received from 32 channels are archived in memory every 3 minutes by a personal electronic computer (PC). For each universal sensor, the program provides the setting of certain lower and upper settings of the value of the reduced specific electrical conductivity (SEC). An alarm is triggered for the operator to make the correct decision. It is triggered when the value of the reduced electrical conductivity exceeds the limits of the installations.

Fig.1 shows a graph of changes in the SEC of clarified water and the filter with H-I cationic filters 2, 4 and 5 of the VTP.

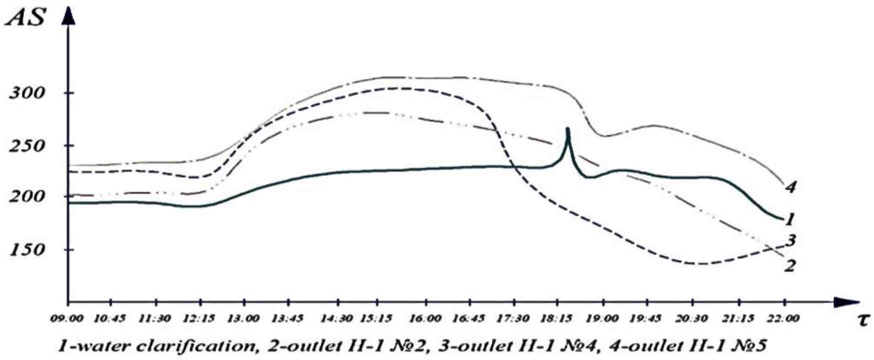

Fig. 1. Graph of changes in specific electrical conductivity

As seen in Fig.1 in the filtering process value based mud filtrates exceeded the value of SEC with clarified water, and the depletion of the filter value based mud filtrate begins to decrease and the curves based mud filtrate and the clarified water intersect.

All this automatic system allows you to monitor real-time compliance with filtration requirements and determine the moment of depletion of the load of H-I cationic filters with an accuracy of tens of minutes.

Since November 2009, the multi-channel conduct metric system online monitoring allows monitoring the regeneration and washing process in real time, and still archives data on regenerations on all cationic filters.

Results of measurements of the concentration of sulfuric acid (H_2SO_4) at the inlet of the regenerated H-I cationic filter No. 5.

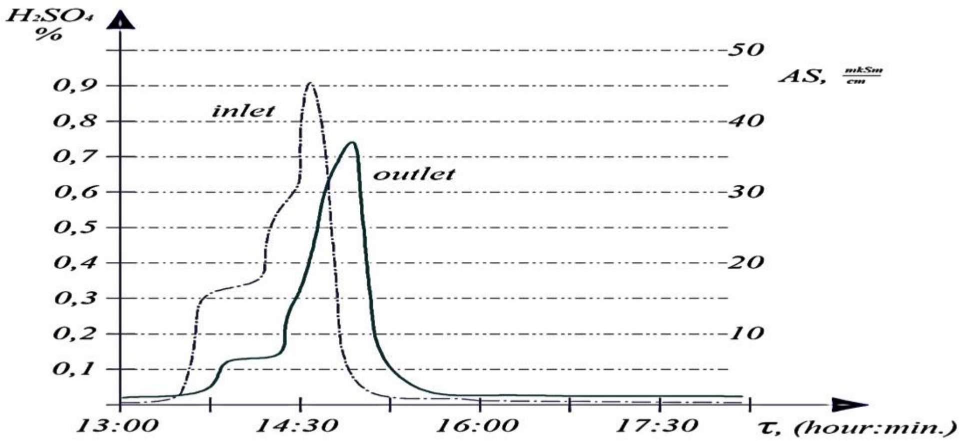

Fig.2. Results of concentration H_2SO_4 measurements at the inlet of the regenerated H-I cationic filter No. 5 and at the outlet of the same filter at the same time

Fig.2 it is clearly visible that the pre-set mode of supply of solution to the input of the filter H_2SO_4 H-I No. 5 is observed. The rise of the SEC $8\ ^{mksm}/_{sm}$ to is visible on the graph from the output of this filter 3, which corresponds to the output of hardness salts. The next peak is shown by the output of the unreached one. These data show that the regeneration of H-I cationic filters at the TPP allows for significant over spend H_2SO_4 .

The developed system quite quickly determines the moment of depletion of anionite filters. In anionite filters, the stage when depletion of ion exchange loading occurs, the SEC $10\ ^{mksm}/_{sm}$ rises from the level to the value $15 \div 20\ ^{mksm}/_{sm}$, and in filters, II the stage rises $0{,}6 \div 1{,}0\ ^{mksm}/_{sm}$ from the level to the value $2\ ^{mksm}/_{sm}$.

It should be noted that the multi-channel conduct metric online monitoring system works at the VTP Tashtes for the use of operational control of compliance with the rules of filtration, regeneration and washing of filters.

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