SCADA system for laboratory research automation in determining the water proportion in oil

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Abstract. Automation of the petrochemical industry has not lost its relevance for a long time, despite the numerous solutions found in this area. The issues of increasing the accuracy indicator, reducing costs, increasing profitability and, importantly, ensuring the safety of petrochemical production are still awaiting a technological solution. The article touches upon the aspects of the harmful environment of the working area, the explosion and fire hazard of substances, the complexity of the chemical processes and their sensitivity to deviation from predetermined modes. The article proposes to solve a number of these problems by creating an automated workplace for a laboratory assistant. The article presents monitoring of laboratory process control.

1. Introduction

The priority areas of most petrochemical enterprises activity are the reduction in the cost of production of wells, due to the improvement of technological processes for the preparation of oil.

The liquid extracted from oil wells (oil-water emulsion) contains a huge amount of water [1, 2]. A water-oil emulsion is formed as a result of mixing water and oil during the extraction of fluid from the well [3, 4]. Watered oil contains a large amount of impurities that reduce the quality of the oil, including mineral salts dissolved in the water that makes up such emulsions.

Today, every oil producing enterprise must have a laboratory complex that performs its functionality accurately and with minimal financial and time costs [5]. Automation of the laboratory assistant's workplace allows to reduce labor input and labor costs, as well as increase productivity [6, 7].

The method for determining the proportion of water in oil by the Dean and Stark method is by far the most accurate, but has its drawbacks: it is time-consuming and labor-intensive [8]. The laboratory research method must be qualitatively improved by creating an automated workplace for a laboratory assistant [9].

2. Material and methods

The installation is schematically presented in Figure 1, where: 1 - a tripod, 2 - a tube with liquid for a cooling installation [10].

The following equipment is used in the method for determining water in an oil-water emulsion: at the bottom of the cooling unit (3) there is a sensor for determining the height of the liquid column (4), a dropping sensor (6) is located at the end of the pipe of the cooling unit, above the collecting beaker (5). All sensors are wired to a data acquisition device, from where information is sent to a computer. Special software makes calculations, on the basis of which the temperature of heating the tile (9) is increased by the heating temperature controller.

The software for creating an automated workstation is used as SCADA and is designed to provide real-time collection systems, analysis, display and storage of information about the object of observation or control [11].

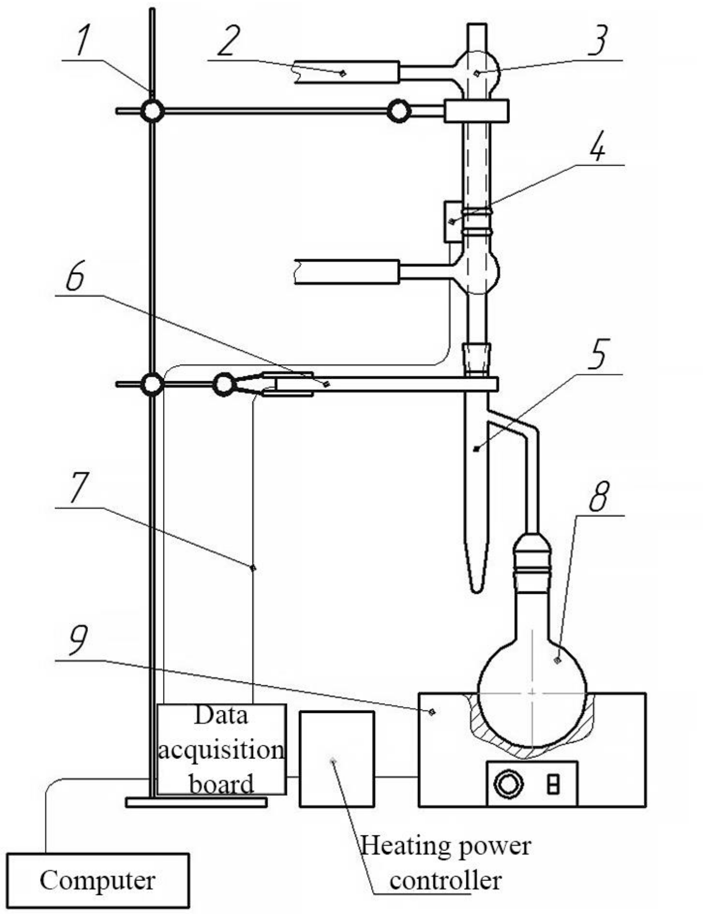

Figure 1. The apparatus of the automated process for determining the proportion of water in oil.

3. Results and discussion

Before starting the test, all systems are turned off and are in the zero value. Figure 2a shows the system start button, the temperature heating controller, the drop counter and the liquid level sensor are shown.

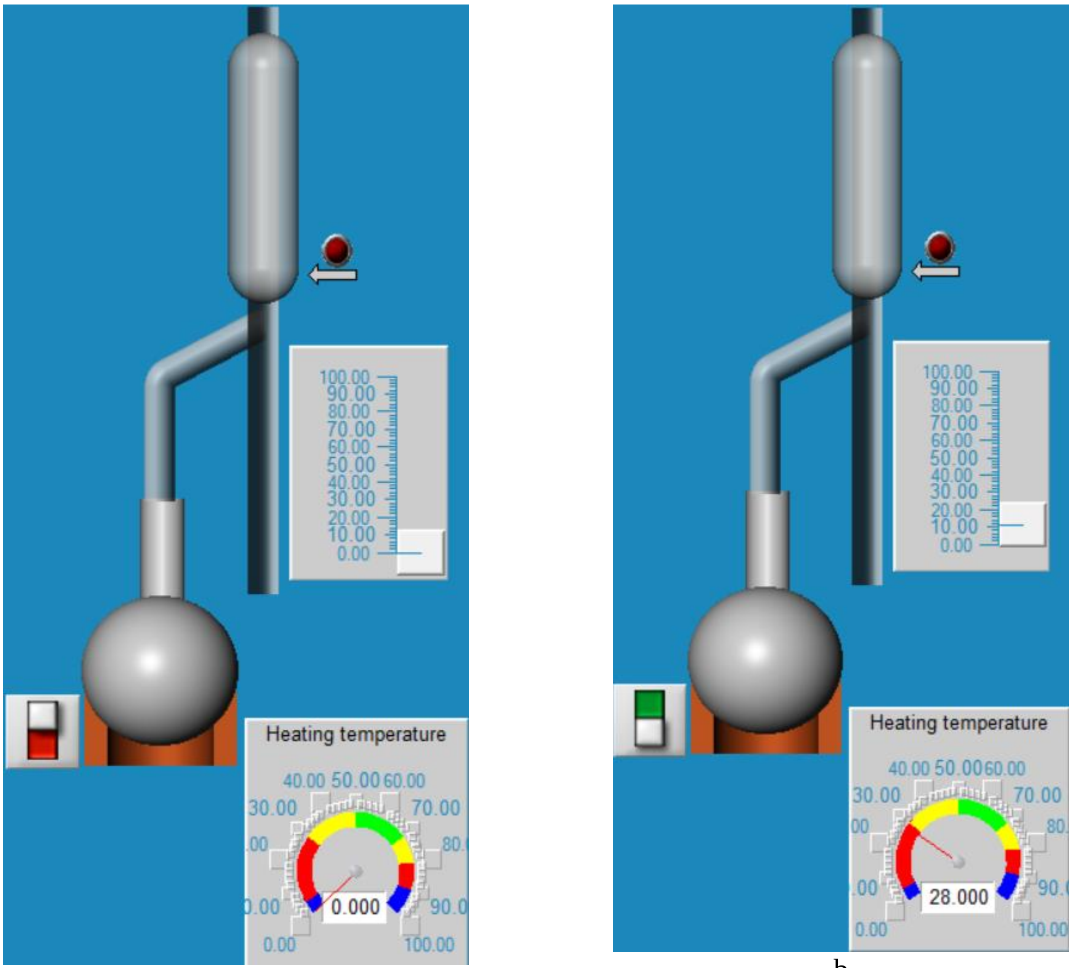

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Figure 2. System at rest and startup.

When you press the system power button, the temperature heater is turned on and the temperature value (in arbitrary units) gradually increases. Accordingly, the dropping rate of drops in the collecting beaker grows, which is also displayed on the scale in arbitrary units (Figure 2b). When deriving the final test results, the laboratory technician is able to automatically translate the unit parameter in a suitable measurement system. [12]

When the sensor for detecting the height of the liquid column is triggered, the indicator on the control panel lights up (Figure 3a) and, in accordance with the algorithm, the system starts changing the parameters in such a way as to lower the liquid level and at the same time keep the indicator of the rate of drop falling in the specified interval. In this way, the heating temperature decreases until the dropping rate drops to its lower limit (Figure 3b).

From which it follows that the result of creating an automated workplace for a laboratory assistant to determine the proportion of water in oil using the specified algorithm of an automated process, the participation of a laboratory assistant in the process remains only as an observer [13]. His responsibilities remain minimal actions: start the installation before analysis, check the tightness and operability of the system and run the algorithm directly in the program. Upon completion of the analysis, the program itself notifies the laboratory assistant about the end of the work and the need to destruct the system [14].

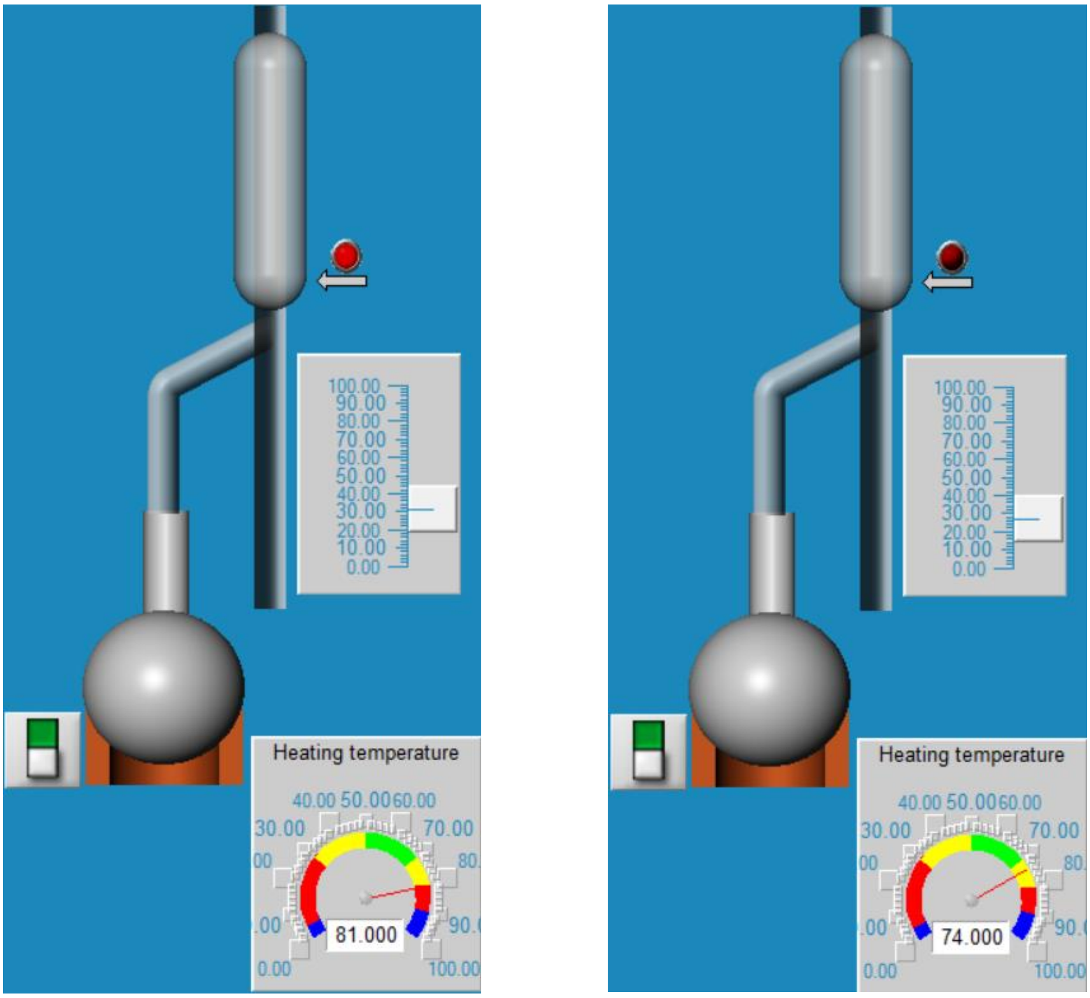

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Figure 3. System in critical condition and operational.

4. Conclusion

As a result of the work, an automated workstation of the laboratory assistant was created to determine the proportion of water in oil.

The main functions that the resulting system has:

- Control by a parameter of temperature heating of a flask.
- Monitoring the level of the liquid column.
- Maintaining the boiling speed parameter in the operating range.
- Visualization of processes for determining water in oil.

An automated workstation of a laboratory assistant with software based on an automated laboratory test algorithm for determining the proportion of water in oil was developed.

Thus, the qualitative indicators of the study are improved, and the human error factor is reduced.

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