mySCADA

Manufacturing Industry

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INTRODUCTION

With the cooperation of mySCADA, the "Artezia" company has developed and implemented a modern, efficient system of **steam supply** and **condensate drainage** for the drying part of the papermaking machine. This is the main equipment and the most important element of the entire facility.

The quality of the system directly affects the performance, energy consumption, product quality, profitability of production, and hence the survival and prosperity of the enterprise. Great attention is paid to automatic control algorithms and human-machine interaction as a necessary condition for effective control of the technological process.

TECHNOLOGICAL PROCESS DESCRIPTION

The importance of quality control of the paper drying process and processes in steam-condensate systems is that it is the most expensive part from many types of operating costs.
It largely determines the quality of the paper canvas. Thus, it accounts for the final formation of the paper canvas and the formation of various defects associated with moisture, drying, overheating of the canvas, uniformity of moisture across the transverse and longitudinal sections of the web.

Facts:

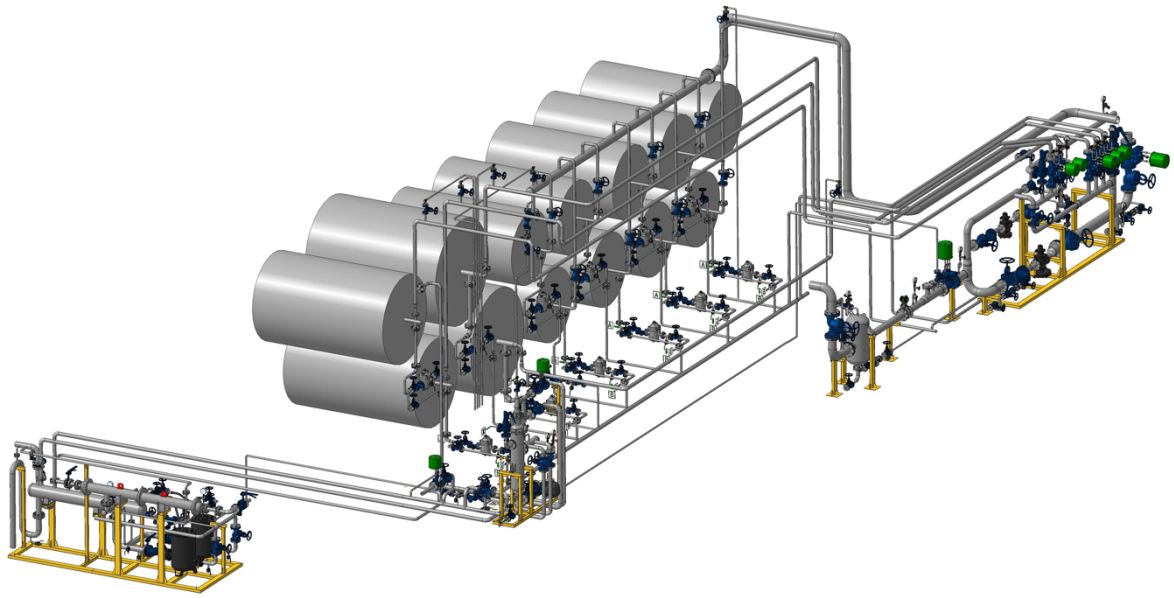
- The steaming section is the longest part of the paper machine, which accounts for 60-70 % of the machine weight.
- The cost of this equipment is up to 50 % of the total machine costs.
- The operating costs (associated with the operation of the drying part) are very significant. The cost of steam for drying is up to 15 % of the paper final price.
- The steam consumption by the drying part from total steam consumption on a paper machine can be up to 70-90 %.

The drying regimes can often vary depending on the characteristics of the paper canvas. With the correct choice of mode, the drying capacity can be increased by 1,3 -1,4 times. Critical in this case is the temperature and time of the canvas on the cylinder, at which breaks and overheating of the paper occur and defects associated with it are detected. That is also why the controlling system was wanted. The process or paper creation is very complex and the task consists of hundreds of variables.

Project assignment

Along with high quality and productivity of the paper machine, we expect high economic indicators. The current situation shows that the existing system is no longer feasible or efficient for human management. Moreover, the modern market requires even higher speeds, quality, efficiency, which can only be achieved by applying a high level of automation.

Modern automation technologies already require the construction of such systems using remote monitoring, management and service. Such an approach to a large extent allows saving on management, reducing costs associated with repair and purchase of out-of-order equipment due to timely and prompt response to anticipation of contingency. In addition, such systems allow for remote situational monitoring and statistics, which provides an opportunity for enterprise management to build a strategy for its production.



Picture 1 - Drying part of steam-condensate system of the papermaking machine.

Customized solution

Operational management and monitoring of the equipment state is implemented with the help of myBOX (hardware and software) from mySCADA. This allows to get rid of the classical scheme with a single stationary computer in a control room and provides all the interested personnel the necessary data.

Information is simultaneously available for the operator-dispatcher, field staff and the maintenance service. The emphasis is on giving just the important data for specific groups of personnel that will ensure a quick, error-free, and optimal decision-making for any production situation.

myBOX is placed directly in the control panel next to the controller (Picture 2). This arrangement minimizes the costs on installation the equipment and its further maintenance. Communication with the controller via the Modbus-TCP protocol provides two-way communication with a polling period of less than 200 ms and without any data loss.

At the same time, data exchange with more than 3000 tags goes without a significant load of the communication channel.

The basis for the automatic control system is the freely programmable Schneider Electric M241 PLC. It helps to solve all the tasks assigned to the team of engineers.

Picture 2 - PLC and myBOX – the hardware basis of the control system.

The developed unique algorithms of automatic control include:

1) automatic adjustment of steam parameters in 12 cylinders of the paper machine, depending on the type of product, speed, desired machine performance and disturbing factors;
2) steam preparation on the steam inlet before it is fed into the cylinders (dehumidification, reduction, accounting, emergency cutoff, soft start, stop steam, warm-up, etc.);
3) measuring of consumed steam and the condensate returned for reuse;
4) reuse of residual heat energy for the technological needs of the factory;
5) automatic system protection and prevention of abnormal situations.

The main page (Picture 3) provides the operator with an overview about the state of the equipment. The interface was built on the recommendations of the progressive standard of the human-machine interface ANSI / ISA-101. It enables the operator to instantly obtain processed information convenient for perception.

The main technological indicators are reflecting the state of the machine as a whole object. Based on current technological values and shown deviations from the permissible norms, it is possible to assess the situation based on the current state, background and possible threats. Thus, it is possible to take preventive actions to maintain the plant operation within acceptable limits and optimize its conditions.

Picture 3 - The main control panel of papermaking machine – with the most important parameters and states, represented in a convenient way for perception.

Observing the actions of qualified operators has shown that enough time to acquire sufficient skills to work with visualization is 15-20 minutes. This is facilitated by the concept of "3 clicks," the techniques of sequential detailing of information about equipment, the balance between symbols, indicators and text prompts with a minimum of cuts. Navigation through the system offers the necessary data in no more than 3 clicks.

For example: to find out all the nuances of the current condition and history of the drying cylinder, click on the menu button "Scheme," then click on the image of the cylinder. In the window that appears, the sensor values, deviations of the parameters from the set points and admissible thresholds, control commands and useful trends are immediately visible.

Picture 4 - There are several ways to get desired information – operator can choose the best for.

The many possibilities of configuring interactive interaction of the operator with any of the visual elements of the page make it even easier to obtain information. So, to open a window with a summary of the cylinder status, just click on the required indicator of the main page.

"The visualization is intuitive to operators and that shortens the time to find the right information and make decisions. Navigation can be implemented in different ways, and we gave operators the freedom to choose a convenient way for them."

says Alexander Stepanets from Artezia company.

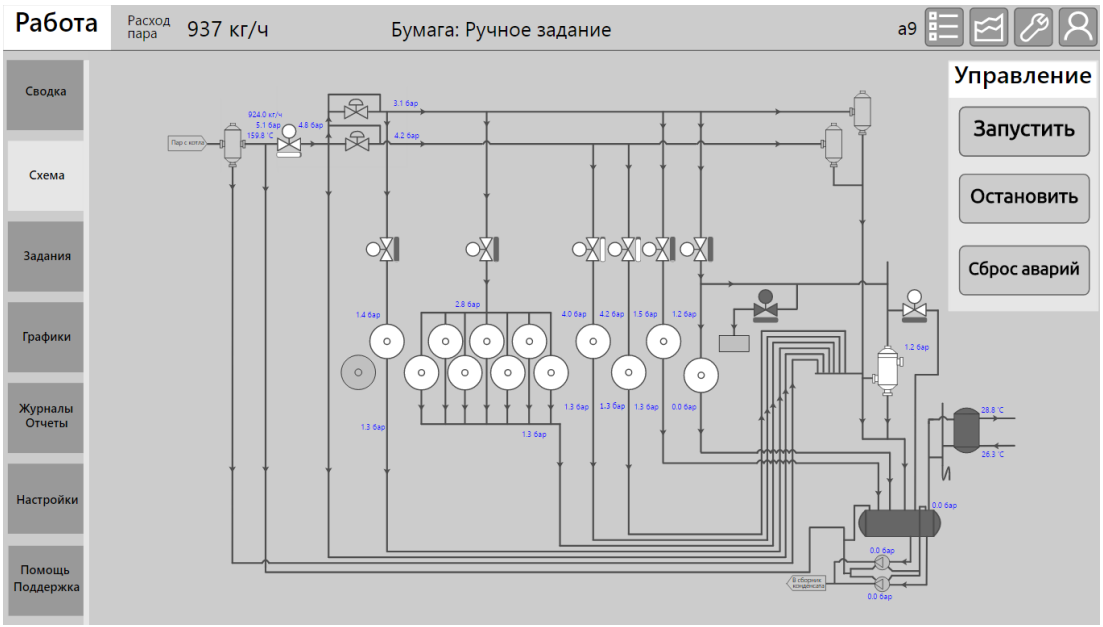
Human machine interface

Many operators and support personnel perceive the equipment visually, presenting it as a technological scheme of pipeline-connected devices. Therefore, the project provides for a classical interactive mnemonic diagram of the technological process. It shows the current state of each mechanism, the values of all accessible sensors and instantly signals faults. At a glance the operator can:

1) assess the state of the system as a whole,
2) identify problem areas and
3) eliminate unwanted behavior of mechanisms - if automation requires human assistance.

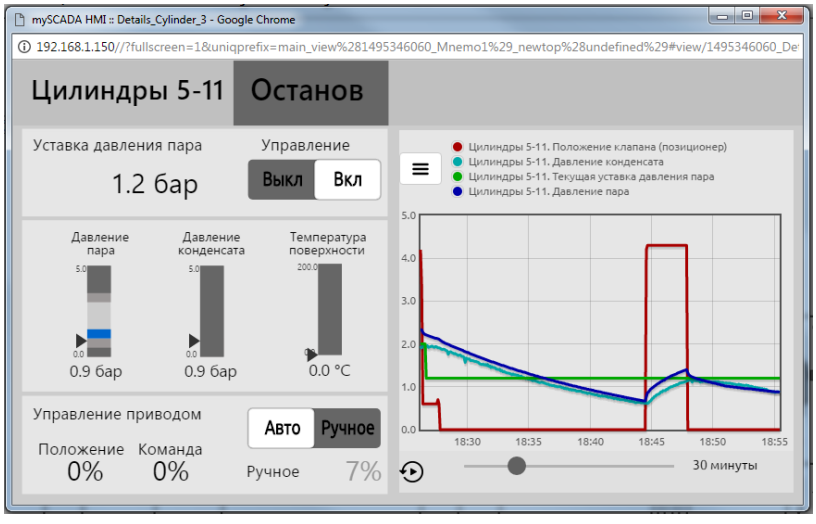
Performed in gray calm tones, the scheme does not attract the attention of the operator while the technological process proceeds as it should. But as soon as an event happens that requires a person's decision, it immediately notifies the user by changing color against the general background.

In addition, such interactive mnemonics contribute to the rapid learning of new personnel. They contain all the necessary information for each device, routes of raw materials and energy resources, possible combinations of operating equipment. In a visual form during the observation of the process, a novice can examine the facility and learn the features of the technological process.



Picture 5 - The overview interactive scheme of technological process.

Each individual unit is presented in a generalized form on the main page and the mnemonic diagram. At the same time, detailed information about the equipment of interest is available for authorized personnel. It contains both current conditions and possible ways to manage the unit and the history of its work in the form of trends. This data set helps to analyze the operation of the device, predict its behavior and plan maintenance. As a result, this transfers into a long, trouble-free operation of the system as a whole.



Picture 6 - Detailed information about each important machine equipment, in this case – about the heating cylinder: steam pressure, condensate pressure, conditions and states, automatic and manual control mode.

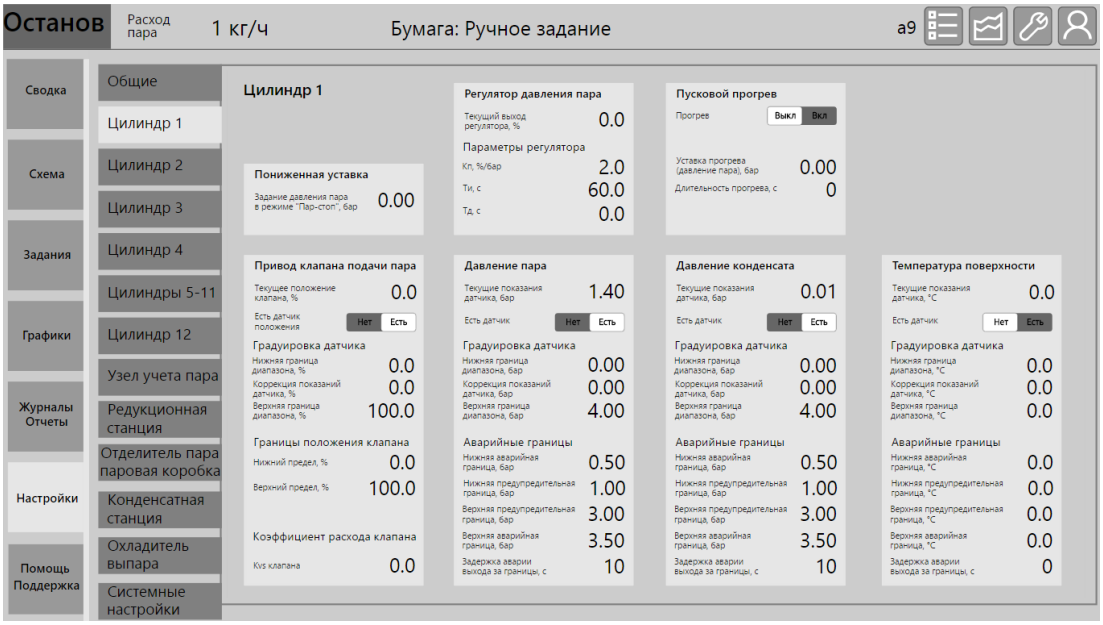
Settings

The papermaking machine can work in different modes with different settings. It depends on the specific order. The leading operator can set all the necessary parameters simply by selecting them from predefined sets. If there is no suitable set for the required conditions, the operator can fine-tune the system. To do this, there is the set points page, where all the most important settings for the technological process are gathered on one screen. The automatic control system will independently adjust the algorithms by received commands and ensure the proper quality of the products.

Picture 7 - A general page of set points settings – all in one place and for the all possible modes

Like any complex system, the automation of the paper machine has a lot of tuning parameters. All of them are accessible from the visualization for people with a certain access level. It is necessary to exclude the factor of interference due to carelessness of people without the need qualification. At the same time, trained personnel are provided with tools for fine-tuning the behavior of the system on-line.

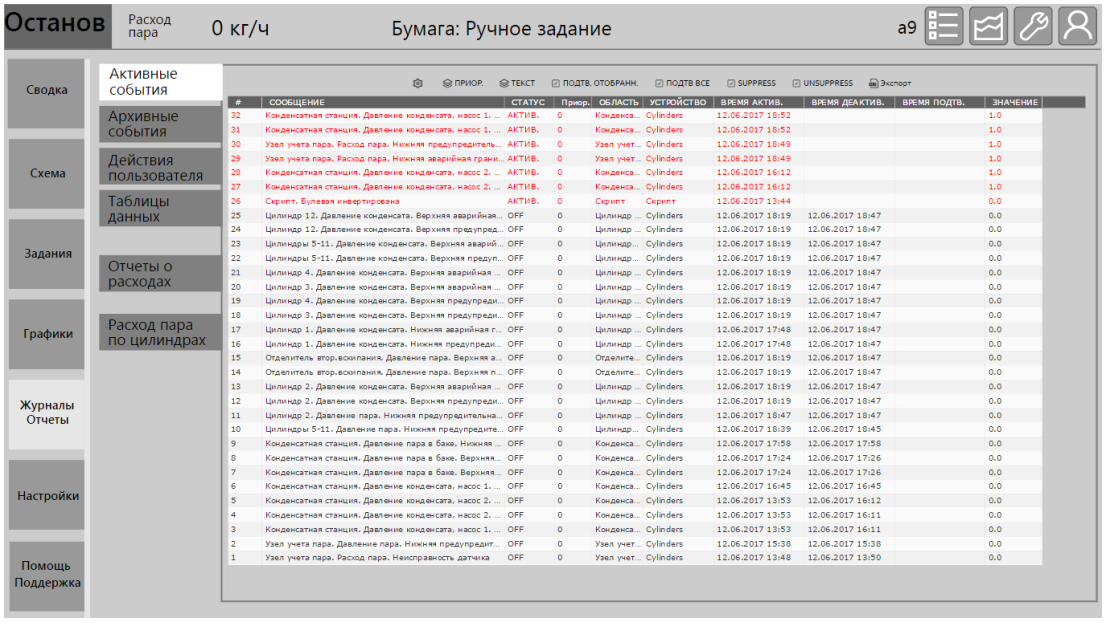
More than 800 settings allow service providers to ensure optimum system performance for each mode. Settings are also grouped by equipment and devices, have intuitive names and explanations in the usual operator terms. This secures ease of mastering the intricacies of the system to any technologically trained person, which reduces the cost of maintenance and the probability of error.



Picture 8 - One of structured pages of fine-tuning the machine.

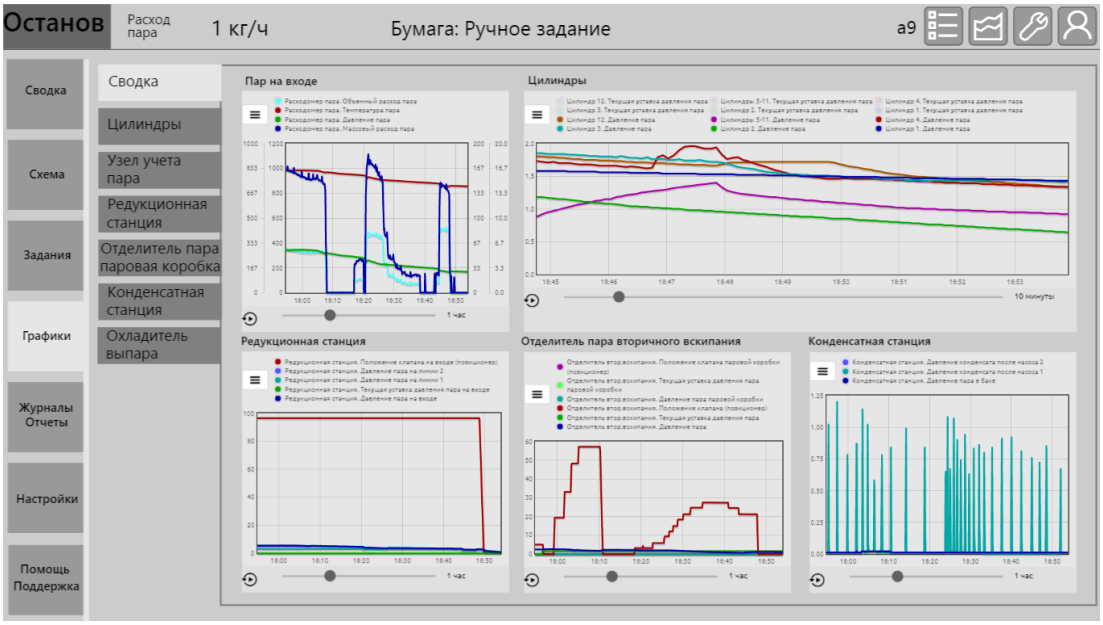
Data logging, alarming

All personnel actions are logged and stored in the internal database. Also in the log are records of all technological and emergency events. The operator views a list of currently active states. Service departments received a useful tool for analyzing the operation of the system, ascertaining the cause of events and the chain of development of contingencies. The reporting system helps to adjust management practices, create recommendations for the operation of the facility and predict possible service scenarios based on the protocols of existing events.



Picture 9 - Active alarms and events in the system.

Also, an important tool for analysis and forecasting is the archive of changes in technological parameters. For convenient human perception, these data are provided in the form of interactive trends with the ability to select an interesting period of time, a joint comparison of various indicators, scaling.

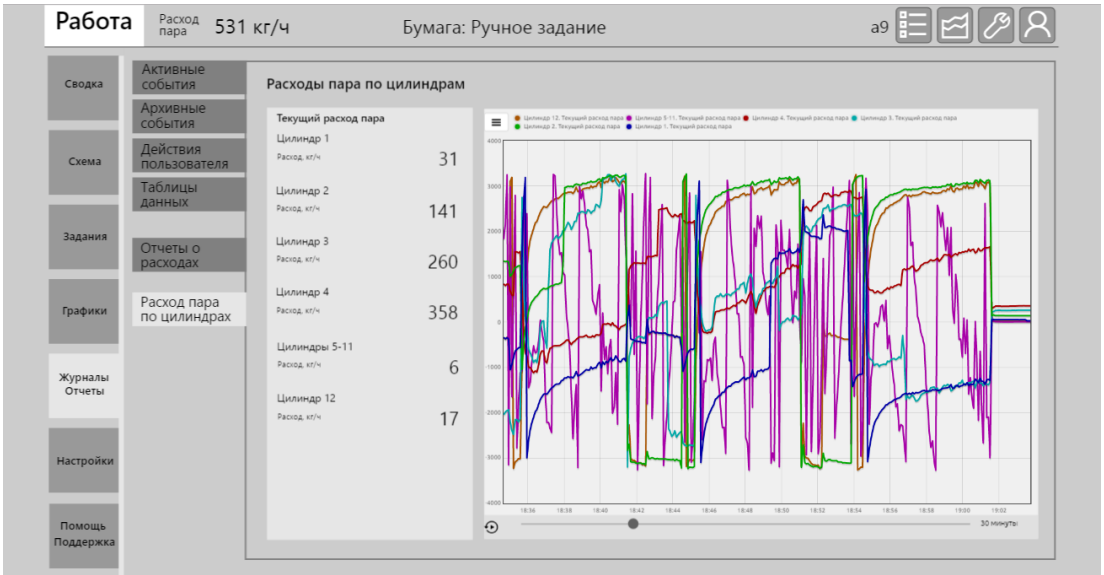


Picture 10 - Trends of important parameters changes.

Event archives, registered alarms along with sensor values and actuator states can easily be exported to CSV files directly from the web browser. This format allows further processing and analysis of data in Excel, Microsoft BI or any other table or cloud analytics systems.

Analyzing the behavior of a different set of technological variables, one can even find unexpected correlations and relationships.

For example: according to the indications of a number of pressure and temperature sensors, experts of the company "Artezia" predicted a possible failure of the specialized check valve. The timely intervention of the service and the elimination of the identified malfunction at an early stage ensured the smooth operation of the production. The machine downtime required to replace the unit is tens of times less than stopping the machine due to a catastrophic malfunction, which would lead to the defective products and long repairs.
Moreover, thanks to the web-oriented architecture of mySCADA, the diagnostics was performed remotely, without going to the site that was 500 kilometers away.



Picture 11 - Dynamics and analytics of the change in steam consumption by cylinders.

This example shows the benefits of serving organizations and suppliers, which save significant money and time resources on the performance of guarantee obligations, preventing emergencies.

THE ADDED VALUE

Except the benefits already mentioned, the huge advantage of mySCADA for this project is the ability to work in a single information space for many employees simultaneously, without interfering with one another.

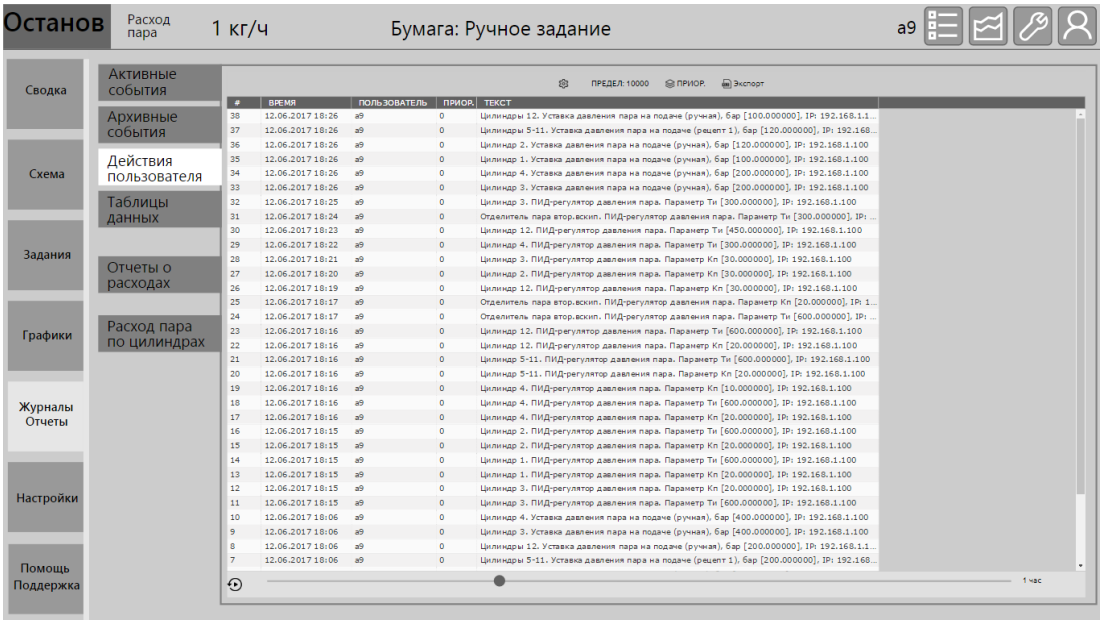
Operators in the control room monitor the overall technical process and control the quality of products while service providers assess the status of individual nodes and perform fine tuning of the system. Since the length of the papermaking machine is much greater, the walks of local operators along the installation and to the control room for the necessary data took considerable time.

As a half-measure one could use telephone communication, but the need for lengthy explanations and distraction of operators from the management context negatively affects the quality of work. Now the employee can independently, from any modern device such as a smartphone or tablet, go to the web page of the equipment of interest and instantly get the full information or send the necessary commands. And this absolutely does not interfere with the work of other participants. Productivity increases at times.

Picture 12 - Simultaneous work and remote control is already a reality and even a necessity.

Security

To prevent unauthorized access, there is an authentication system for each user, and communication between mobile devices and the myBOX server is performed over the encrypted https protocol. In addition to this, the source of each parameter change and the fact of its change are recorded.



Picture 13 - All user actions are registered, stored and available for analysis.

Thus, along with ensuring the safety of the installation, the discipline of the personnel also increases - if all moves are recorded, then each of them is considered before execution. Subjectively, this reduces the probability of operator error as well.

IMPLEMENTATION RESULTS

A modern web-based visualization system was created to facilitate the work of staff and increase the productivity of its work. This directly affects the company's economic performance and business development.

According to the results of the implementation, it is safe to say that the operators received a convenient and powerful tool for monitoring and controlling the machine. They completely control the object in all permissible modes, which is checked by automation. Reduced response time to the behavior of the object and the probability of erroneous actions. The adjustment time for the features of the order was reduced to a minimum due to a convenient intuitive interface. Maintaining the necessary parameters with automatic regulators and error-free testing of the operators' commands reduced the amount of rejects.

The developed system facilitates easy training of new personnel and shortens the time of its adaptation to the features of production. The number of operator errors has been reduced because of the timely, complete and, most importantly, understandable provision of all the necessary information.

Web-oriented and multi-platform mySCADA allowed to ensure the simultaneous operation of the entire shift within a single information space. And for this, their own personnel devices, especially smartphones, are involved.

Remote continuous access of authorized services makes it possible to identify potentially dangerous deviations in the operation of nodes at the initial stage and prevent emergency situations. In general, this leads to significant savings in money, and also helps to optimize the process itself. Trends, graphs, tables, event archives, interactive mnemonics and processed data available at anytime, anywhere and from any smart device as a tool of a technologist and analyst, have shown their superiority over classical dispatching systems. People became comfortable working, and this positively affected the company's profits.

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