The results showed that the data on growth and development of live weight of hens throughout the experiment showed that there was no significant increase in all groups, but in the control group and in the group fed with Basulifor-C and Clostridium butyricum there was a slight increase in live weight at the end of the accounting period. Regarding the egg productivity of the hens, the average daily egg production was 5.23% and 5.48% higher in the groups fed Basulifor-C and Basulifor-C with Clostridium butyricum in the main diet, respectively, compared to the control group, and the gross number of eggs per trial was 26 and 27 eggs higher in the same trial groups.

Conclusion. We can summarize the main results of previous works that the use of probiotic Basulifor with both a single additive and in combination with Clostridium butyricum in the diet of laying hens allowed to increase egg production and egg mass yield, the addition of Clostridium butyricum did not significantly affect the productivity or in the growth of laying hens compared to the control group.

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MACHINE LEARNING AS A TOOL FOR EFFICIENT MANAGEMENT IN PETROCHEMICAL ENTERPRISES

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Abstract: *The reagent selection is complicated due to high stability of emulsions. It is often ineffective and long. A study was carried out in laboratory settings on several demulsifier samples to identify their effectiveness in dehydration of heavy oil fractions. The comparison of physical-chemical properties of demulsifier reagents and water separation dynamics is presented. A program has been developed to increase the speed of determining the reagent effectiveness in the oilfield. An algorithm of work in the program is presented to*

introduce machine learning in the oilfield.

Keywords: *data analysis, model, programming, Python, Random Forest, demulsifiers, high-viscosity oil fraction, water-efficient technology, emulsion, bituminous oil, dehydration.*

The aim of the research is to evaluate demulsifier selection methods and make a model based on machine learning methods to identify the best reagent and improve oil quality during production. The tasks of researching machine learning methods and increasing the efficiency of demulsifier method selection are assigned:

- selection of the most acceptable chemical reagents from the tested ones for further industrial pilot tests (IPT);
- recommendations for the pilot testing of chemical reagents under the condition of water conservation;
- investigate the possibility of using machine learning;
- propose options to reduce expenditures on demulsifier selection works.

The input data for the analysis are the results of laboratory research on the selection of chemistry for oil production with different demulsifiers. We took into account the climatic conditions of the implementation site when selecting methods of monitoring, sampling and associated petroleum gas extraction.

One emulsion sample of 100 ml for each demulsifier was taken. The dosage of each demulsifier was 75 g/t in the sample. The resulting mixture was stirred with a stirrer (60 min at 1500 rpm) and poured into separating funnels of appropriate volume.

The laboratory experiment's progress:

Phase I. In the temperature range 200÷350°C no sufficient amount of water was released

Phase II. The first drops of released hydrocarbons (hereinafter HC) were fixed at a temperature of 400°C

Phase III. At 500÷550°C there was a rapid release of HC and abundantly released HC of dark brown colour and white gas (HC were released much faster than in the first experiment). Total volume of HCs released = 89 ml. The total mass of released HC = 78.80 g. Water was not released during the experiment. The average molecular weight of the resulting HCs is -224n_D^{20} (Unwatered) = 1.499. Atmospheric distillation of the released hydrocarbons. At a temperature of 45 °C, an oil fraction boiled in an Engler flask. The first drop was formed at 98 °C (beginning of boiling).

Phase IV. The boiling point end temperature was 347.9°C (after that, the degradation process began). The temperature regime decreased to 347.9°C. The volume of light fractions expelled was 63 ml (from 100 ml of the working time).

The elaborated model will primarily help to screen out inappropriate demulsifiers, as well as to recommend those reagent parameters that will be effective for the object under research [1].

We consider density, active substance fraction and viscosity coefficient for each demulsifier. Only density was available for oil from different fields, which is a peculiarity of laboratory research and a trade secret of production companies. To carry out the analysis and search for a machine learning method we used the Python language and the following libraries: Pandas, Scikit-learn, Matplotlib and Seaborn [2, 3].

The available data on demulsifier performance monitoring at different fields for different years were compiled, then uploaded into a comprehensive Excel sheet. Various grades, which are specific to laboratory tests, were used to evaluate the results of water, oil, phase separation: "fail", "bubble", "satisfactory", "good", "excellent", "bad", "none". The search for a machine learning method was influenced by the large number of grades reducing the accuracy of the model, so the grades were revised to the following: "fail", "satisfactory", "good", "excellent". If data on demulsifiers were missing (density, or viscosity), because this is also a trade secret for the enterprises, the experiments on them were excluded from the model.

Dot plots were constructed for further analysis depending on the water and oil separation assessments according to the existing laboratory results. The primary analysis allows us to already say that we can consider the methodology to change the approach in laboratory tests and the low dependence on the amount of active substance and residual water content. Accordingly, we can reduce the primary consumption of substances, reduce the number of experiments, increase the efficiency of the working day and reduce the cost of laboratory tests without losing in quality and increase the profit margin of the work.

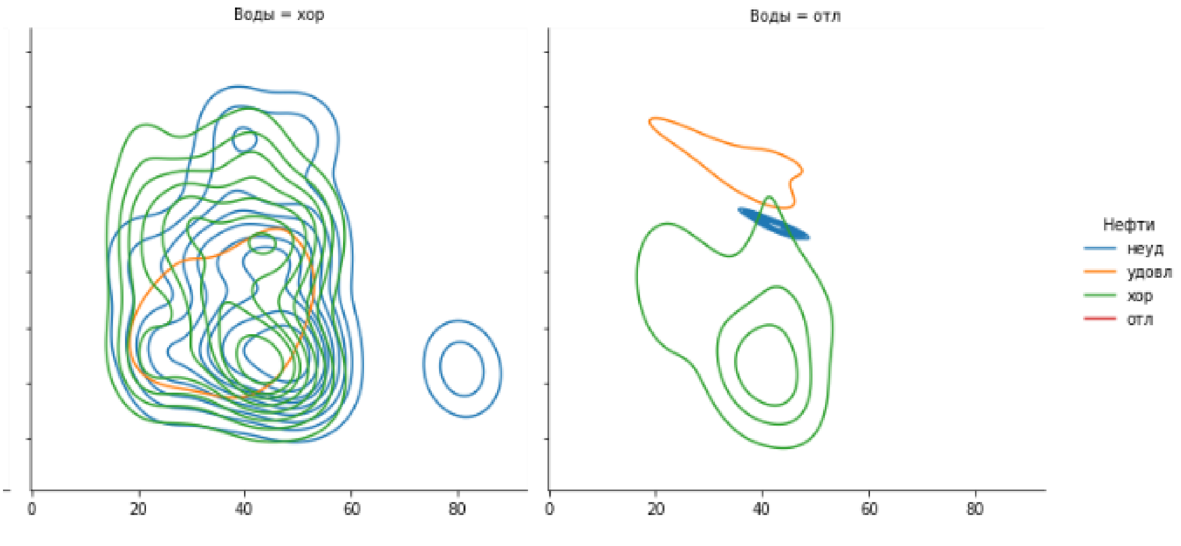

Figure 1. Dependence of residual water content on mass fraction of active substance active ingredient fraction

According to the active substance mass fraction, it can be realized that there are certain groups of substances that can ensure high oil quality and low water content in the samples. The dependence on the mass fraction has a strongly normal distribution character.

The trend of dependence of good product quality on demulsifier density is noticeable, but more blurred and will require more fine-tuning when choosing the right machine learning model.

The program also generates a grid. One more variable is entered into the grid (column "y"), the value in it will mean the following - 1 - successful demulsifier, 0 - unsuccessful demulsifier is not recommended for use. The values are set, according to the following assessment, if the demulsifier has a flow rate less than or equal to 50 g per tonne, if the residual water content is less than or equal to 20 per cent, the scores in the Oil, Water and R/F sections are " Good", then the "y" value is 1, otherwise 0.

The program gives the result in numerical expression from 0 to 1 and gives the probability of this or that event. i.e. when entering the parameters of demulsifier and oil we can say how much the demulsifier will be successful, with what probability [4].

Finally, an optimal dataset for machine learning was generated using Pandas, Matplotlib and Seaborn libraries. Further machine learning using Scikit-Learn showed that the machine picks the required demulsifier with an accuracy of 95.95% in laboratory conditions compared to a human. The next step is to apply machine learning methods to select demulsifiers in a production environment to confirm the hypothesis that these methods are effective for the oil industry. If this hypothesis is confirmed, we can say that laboratory research will become more narrowly focused and the selection of the necessary components in the fields will be more efficient, which will unambiguously increase the productivity of oil producing wells. Our software was registered and a patent was obtained. In addition, we received a certificate of implementation from a well-known oil company for that elaboration.

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