European Journal of Technical and Natural Sciences

2024, No 2

PREMIER Publishing

Vienna
2024

European Journal of Technical and Natural Sciences

Scientific journal

№ 2 2024

ISSN 2414-2352

Proofreading Kristin Theissen
Cover design Andreas Vogel
Additional design Stephan Friedman
Editorial office Premier Publishing s.r.o.
Praha 8 – Karlín, Lyčkovo nám. 508/7, PSČ 18600
E-mail: pub@ppublishing.org
Homepage: ppublishing.org

European Journal of Technical and Natural Sciences is an international, English language, peer-reviewed journal. The journal is published in electronic form.

The decisive criterion for accepting a manuscript for publication is scientific quality. All research articles published in this journal have undergone a rigorous peer review. Based on initial screening by the editors, each paper is anonymized and reviewed by at least two anonymous referees. Recommending the articles for publishing, the reviewers confirm that in their opinion the submitted article contains important or new scientific results.

Premier Publishing s.r.o. is not responsible for the stylistic content of the article. The responsibility for the stylistic content lies on an author of an article.

Instructions for authors

Full instructions for manuscript preparation and submission can be found through the Premier Publishing s.r.o. home page at: http://ppublishing.org.

Material disclaimer

The opinions expressed in the conference proceedings do not necessarily reflect those of the Premier Publishing s.r.o., the editor, the editorial board, or the organization to which the authors are affiliated.

Premier Publishing s.r.o. is not responsible for the stylistic content of the article. The responsibility for the stylistic content lies on an author of an article.

Included to the open access repositories:

H – 15 and more than 500 citations in international periodicals and monographs.

The jurnal has Index Copernicus Value (ICV) 92.08 for 2022.

The European Journal of Technical and Natural Sciences 2024, No 2
ISSN 2414-2352

PREMIER Publishing
ppublishing.org

Section 1. Electrical engineering

DOI:10.29013/EJTNS-24-2-3-9

ON THE ISSUE OF INCREASING THE EFFICIENCY OF USING SOLAR INSOLATION IN WATER-HEATING SOLAR COLLECTORS

Rustamov Nasim Tulegenovich [1], ***Kibishov Adylkhan Talgatovich*** [1], ***Mukhamejanov Nuridin Baktiyaruly*** [1], ***Seimanova Aida Saurbekkyzy*** [1]

[1] International Kazakh-Turkish University named after Khoja Ahmed Yasawi

Cite: *Rustamov, N. T., Kibishov, A. T., Mukhamejanov, N. B., Seimanova A. S. (2024). Thermal and Energy Characteristics of a Cogenerative Fractal Solar Collector. European Journal of Technical and Natural Sciences 2024, No 2.* https://doi.org/10.29013/EJTNS-24-2-3-9

Abstract

This paper considers an urgent issue related to increasing the efficiency of using solar insolation on water-heating solar collectors (WSC). Analyzing the structural changes of the WSC, in order to increase the effective use of solar insolation, a method is proposed without changing the design of the WSC to solve this issue. The essence of the proposed tracker is to use it to orient the WSC to the position of the Sun, using solar panels.

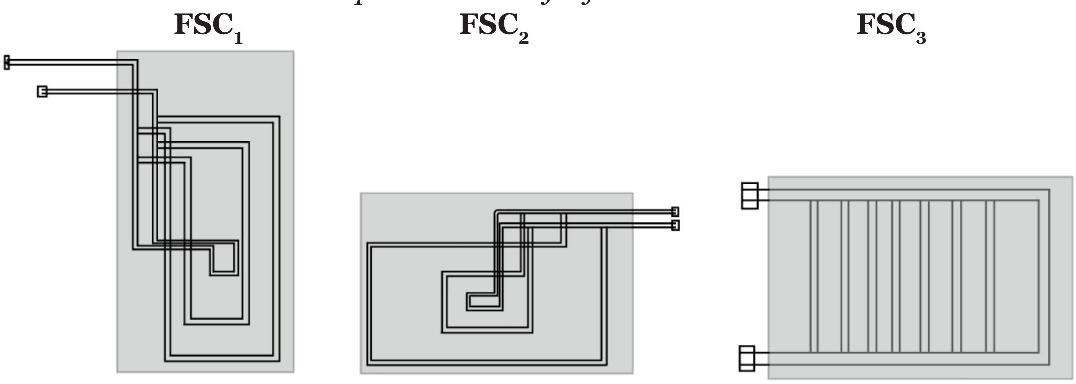
Keywords: *Orientation, position, Sun, solar collector, efficiency, solar insolation, automation, horizontal solar tracker*

Introduction

Today, flat water heating solar collectors (WSC) are widely used in practice. The main advantages of solar heat collectors are: high process efficiency even in subzero temperatures; ease of installation of the entire structure; anti-wind resistance of the collector; duration of operation. However, the efficiency of using solar insolation remains much to be desired. This is probably why many researchers and engineers working in this field, in order to increase the efficiency of using solar insolation, are trying to change the very design of the WSC and the materials used in this design (Avezova N. R., Avezov R. R., Rustamov N. T., Vakhidov A., Suleymanov Sh. I., 2013; Ermuratskij V. V., Postolatij V. M., Koptyuk E. P., 2009; Ermuratskij V. V., 2009; Avezova N. R., 2003). In this case, the cost of the thermal energy produced by WSC increases. It should be noted that the thermal and energy characteristics of these solar installations, in addition to its design and the use of various metal materials, also depend on the degree of how to use Solar insolation. This is an urgent task that needs to be solved today. Interestingly, due to the tilt of the Earth's axis, the Sun also moves 46° north and south during the year. Thus, the same set of WSC installed at the midpoint between two local extremes will see the Sun moving 23° in both directions. Given this situation, the researchers began using solar trackers at the WSC in order to increase the efficiency of using solar insolation in the production of thermal energy. The results were not encouraging (URL: https://dzen.ru/a/XmwFOKI43BdEorSK; URL: https://www.youtube.com/watch?v=7qq8g38jwd7; Pulungan A. B. et al. 2020; Brito M.C. et al. 2019). Due to the complexity of the tracker's design, the cost of the generated thermal energy did not really satisfy the consumer. Despite this, everyone knows that the aim of increasing the use of solar insolation in the WSC system is becoming in demand today.

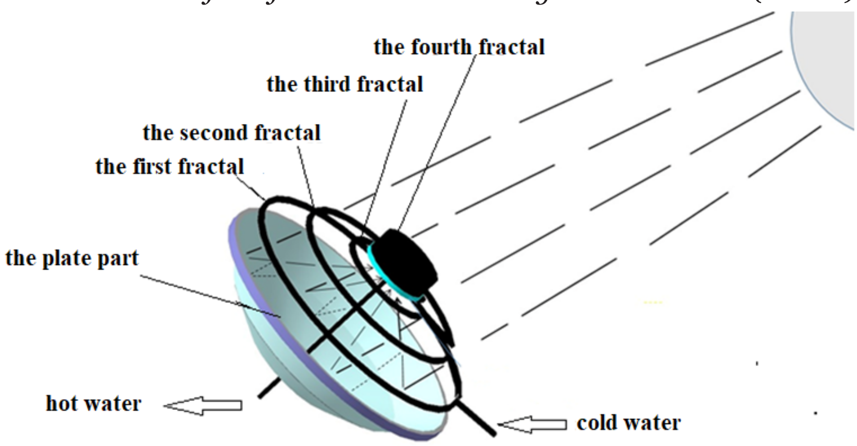
Interestingly, there are simpler methods to increase the efficiency of using solar insolation and the design of solar trackers on the WSC. In (Rustamov N. T., Kibishov A. T., Isroilov F. M., Ernazar K. E., 2023), a simple method for increasing the efficiency of using solar insolation at WSC is described. By changing the location of the absorbers on the aperture area of the WSC, it is possible to increase the efficiency of using solar insolation in a solar installation. The first option is shown in (Fig. 1).

Figure 1. *Different designs of the absorber arrangement on the aperture area of a flat solar collector*



The first method (Fig.1) (Rustamov N. T., Kibishov A. T., Isroilov F. M., Ernazar K. E., 2023): absorbers are positioned on the aperture area of flat solar water heating collectors according to the "golden section" principle. Fig.1 shows such an arrangement of absorbers (FSC_1 and FSC_2) FSC_3 is a classic arrangement of absorbers on the aperture area. The second method (fig. 2) Rustamov N., Kibishov A., Naci Genc, Shokhrukh Babakhan, Ernazar K. 2023). The absorbers are located on the aperture area of the parabolic concentrator according to the Fibonacci number principle. At the same time, by changing the fractal dimension of the absorbers, it is possible to further increase the efficiency of using solar insolation (Rustamov N. T., Mejrbekov A. T., Kibishov A. T., ot 30.06.2023). The third method. If we design a uniaxial horizontal solar tracker that causes the movement of the FWSC as shown in (Fig. 3), then it will also be possible to increase the use of solar insolation by a solar installation without changing the design of the WSC.

Figure 2. *General view of the fractal water heating solar collector (FWSC) design*

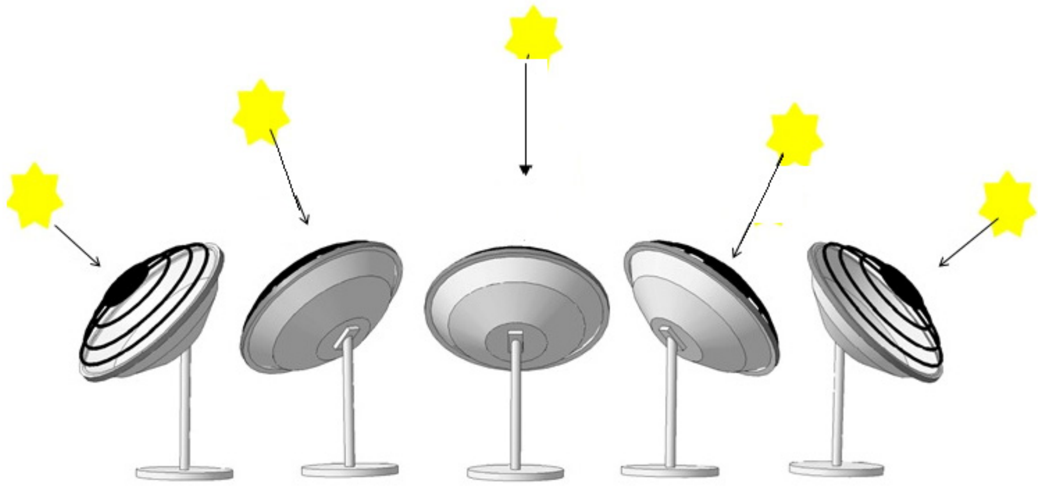


As you know, the Sun travels 360° from east to west per day, but from the point of view of any fixed location, the visible part is 180° maximum during the average period of half a day (more in summer, slightly less in spring and autumn and significantly less in winter). FWSC with a fixed orientation between the extreme points of dawn and sunset will move. approximately 75° in both directions and will lose more than 75% of energy in the morning and evening. The rotation of the FWSC to the east and west can help make up for these losses.

The aim of the work is to develop a horizontal solar tracker for a fractal water heating solar collector powered by a renewable energy source.

The solution method. By definition, a FWSC tracker is a system with rotary mechanisms that automatically deploys FWSC along the line of movement of the sun, as shown in Fig. 3. So more direct rays fall on their surface during the day, which increases the overall efficiency of using solar insolation by solar collectors. It is clear that the design of such a tracker should ensure a reduction in the cost of generated thermal energy. This is also one of the options for increasing the efficiency of using solar insolation, which does not require changing the design of the WSC.

Figure 3. *Options for the orientation of the fractal water heating solar collector to the movement of the Sun*



The tracker being developed should have the following functions: to be constantly pointed at the Sun, at best at a right angle. Tracking of the Sun, the FWSC should be carried out autonomously, i.e. without manual control. Remote control by connecting it to a horizontal tracker will also provide an opportunity to expand functions. In this case, the axis of rotation of the horizontal uniaxial tracker must be horizontal relative to the ground. To do this, the FWSC itself is attached to a rotating disk attached to a vertical axis.

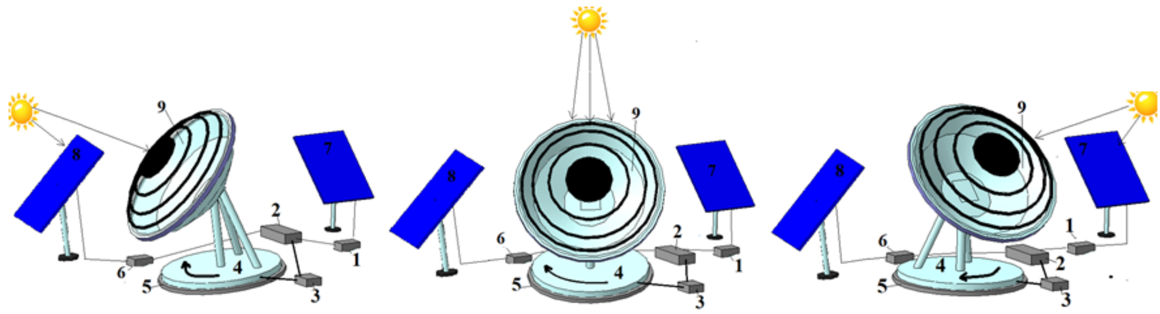
To reduce the cost of the solar tracker, we will use solar photo panels to operate the engine. The rotating disc itself is put on a vertical axis attached to a non-moving disc. This type of horizontal solar tracker is most suitable for low latitude regions. The layout of the field for FWSC with horizontal uniaxial solar trackers is very flexible. The appropriate field can maximize the ratio of energy production to costs, and this depends on the local terrain and shading conditions, as well as on the time of day and the value of the energy produced. With this design of the horizontal solar tracker, reverse tracking is not required for the WSC. The FWSC are mounted on a rotating disk, and this disk will rotate around its axis to track the visible movement of the Sun during the day. Now the question arises how to rotate the disk where the FWSC is attached. To generate electricity for the rotating rotating disk engine, we will use a solar photo panel. Figure 4 shows such a horizontal solar tracker powered by renewable energy sources.

This system works as follows. In the morning, position c). When the sun's rays fall on the FWSC9 and on the solar panel 7, the FWSC9 begins to generate thermal energy and at the same time the solar photo panel 7 will generate electrical energy.

Here 1,6 is a controller, 2 is a reversible asynchronous motor, 3 is an electric drive, 4 is a rotating disk where the FWSC is attached, 5 is a support disk holding the rotating disk, 7,8 solar photo panels, FWSC9.

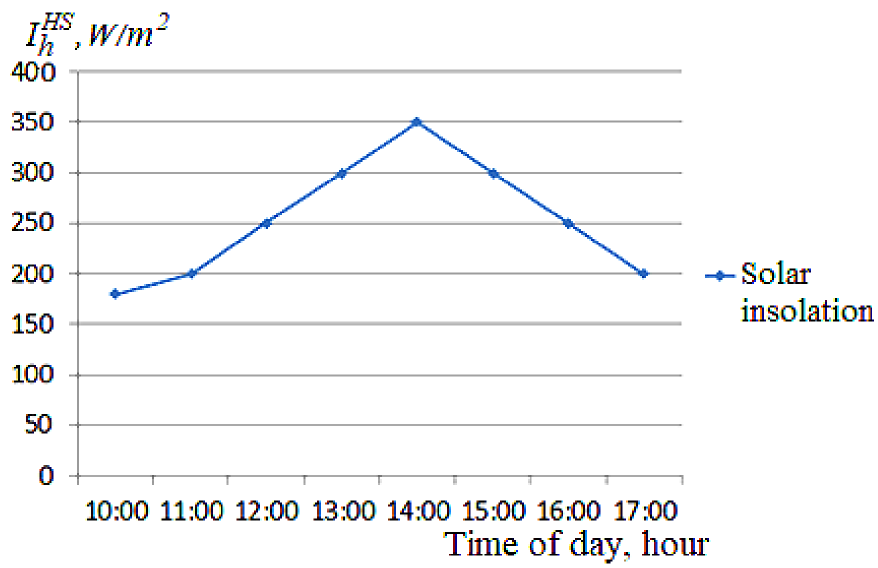
Figure 4. *Uniaxial horizontal solar tracker for FWSC operating on an alternative energy source*

a) b) c)



The generated electrical energy is fed through the controller 1 to the reverse asynchronous motor 2. The reverse asynchronous motor using an electric drive 3 begins to rotate the rotating disk 4. At this time, the second solar photo panel 8 is in the shade, and does not generate electrical energy. Position b). Noon in this position, the first photo panel will be in the shade, the production of electrical energy is suspended. But the FWSC continues to generate thermal energy. The engine is not working. Position a). After lunch, the sun's rays fall on the second photo panel 8, it begins to generate electrical energy. The generated electrical energy is supplied to the engine 2 through the controller 6, the engine begins to rotate the disk 4 with the help of an electric drive 3. Thus, the FWSC9 will generate thermal energy during this period of movement. At this time, the first photo panel 7 remains in the shade, i.e. the sun's rays do not fall on this photo panel. When the movement of the Sun ends, the reversing engine returns the rotating disk 4 to its original position.

Figure 5. *Daily solar insolation for Turkestan (1.03.2023)*



These three designs were experimented with under the same external and internal conditions. At the same time, the aperture areas of the WSC and the size of the absorbers were the same. But the structures of the absorber arrangement were as shown in (Fig. 2 and 3).

Figure 5 shows the changes in solar insolation when the experiments were conducted.

From the graphs obtained as a result of the experiment, the efficiency of water-heating solar collectors shown in Figs.6 and 7, one can see the trend in the efficiency of using solar insolation depending on the location of absorbers on the aperture area of solar collectors.

Collectors where the absorbers are fractally arranged according to the principle of the "golden section" of FSC_1 and FSC_2 use solar insolation more effectively compared to where the absorbers are located on the aperture area parallel to the FSC_3. 6 and 7 shows that when the collector structure has a shape as shown in Figure 2, the efficiency of using solar insolation by a solar installation will be more efficient compared to previous VSCs. Since in this case, the solar installation uses solar insolation multiple times to generate thermal energy. This installation is patented (Rustamov N.T., Mejrbekov A.T., Kibishov A.T., ot 30.06.2023).

Figure 6. *Hourly efficiency of WSC with different absorber arrangements*

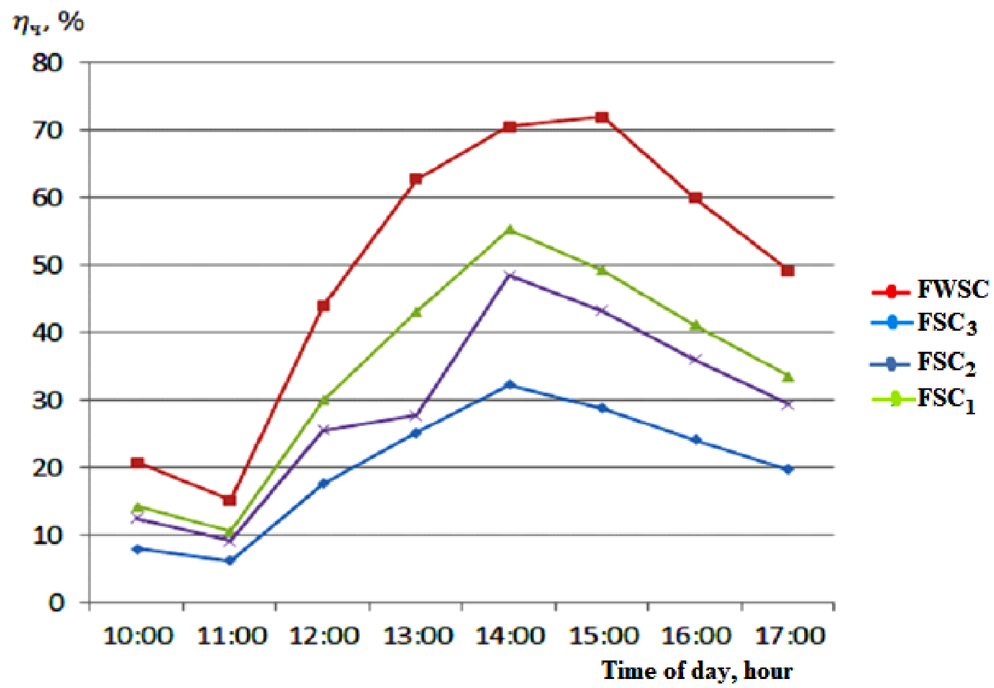
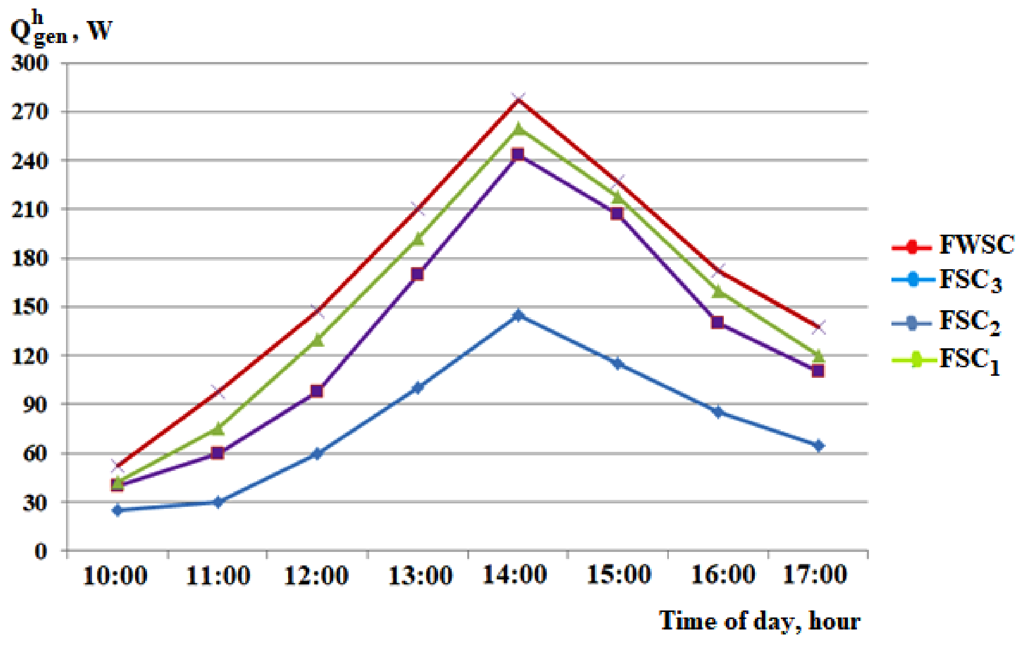


Figure 7. *Hourly WSC heat generation with different absorber arrangements*



The problem of increasing the use of solar insolation in water-heating solar collectors is strongly associated with a decrease in the cost of generated thermal energy. Analyzing the results of the experiment shown in Figures 6 and 7, we can say that when the WSC absorbers are located on the aperture area according to the "golden section" principle, if the WSC is flat and the absorbers are located on the aperture area of the parabolic concentrator fractally according to the Fibonacci number principle, then the efficiency of using solar insolation increases. This can be seen from the values of the hourly efficiency of water heating solar collectors and the hourly heat generation by these solar collectors.

Conclusions

Summarizing the work, we can say the following:

1. Absorbers and their locations in solar collectors are one of the main design elements in the heat supply of solar installations, on which both energy and economic indicators of solar heat supply systems depend.
2. In flat solar collectors, the absorbers are located in a planar projection. In such structures, the reflected from the aperture area is not used to generate thermal energy.
3. When the aperture area is a parabolic plane and the absorbers are located in this plane fractally according to the Fibonacci number principle, then solar insolation can be used in multiples
4. The concept proposed in the work methods for increasing the efficiency of using solar insolation by changing the location of absorbers in the aperture area of water heating collectors is objective.
5. The results of the experiments have shown that changing the location of absorbers on the aperture area can increase the efficiency of the WSC.
6. The proposed method of increasing the efficiency of the FWSC using a horizontal solar tracker is a fundamentally new approach not only to the design of a uniaxial horizontal solar tracker, but also to generate low-cost thermal thermal energy.

References

Avezova N. R., Avezov R. R., Rustamov N. T., Vakhidov A., Suleymanov Sh. I. Resource indexes of flat solar water-heating collectors in hot-water supply systems: 4. Specific collector thermal yield and efficiency. Journal Applied Solar Energy, 2013,– Vol. 49.– Issue 4.– P. 202–210.

Ermuratskij V.V., Postolatij V. M., Koptyuk E. P. Perspektivy primeneniya v Respublike Moldova solnechnyh nagrevatelej vody sanitarno-bytovogo naznacheniya. Problemy regional'noj energetiki. 2009.– № 2. URL: http://ieasm.webart.md/data/m71_2_107.doc

Ermuratskij V. V. Opredelenie koefficienta teplovyh poter' kollektora solnechnoj energii s absorberom iz polimernyh trub. Problemy regional'noj energetiki. 2009.– № 3. URL: http://ieasm.webart.md/data/m71_2_120.doc.

Avezova N. R. Issledovanie absorbcionnyh solnechnyh kollektorov s emkimi preemnikami polucilindricheskoj formy. Dissertaciya na soiskanie uchenoj stepeni k.t.n.– Tashkent, 2003.– 172 p.

URL: https://dzen.ru/a/XmwFOKI43BdEorSK

URL: https://www.youtube.com/watch?v=7qq8g38jwd7

Pulungan A. B. et al. Design and development of real time monitoring single axis solar tracker by using internet of things // International Journal. 2020.– T. 18.– № . 69.– P. 81–87.

Brito M. C. et al. Passive solar tracker based in the differential thermal expansion of vertical strips //Journal of Renewable and Sustainable Energy. 2019.– T. 11.– № 4.– P. 043701.

Rustamov N. T., Kibishov A. T., Isroilov F. M., Ernazar K. E. Koefficient poleznogo dejstviya vakuumirovannogo fraktal'nogo solnechnogo kollektor. European Journal of Technical and Natural Sciences – 2. 2023.–P. 46–53.

Nassim Rustamov, Adylkhan Kibishov, Naci Genc, Shokhrukh Babakhan, Ernazar Kamal. Thermal Conductivity of a Vacuum Fractal Solar Collector. International Journal of Renewable Energy Research N,– Vol. 13.– No. 2. June, 2023.– P. 613–618.

Rustamov N. T., Mejrbekov A. T., Kibishov A. T. Vakuumnyj fraktal'nyj solnechnyj kollektor. Patent RK na izobretenie № 36213 ot 30.06.2023.

submitted 15.03.2024;
accepted for publication 01.04.2024;
published 30.04.2024

Contact: babakhan.shokhrukh@ayu.edu.kz

The European Journal of Technical and Natural Sciences 2024, No 2
ISSN 2414-2352

PREMIER Publishing
ppublishing.org

DOI:10.29013/EJTNS-24-2-10-18

MANAGEMENT OF POWER GENERATION BY A DISTRIBUTED GENERATION MICRO GRID

***Babakhan Shokhrukh Abdilkasymuly* [1], *Tulebayeva Guldana Anapiyaevna* [1], *Rustamov Nasim Tulegenovich* [1], *Kakharman Ademi Kairatkiziz* [1]**

[1] International Kazakh-Turkish University named after Khoja Ahmed Yasawi

Cite: *Babakhan S.A., Tulebayeva G.A., Rustamov N. T., Kakharman A.K. (2024). Management of Power Generation by a Distributed Generation Micro Grid. European Journal of Technical and Natural Sciences 2024, No 2.* https://doi.org/10.29013/EJTNS-24-2-10-18

Abastract

The paper considers issues related to the management of the efficient operation of distributed generation and microgrid. It is also proposed to control a distributed generation microgrid, where the generating device is a fleet of hybrid wind-solar energy devices, based on taking into account consumer demand and supply for the generated electric power. At the same time, it is said that such accounting is carried out using a virtual power plant. A rational scheme for integrating a microgrid into a distribution network is proposed. It has been established that when connecting a distributed generation micronet to a distribution network, one of the main tasks that must be solved for each hour of the billing period is the distribution of loads between generating capacities based on consumer demand and supply. An algorithm for solving this problem is proposed.

Keywords: *Distributed generation, microgrid, demand, supply, control, DC bus, distribution network, consumer, algorithm*

Introduction

Today, there is a trend in the development of the electric power industry in the world associated with an increase not only in the scale of electricity production at traditional large power plants, but also in the share of distributed generation and micro grids based on renewable energy sources. The development of distributed generation and microgrid are modern concepts in the field of electrical engineering that play an important role in ensuring energy independence and sustainability of power supply systems. The main motivation for the development of distributed generation is to stabilize the operation of the power system. The second motivation is to provide power for a balancing market. These advantages for the energy system should also be a motivation for consumers (Malkov A.). The motivation may be the desire to participate in these programs and provide load management (in particular, this is the shutdown of cooling/heating equipment). Or – the desire to generate even more power (in particular, diesel generation). This system should work as a cycle, and some participants should motivate others in this system. These motivations for the development of distributed generation are the basis for the management of distributed generation and the microgrid (Rustamov N. T., Babakhan Sh.A., Orysbaev S. A., 2020).

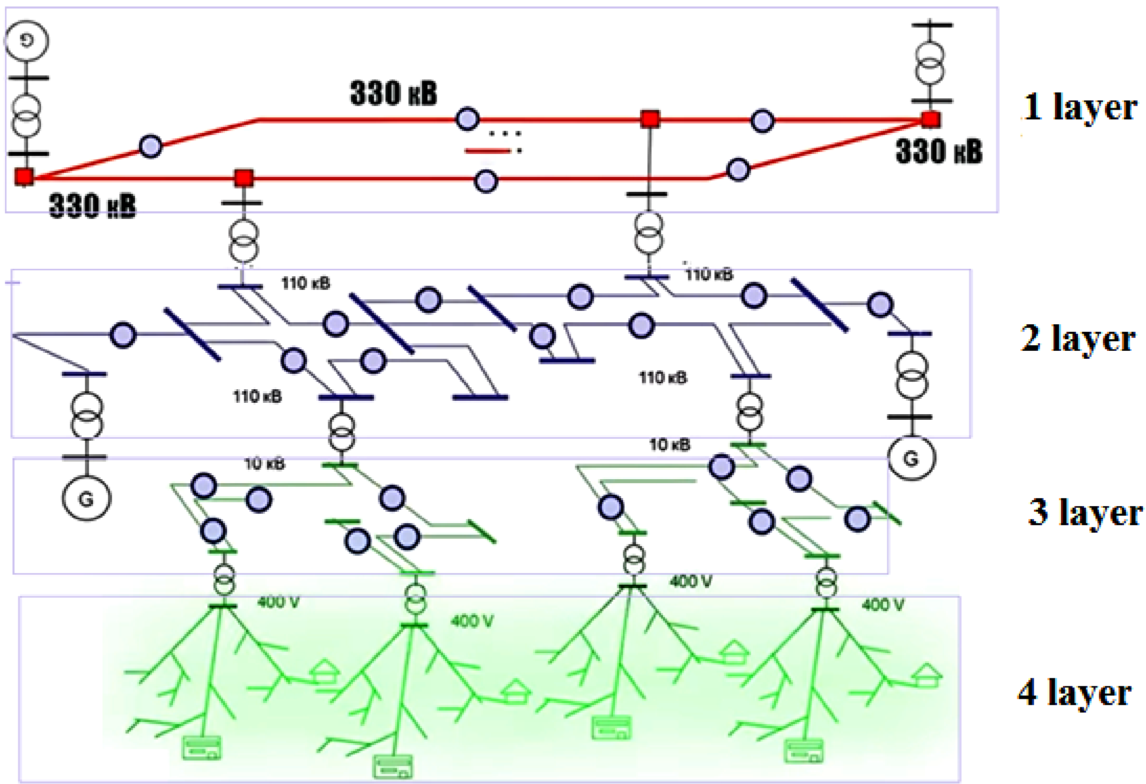
As we know, distributed generation differs from traditional centralized power generation systems in that energy production is carried out in the vicinity of consumption, and not at remote power plants. And microgrids, in turn, represent a distributed generation park that can operate independently or conjugately in a microgrip system that can interact with a centralized network (Chindyaskin V. I., Grinko D. V., 2014).

The main task of modern electrical systems is the constant balancing of supply and demand, flexible network management and ensuring an optimal level of energy efficiency. These problems also appear in distributed generation systems that provide electricity in the vicinity of the consumer. But here it should also be noted that connecting distributed generation, in order to transfer personal generated electric energy to a common distribution network, creates an additional difficulty associated with a violation of the power balance in the common network. In this case, the dispatching and automatic control of the electric power system becomes more complicated. Such a situation may slow down the development of distributed generation and microgrid. All this requires the development of a new algorithmic model for controlling the distribution of loads between generating units of a distributed generation microgrid. The solution to this problem is considered to be in demand.

The aim of the work is to develop a control algorithm based on the control of supply and demand for electric power generated by a microgrid distributed network.

The solution method. A feature of the operation of any distributed generation system is the single-stage production and consumption of electric energy. This requires equality of energy generated by a distributed generation park combined into a micro grid (Rustamov N. T., Egamberdiev B. E., Meirbekova O. D., Babakhan Sh., 2023).

Figure 1. *The structure of the traditional energy system*



Violation of this equality leads to a change in the parameters of the microgrid in voltage and frequency, and with large deviations – to a loss of dynamic stability and disruption of the normal functioning of the microgrid and disruption of consumer power supply (Obukhov S. G., Plotnikov I. A., 2012).

If we take into account the construction of modern electric power systems and networks, it will be understandable the problems that arise when connecting a distributed generation microgrid, where the generating unit is a wind-solar energy system.

As you know, the traditional power system and networks are designed in the form of a layer. The top layer is called generation and transport. In this layer, large amounts of electricity are generated at power plants and transmitted to node substations. All power plants generating electric energy of this layer are interconnected, by banding high-voltage transmission lines. In this layer, the synchronization of electricity generated at various power plants is carried out (Fig.1).

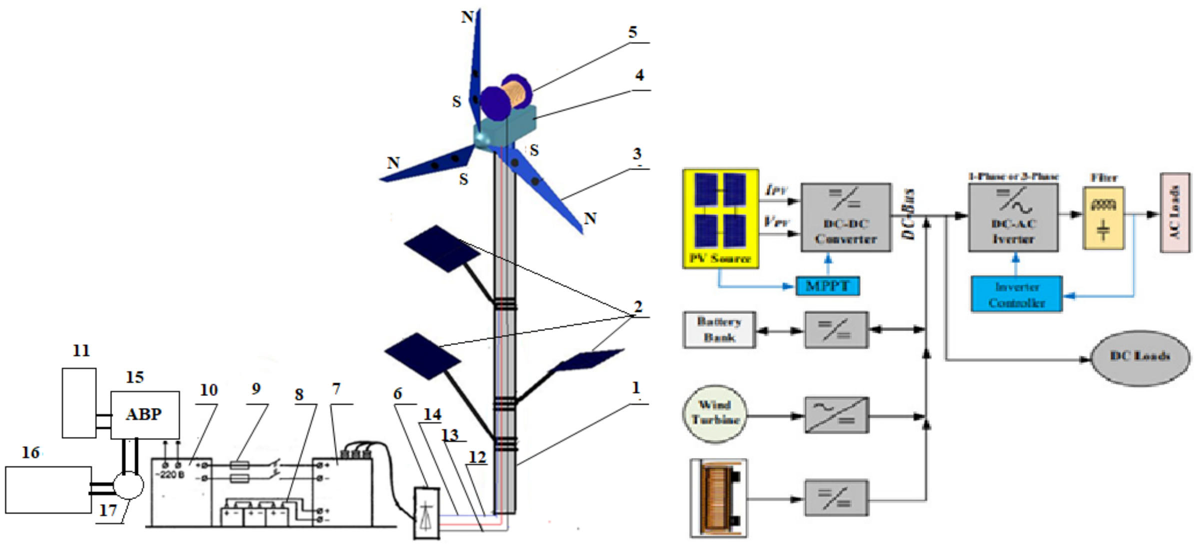
Further, through the node substations, the generated electricity is transported to the next layer of the power system. It is at these node substations that there are bridges that connect the upper layer of the power system with the next, lower layer. These bridges consist of transformers. It should be noted that these processes are also managed by the dispatchers of the system operator.

The next 2 layer is a layer of high electrical energy. In this layer, the generation of active and reactive energy is regulated, changing the operating modes of the station's generators. This layer is the main layer of the entire energy system. Then the layers go down. The next 3 layer is the average regional distribution layer or 110–220 kW network. Through bridges, electrical energy is transferred to separate looped power grids. There are even sources of electricity in this layer. These sources of energy can be small local thermal power plants, hydroelectric power plants, even distributed generation micro grids based on renewable energy sources.

They generate electricity for the third layer. In this case, an important condition is to push electrical energy from the top down, not from the bottom up. Because high-power electrical energy is generated on the upper layer. In this layer we see the looped islands of the network. These networks are called regional distribution networks. Here, each island has its own dispatch service, which manages all the energy processes taking place on the island. This is where the ring layers end.

Figure 2. *Of the distributed generation of the generating wind-solar installation a and its electrical diagram*

a) b)



Now let's look at the structure of a distributed generation micronetwork. We have chosen a hybrid wind power plant developed by us for distributed generation based on wind and solar energy, shown in (Fig. 2).

The generating unit consists of a mast 1, solar panels 2, magnetic blades 3, a generator 4, an induction coil 5, a rectifier 6, a controller 7, batteries 8, a switch 9, an inverter 10, a bypass 15, an electric energy meter and a distribution network 1 hybrid wind power plant operates as follows (Fig.2). Under the influence of wind, the magnetic blades 3 generate an electric current 13 using a generator 4, and create a magnetic field around themselves, which, crossing the windings of the induction coil, generates an induction current 12. The current generated by the solar panels 14, the electric current from the generator 13 and the induction current 9 are supplied to the rectifier 6.

The rectified current is transmitted through the controller 7 to the batteries 8 and through the switch 9 these currents are sent to the inverter 10. Electricity is supplied from the inverter 10 to consumers 11. Wind power installations with batteries and switching with the grid 15 Automatic reserve input (bypass) allows you to switch the power supply of the object in the absence of wind and full discharge of batteries to the distribution grid 16 through the counter 17. The same circuit can be used vice versa as a backup power supply. In this case, the automatic input of the reserve switches you to the batteries of wind power plants when power is lost from the distribution grid.

Based on this distributed generation, we will design the microgrid shown in (Fig. 3).

Figure 3. *A micro grid based on a distributed generation park powered by renewable energy sources*

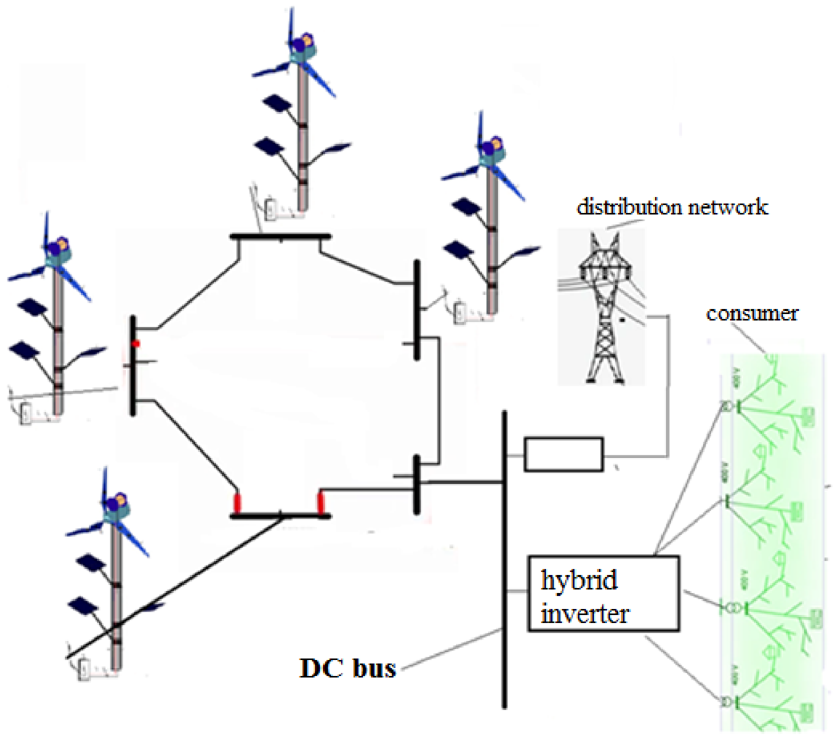
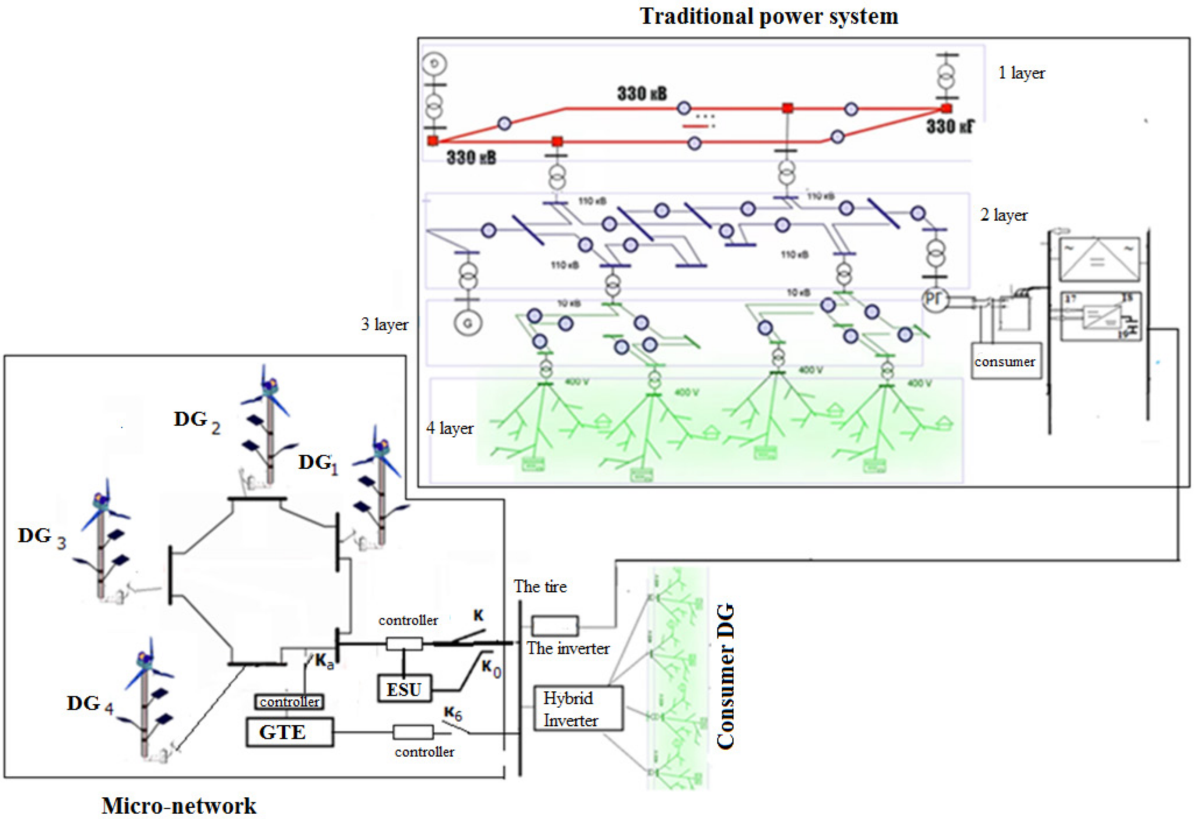


Figure 4 shows the connection of a distributed generation microgrid to a common distribution network (layer 3) via a private bus. At the same time, the equality of generated and consumed electricity in a distributed generation system is maintained continuously in time (Rustamov N.T., Babakhan Sh.A., Kaharman Ə.K. 2023; J. Rocabert, A. Luna, F. Blaabjerg h gp. 2012; J.M. Guerrero, J.C. Vasquez, J. Matas h gp. 2011).

There are two possible ways to maintain the continuous equality of generated and consumed electricity in distributed generation micro grids powered by renewable energy sources. The first method consists in constant monitoring of electric energy consumption and proper regulation of the power of the generated installations in order to constantly maintain equality between the two aforementioned capacities (J.M. Carrasco, L.G. Franquelo, J.T. Bialasiewicz h gp. 2006). The second method is to include a battery in the microgrid, which saves electricity with reduced consumption and, after conversion, supplies it to the microgrid when a certain consumption level is exceeded (Nassim Rustamov, Shokhrukh Babakhan, Naci Genc, Adylkhan Kibishov, Oksana Meirbekov. 2023; URL: http://www.alterenergy.info/interesting-facts/123-the-distributedgeneration). This process is controlled by a virtual power plant.

Figure 4. *Connecting the microgrid of the distributed generation park to the general distribution network via a high-frequency bus*



Currently, the Smart Grid concept is developing in the world, which involves the transition from generating electricity centrally at large power plants and transferring it to consumers over distances of tens and hundreds of kilometers to generating it near consumers (farms, residential buildings, etc.) from renewable sources (wind, solar battery). A feature of alternative sources is the uneven and uncontrollable intensity of the energy flow over time, as a rule, which does not coincide with the intensity required by the consumer. A battery is used to coordinate the generated and consumed energy flows.

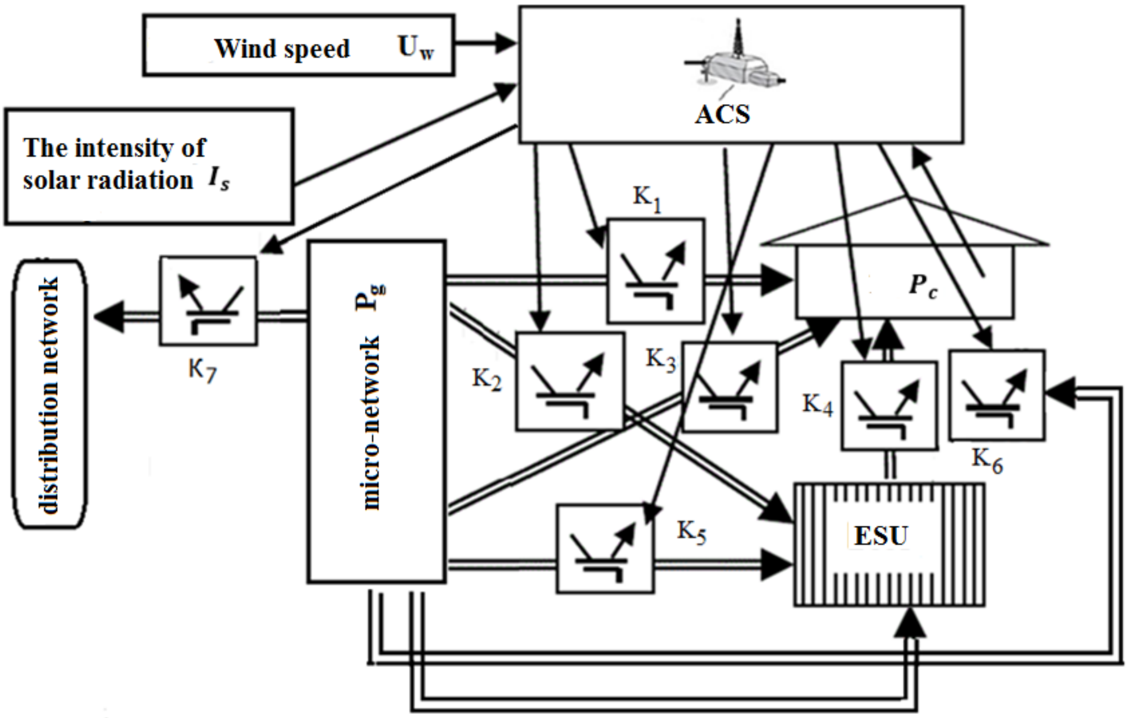
There is an obvious need to control the energy flows between the wind generator, solar battery, accumulator and consumer, ensuring reliable and uninterrupted power consumption, regardless of the state of external flows – wind and sun. Modern electronics are able to provide switching and conversion of electric power parameters, but an algorithm is needed to control it.

The object under study (Fig. 1) is a power consumer localized in space, connected electrically through switches or converters (K_1 ÷ ÷ K_6) K_7 – the key connects a micro-grid to a distribution network, a solar battery, a wind generator, an energy storage unit and a backup source, which can be a non-renewable energy source – a diesel generator or a centralized power line power transmission lines. $\mathbf{U_w}$ – is the wind speed, $\mathbf{I_s}$ – is the intensity of the sun, $\mathbf{P_c}$ – is the power consumption of the electric meters, $\mathbf{P_g}$ – is the power generated by the microgrid

When operating a distributed generation system, the control device compares the energy flows from sources external to the consumer with the power required by the consumer. Depending on the values of these flows, the consumer is connected to one or another energy source.

Below (Fig. 6) is a block diagram implementing the operation algorithm of the control device. The diagram shows: R_{wg} – power of the wind generator; R_{bp} – power of the solar battery; R_{es} – power of the energy storage unit; P_C – load power R_d – power of the microset, U_w – wind speed, I_s – solar radiation intensity.

Figure 5. *Microgrid management system from the distributed generation park ⇒ –energy, → – information and management*



η. If there is no wind and sun, but the energy storage unit is charged sufficiently to provide the necessary power to the consumer (situation 1 in the block diagram), the control device gives the command to turn on K_4, which supplies energy to the consumer from the energy storage unit. K_4 is an autonomous inverter that converts the voltage of the energy storage unit into an alternating voltage of standard frequency. $R_{wg} = 0$, $R_{bp} = 0$, $R_d = 0$ $R_{es} > P_C$ in this case we denote by the letter n

$η_1$. If there is no wind and the intensity of solar radiation is such that the solar battery cannot provide the power needed by the consumer (situation 2 in the block diagram), the short circuit and K_4 are switched on so that the consumer is powered by a solar battery and an energy storage unit. The K_3 device ensures the operation of the solar battery at the maximum possible efficiency. $R_{wg} = 0$, $R_{bp} < P_C$, $R_{es} > P_C - R_{bp}$ in this case we denote by the letter n_1

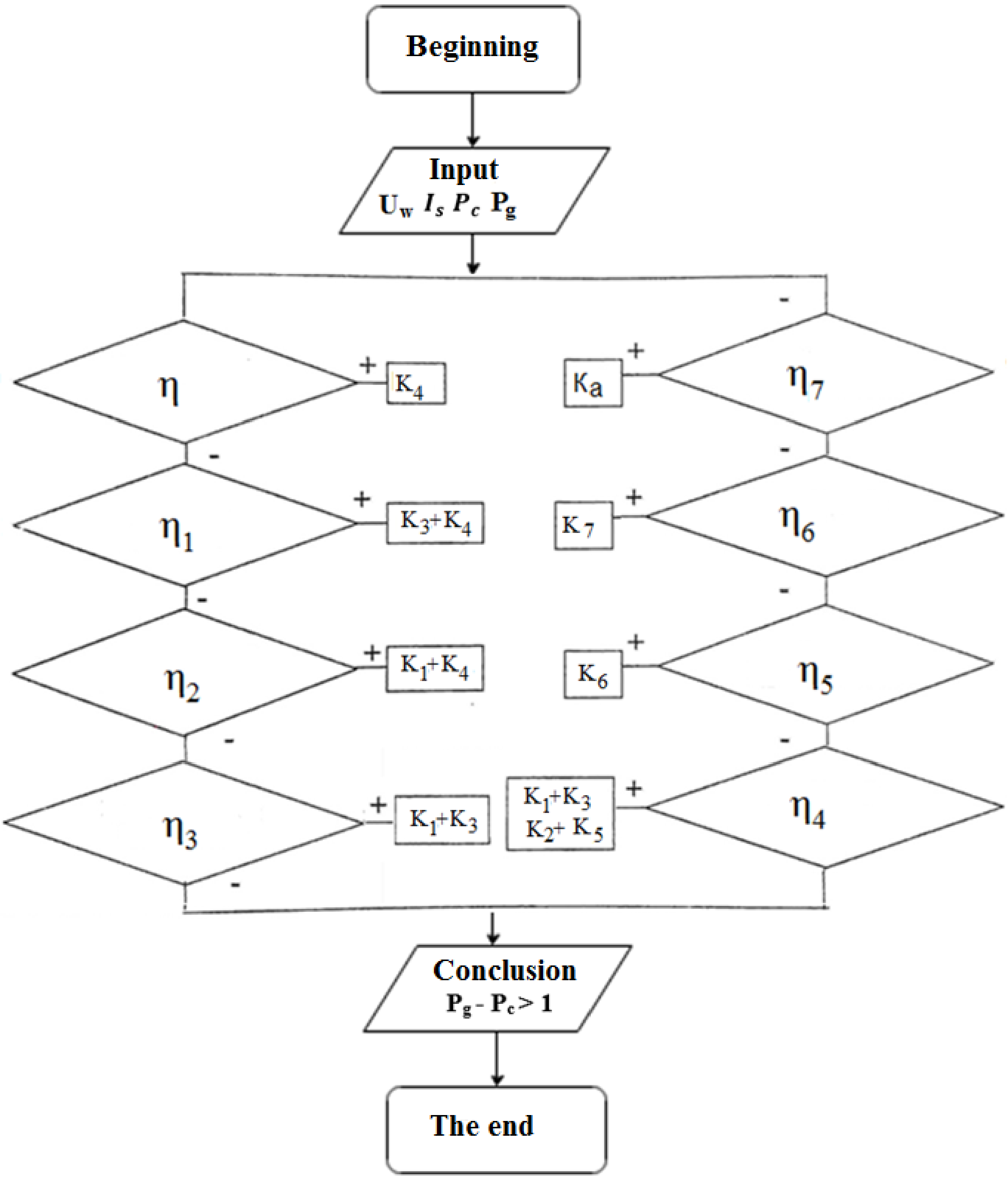
$η_2$. If there is no sun and the wind speed is such that the wind generator cannot provide the power needed by the consumer (situation 3 in the block diagram), K_1 and K_4 are switched on so that the consumer is powered by the wind generator and the energy storage unit. The K_1 device converts the voltage of the wind generator to the value required by the consumer. $R_{wg} < P_C$, $R_{bp} = 0$, $R_{es} > P_C - R_{wg}$ in this case we denote by the letter n_2

$η_3$. If the wind speed and intensity of solar radiation are such that the wind generator and solar battery individually cannot provide power to the consumer (situation 4 in the block diagram), the K_1 and K_3 devices work so that the latter is powered simultaneously from both sources. The rolled-up devices coordinate the parallel operation of the source so that energy does not flow from one to the other. $R_{wg} < P_C$, $R_{bp} < P_C$, $R_{wg} + R_{bp} > P_C$ In this case, we denote the letter n_3

$η_4$. If the wind speed and intensity of solar radiation are such that the wind generator and solar battery generate more power than the power of the consumer (situation 5 in the block diagram), the devices K_1, K_2, K_3 and K_5 are switched on so as to provide energy to the consumer, and the excess energy goes to charge the energy storage unit. These devices provide an energetically rational mode of generators and an energy storage unit. $R_{wg} + R_{bp} > P_C$ In this case, we denote the letter n_4

$η_5$. If the wind speed and solar radiation do not provide power to the consumer, and the energy storage unit is discharged (situation 6 in the block diagram), a command is given to turn on the gas turbine engine into the K_6 microgrid bus. $R_{wg} = 0$, $R_{bp} = 0$, $R_{es} = 0$ or $< P_C$ in this case we denote by the letter n_5

Figure 6. Block diagram of the distributed generation control program



η_6. If the wind speed and solar radiation provide the power output of the electrical energy needed by the consumer, and the energy storage unit is filled (situation 7 in the block diagram), the devices K_7 are turned on. $R_{wg} > P_C$, $R_{bp} > P_C$, $R_{es} > P_C$ in this case we denote by the letter n_6

η_7. If the wind speed is high, in that case the wind generator will not work, but instead the gas turbine engine will be connected to the microgrid (situation 8 in the block diagram), the device K_a is turned on. $R_{wg} = 0$, $R_{bp} > P_C$, $R_{es} > P_C$ in this case we denote the letter n_7

When implementing the described algorithm, it is necessary to combine the dynamic parameters of electric power generators with the operating period of the control device: if, for example, a decrease in the power of the solar battery occurs before the control device detects and compensates for it, the consumer will be de-energized or forced to reduce the power consumption.

Let's assume that each distributed generation under normal conditions will develop about 3 kW/hour of energy, there are 4 distributed generation devices on the microset, we get a total of 12 kW/hour of electric energy per hour. Let's say consumers require 10 kW/hour of electrical energy, the lagging 2 kW/hour of energy we will send to the energy storage unit, and if the energy storage unit is full, then we will send the rest of the energy to the distribution network.

Conclusions

Summarizing the work, the following conclusions can be drawn:

1. The use of distributed generation to generate electrical energy for the consumer is beneficial through a micro-network, where a distributed generation park is connected to a common DC bus.

2. In case of insufficient generation of electric energy at the request of the consumer, the optimal provision for this request is to connect a backup energy source, a gas turbine engine and an energy storage unit.

3. For effective management of the microgrid, it is of great importance to use a virtual power plant (Smart Grid)

4. The proposed block diagram of the microgrid management program ensures the stability of the balance of consumer demand for power and electricity.

5. The control device for the implementation of the algorithm must have dynamic parameters corresponding to the parameters of the generators.

6. An indispensable condition of a distributed generation microgrid is that the amount of energy generated per year should not be less than the amount of energy received by the consumer over the same period.

References

Мальков А. Тайны энергосистемы.– thewikihow.com/aleksandr-malkov

Рустамов Н. Т., Бабахан Ш. А., Орысбаев С. А. Одностадийное электроснабжение на базе ВИЭ.– Екатеринбург. Международный научно-исследовательский журнал,– Ч. 1. 2020.– № 12 (102).– С. 71–75.

Чиндяскин В. И., Гринько Д. В. Выбор оптимального решения для применения комбинированных установок на основе возобновляемых источников энергии // Известия Оренбургского государственного аграрного университета. 2014.– № 1(45).– С. 40–43.

Рустамов Н. Т., Эгамбердиев Б. Э., Меирбекова О. Д., Бабахан Ш., Гибридная система распределенной генерации энергии. European Journal of Technical and Natural Sciences – 1. 2023.– P. 37–44.

Обухов С. Г., Плотников И. А. Сравнительный анализ схем построения автономных электростанций, использующих установки возобновляемой энергетики // Журнал «Промышленная энергетика». 2012,№ 7. С. 46–51.

Абдрасилов Б. С., Мейрбеков А. Т., Рустамов Н. Т., Мейрамкулова К. С., Бабахан Ш. А. Гибридный ветрогенератор. Патент РК на полезный модель № 6142 от 11.06.2021

Рустамов Н. Т., Бабахан Ш. А., Қахарман Ә. Қ. К вопросу подключения системы распределенной генерации в общую распределительную сеть.– Фергана, Материалы международной научно-технической конференции – Ч. 1. 2023.– С. 193–196.

Control of power converters in AC microgrids / J. Rocabert, A. Luna, F. Blaabjerg h gp. // IEEE Trans. Power Electron. 2012.– № 27.– С. 4734–4749.

Hierarchical control of droop-controlled AC and DC microgrids – A general approach toward standardization / J. M. Guerrero, J. C. Vasquez, J. Matas h gp. // IEEE Trans. Ind. Electron. 2011.– № 58.– С. 158–172.

Power-electronic systems for the grid integration of renewable energy sources / J. M. Carrasco, L. G. Franquelo, J. T. Bialasiewicz h gp. // IEEE Trans. Ind. Electron. 2006.– № 53.– С. 1002–1016.

Nassim Rustamov, Shokhrukh Babakhan, Naci Genc, Adylkhan Kibishov, Oksana Meirbekov. An Improved Hybrid Wind Power Plant for Small Power Generation. International Journal of Renewable Energy Research N,– Vol. 13.– No. 2. June, 2023.– P. 629–635.
Распределенная генерация электроэнергии – важное условие развития альтернативной энергетики. URL: http://www.alterenergy.info/interesting-facts/123-the-distributed-generation

submitted 12.02.2024;
accepted for publication 26.02.2024;
published 30.04.2024

Contact: babakhan.shokhrukh@ayu.edu.kz

The European Journal of Technical and Natural Sciences 2024, No 2
ISSN 2414-2352

PREMIER Publishing
ppublishing.org

Section 2. Medical science

DOI:10.29013/EJTNS-24-2-19-21

CLINICAL AND PATHOLOGICAL SPECIFICS AND RESPONSE TO TREATMENT OF RARE HISTOLOGICAL FORMS OF BREAST CANCER

Kahharov A.J.[1], Djumaniyazova G.M.[1]

[1] Tashkent State Dental Institute, Republic of Uzbekistan,
Urgench branch of Tashkent Medical Academy, Republic of Uzbekistan

Cite: *Kahharov A.J., Djumaniyazova G.M. (2024). Clinical and Pathological Specifics and Response to Treatment of Rare Histological Forms of Breast Cancer. European Journal of Technical and Natural Sciences 2024, No 2.* https://doi.org/10.29013/EJTNS-24-2-19-21

Abstract

The purpose of the study is to study the features of the clinical course, characteristics and response to treatment of rare histological forms of breast cancer.

Methods: The study included 102 patients with rare forms of breast cancer and a control group of 54 patients with invasive ductal cancer. Analysis of histological subtypes was performed, as well as evaluation of clinical and pathological parameters. Statistical methods were used to compare survival and other key metrics between groups.

Results: The study revealed statistically significant differences in age, histological grade, tumor size, lymph node incidence and incidence of stage IV de novo between patients with rare histological forms of breast cancer and standard invasive ductal carcinoma. In addition, differences in response to therapy have been found among different subtypes of these rare forms

Conclusions: Rare histological forms of breast cancer exhibit unique clinicopathological features and disease behavior, which may influence treatment strategy and prognosis. The results highlight the importance of an individualized approach to the diagnosis and treatment of these patients, as well as the need for in-depth stratification to improve therapeutic outcomes and quality of life.

Keywords: *breast cancer, rare histological forms, clinicopathological features, survival, individualized treatment*

Introduction

Breast cancer (BC) occupies a leading position in terms of prevalence among cancer diseases in women around the world. The annual morbidity and mortality caused by this disease highlight the urgency of continuing to study its characteristics and search for new approaches to treatment and prevention. IIIn addition to the generally recognized invasive ductal breast cancers, which constitute the majority of cases, there is a spectrum of rare histological subtypes, each characterized by individual clinicopathological features and response to therapeutic interventions. These specific forms of breast cancer, which include adenoid cystic, apocrine, medullary, metaplastic, and other types, constitute a significant percentage of breast cancer and require careful consideration to understand their impact on prognosis and treatment strategies.

The traditional approach to the classification and treatment of breast cancer often does not take into account the specifics of these rare forms, which can lead to suboptimal treatment results. Understanding the unique characteristics of these subtypes is critical to developing targeted and effective therapeutic strategies.

The purpose of this article is to identify the features of the clinical course of rare histological forms of breast cancer.

Materials and methods

The main group included 102 patients with breast cancer who were diagnosed with rare histological forms of breast cancer; the control group included 54 patients with invasive ductal breast cancer. This study identified eight groups of histological subtypes of breast cancer, including adenoid cystic, apocrine, medullary, metaplastic, micropapillary, mucinous, papillary, and tubular breast cancer.

Data from the patients' medical records were used to determine clinical and pathological characteristics. Based on these data, an analysis was carried out of the distribution of patients by age, stage of cancer, tumor size, as well as the presence of metastases in the lymph nodes and hormonal status. Immunohistochemical staining was used to determine the expression of estrogen receptor, progesterone receptor, and HER2/neu.

The study included a data collection system including demographic information, medical history, clinical trial results, and follow-up events. Overall survival and disease-free survival were assessed using the Kaplan-Meier method, and statistical methods were used to compare survival between groups.

Descriptive statistics and student t-test were used to analyze statistical data to compare means. Differences between categorical variables were assessed using the chi-square test or Fisher's exact test when necessary due to small sample size. The significance level for all statistical tests was set at 0.05.

All procedures were in accordance with the ethical standards of the national research committee and with the Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from patients to participate in the study.

Results

Significant differences were found in the clinicopathological characteristics of the patients between both groups. The average age of the patients was 60.99 and 64.24 years ($P < 0.01$). Compared with invasive ductal breast cancer, rare histological forms of breast cancer had a lower histological grade (III–IV, 22.5% vs. 35.3%, $P < 0.01$), smaller tumor size (>5 cm, 11. 7% vs. 13.72%, $P < 0.01$), higher incidence of node-negative disease (N0, 80.39% vs. 70.6%, $P < 0.01$), and lower incidence of stage IV de novo disease (M1, 0.98% vs 5.5%, $P < 0.01$), while the proportion of the TN subtype was significantly higher in patients with specific breast cancer (TN, 13.2% vs 9.8%, $P < 0.01$). In terms of therapeutic options, receipt of both systemic and local treatment was consistently lower in patients with rare histologic forms of breast cancer, including radiation therapy (46.1% vs. 56.9%, $P < 0.01$) and chemotherapy (24 .5% vs. 41.1%, $P < 0.01$).

Regarding specific subtypes, patients with rare histological forms of breast cancer tended to be older than patients with invasive breast cancer. The histological grade of IDC was significantly higher than that of medullary breast cancer (III–IV, 92.6% vs. 36.2%, $P < 0.01$) and metaplastic breast cancer (III–IV, 80.4% vs. 35 .3%, $P <0.01$), while it was relatively lower than in adenoid cystic breast cancer (III–IV, 12.7% versus 37.2%, $P < 0.01$), mucinous breast cancer gland (III–IV, 3.9% vs. 34.3%, $P < 0.01$) and tubular breast cancer. Breast cancer (III–IV, 0.98% vs. 34.3%, $P<0.01$). Overall survival for rare histological forms of breast cancer and invasive breast cancer was 79.2 months (95% CI, 75.71–80.39 m) and 71.56 m (95% CI, 67.15–73.1 m) accordingly with a statistical difference ($P = 0.05$). There was heterogeneity among the identified histological subtypes of breast cancer ($P < 0.05$). Regarding the prognosis of molecular types, OS was significantly improved in specific breast cancers with HER2 subtypes (mOS71.15 m vs 67.19 m, P = 0.01).

Comparison of treatment approaches and response to treatment of different histological subtypes also revealed significant differences. Thus, patients with adenoid cystic and mucinous breast cancer more often received hormone therapy due to the high frequency of hormone-positive tumors (ER and PR positive status), which potentially improved prognostic indicators and overall survival.

Immunoprofile evaluation has shown that, in contrast to invasive ductal carcinoma, rare histological forms are often characterized by higher lymphocyte infiltration, which may partly explain the more favorable prognosis of some forms, such as medullary breast cancer.

In addition, it was observed that relapse-free survival (RFS) was significantly improved in patients with specific histologies, especially those with hormone-sensitive tumors. Factors such as HER2 status and triple negative status served as important predictors of treatment outcomes for various breast cancer subtypes.

From a clinical perspective, the data from our study highlight the need for an individualized approach to the treatment of patients with rare histological forms of breast cancer, based on accurate diagnosis of tumor subtype and its molecular biological characteristics. An adapted treatment plan depending on the tumor subtype can increase the effectiveness of therapy, improve the quality of life of patients and increase overall and relapse-free survival.

Conclusions

In summary, the present study revealed differences in the clinicopathological features and treatment outcomes of invasive ductal breast cancer compared with rare histological forms, providing valuable information to further improve treatment protocols and increase clinician awareness of the need for in-depth patient stratification.

References

Tavassoli F. A., Devilee P. *World Health Organization Classification of Tumors: Pathology and Genetics of Tumors of the Breast and Female Genital Organs*. Lyon, France: IARC Press; 2003.

Lakhani S. R., Ellis I. O., Schnitt S. J., et al. *WHO Classification of Tumors of the Breast*. Lyon, France: IARC; 2012.

Luini A., Aguilar M., Gatti G., et al. Metaplastic carcinoma of the breast, an unusual disease with worse prognosis: The experience of the European Institute of Oncology and review of the literature. *Breast Cancer Res Treat*. 2007; 101: 349–353.

Horlings H. M., Weigelt B., Anderson E. M., et al. Genomic profiling of histological special types of breast cancer. *Breast Cancer Res Treat*. 2013; 142: 257–269.

Capella C., Eusebi V., Mann B., et al. Endocrine differentiation in mucoid carcinoma of the breast. *Histopathology*. 1980; 4: 613–630.

Clayton F. Pure mucinous carcinomas of breast: Morphologic features and prognostic correlates. *Hum Pathol*. 1986; 17: 34–38.

Dieci M. V., Orvieto E., Dominici M., Conte P., Guarneri V. Rare breast cancer subtypes: histological, molecular, and clinical peculiarities. Oncologist. 2014 Aug; 19(8): 805–13. Doi: 10.1634/theoncologist.2014–0108. Epub 2014 Jun 26. PMID: 24969162; PMCID: PMC4122475.

Yerushalmi R., Hayes M. M., Gelmon K. A. Breast carcinoma: Rare types: Review of the literature. *Ann Oncol*. 2009; 20: 1763–1770.

submitted 14.02.2024;
accepted for publication 26.02.2024;
published 30.04.2024

Contact: alisher1510@mail.ru; djumaniyazova.gulnoza1234@gmail.ru

The European Journal of Technical and Natural Sciences 2024, No 2
ISSN 2414-2352

PREMIER Publishing
ppublishing.org

Section 3. Physiology

DOI:10.29013/EJTNS-24-2-22-28

IDENTIFYING FACTORS RELATED TO SLEEP DISORDERS AMONG ADULTS IN NHIS 2022

Yiwen Zhou [1]

[1] Saint James School, MD

Cite: *Yiwen Zhou. (2024). Identifying Factors Related to Sleep Disorders Among Adults in Nhis 2022. European Journal of Technical and Natural Sciences 2024, No 2.* https://doi.org/10.29013/EJTNS-24-2-22-28

Abstract

Sleeping is a fundamental aspect of our daily lives. Sleep deprivation, such as dyssomnia, parasomnias, or insomnia, can have far-reaching implications. The lack of sleep can be due to plenty of reasons. Setting an application to predict people's potential risks of developing sleep disorders has become a pragmatic and intricate endeavor.

This paper discusses factors related to sleep disorders among adults using data from the National Health Interview Survey (NHIS) in 2022. Sleep deprivation, like insomnia, adversely affects mental and physical well-being. This study uses logistic regression along with regularization and cross-validation to analyze the data, considering variables like sex, medication usage, trouble staying asleep, feeling well-rested, and hours of sleep. The model performance is shown with a confusion matrix and a ROC curve analysis. This study also examines the correlation between variables and features' importance, highlighting variables like trouble staying asleep (SLPSTY_A) and feeling well-rested (SLPREST_A) as significant factors related to sleep disorders.

The conclusion is that variables such as sleep difficulties (SLPSTY_A) are significant, while waking up feeling well rested (SLPREST_A) is less critical. Overall, this article provides an overview of the research methods, findings, and factors related to adult sleep disorders.

Keywords: *Sleep disorder, NHIS, machine learning, logistic regression, correlation, ROC*

Introduction

Sleeping is a fundamental aspect of our daily lives. Two internal biological mechanisms govern sleep: circadian rhythm and sleep-wake homeostasis. The circadian rhythm is regulated by the biological clock and influenced by external factors such as ambient light, which triggers the release of hormones to regulate wakefulness (www.ninds.nih.gov/health-information/public-education/brain-basics/brain-basics-understanding-sleep./2023). Sleep-wake homeostasis is an alarm to signal the body when it is time to sleep and to determine the depth and intensity of sleep (URL: https://www.cdc.gov/nchs/nhis/quest_doc.htm/2022).

Every living organism, human, animal, and even plant needs to sleep. Beyond its physical benefits, sleep also provides significant mental advantages, reducing fatigue, increasing vitality, and aiding in healing.

Conversely, sleep deprivation, such as dyssomnia, parasomnias, or insomnia, can have far-reaching implications. These repercussions will involuntarily exacerbate lots of apprehensions and conjectures. The lack of sleep can be due to plenty of reasons. For instance, consistent hullabaloo, overwhelmed pressure, unhinged delusion, peevish temper, paranoid personality, or pensive mental health. Although there are some correspondent remedies to assist individuals in recovering from sleep disorders, most of the treatments are still tentative, equivocal, and inconsistent due to a limited understanding of the patient's unique circumstances. Setting an application to predict people's potential risks of developing sleep disorders has become a pragmatic and intricate endeavor.

The effects of sleep deprivation on N2-P3 component event-related potential waveforms associated with working memory were investigated through event-related potential (ERP) analysis (URL: https://www.cdc.gov/nchs/nhis/quest_doc.htm/2022). Sixteen healthy college students participated in working memory tasks and had their EEG data recorded before and after post-traumatic stress disorder. The study focused on the N2 and P3 parts of ERP related to working memory processes. The research emphasizes the adverse effects of sleep deprivation on working memory.

In particular, to fulfill this task, we pre-processed the dataset, built a logistic regression model, and tuned its hyper-parameters to find the most optimal parameters with superior predictive performance. Then the model was validated using different techniques and the coefficients were used to find the most important variables contributing to sleep disorder.

Method

1 Data

The data used in this study is from the 2022 National Health Interview Survey (NHIS), a population-based survey established by the CDC to monitor the prevalence of the population health condition in the United States and evaluate the effects of illness on individuals (Effect of Sleep Deprivation on the Working Memory-Related N2-P3 Components of the Event-Related Potential Waveform). The survey includes family composition, tobacco use, alcohol, and drug usage, as well as other dietary behaviors and physical activity questions. The data is collected by a face-to-face survey of random household adults by asking demographic and related questions.

The dependent variable is coded as 'SLPFLL_A,' indicating how often the interviewee has trouble falling asleep in the past 30 days. We recorded the variable into a binary variable by categorizing those who have difficulty falling asleep as positive samples and the others as negative samples. The list of independent variables used in this study is shown below.

Table 1. *List of independent variables used in this study*

Name	Description	Response
SEX_A	The person's sex at birth	1: Male 2: Female
SLPMED_A	The frequency that people take any medication to help them fall asleep or stay asleep. Include both prescribed and over-the-counter medications.	1: Adults that are 18 and above
SLPSTY_A	The frequency people have trouble staying asleep	1: Adults that are 18 and above
SLPREST_A	The frequency people wake up feeling well-rested	1: Adults that are 18 and above
SLPHOURS_A	On average, the hours of sleep people get in a 24-hour period	1: Adults that are 18 and above

2 *Statistical Method*

2.1 Pre-processing

As most machine learning algorithms cannot deal with missing values, all the data points with lost entries or invalid responses to the dependent variable are excluded from training and testing.

One of the first steps of preprocessing is the feature standardization. The goal is to transform different variables into similar scales so that the machine learning model can treat them equally during the training process. In the formula shown below, *avg(x)* is the variable's mean value, and *std(x)* is the variable's standard deviation. Then each value *x* of the feature is replaced by y_i calculated as:

$$y_i = \frac{x - avg(x)}{std(x)}.$$

Finally, the dataset is split into the train and test sets: the train set (70%) is to help the model learn and the test dataset (30%) is for model performance evaluation and validation.

2.2 Logistic Regression

Logistic regression model was used to fit the current data and to predict future data. It's widely used in different fields, including machine learning, statistics, and social sciences.

The logistic regression model can be expressed with the formula:

$$ln\left(\frac{y}{1-y}\right) = w_0 + w_1 x_1 + \ldots + w_m x_m$$

In the logistic regression, each feature x_i has its specific weight w_i, where w_0 is the intercept while w_1 through w_m are the coefficients of the independent variables.

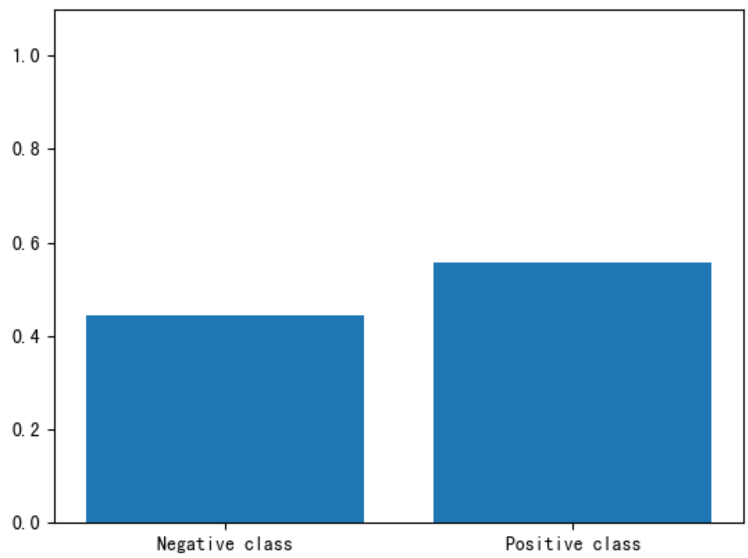
Our task is to find a set of parameters $w_0, \ldots, w_m$ such that the loss function

$$l(y,u) = ||y-u||_2^2$$

is minimized.

In addition, elastic-net regularization was applied to constrain model complexity and prevent the model from over-fitting with an L-1 ratio being 0.5. The optimal regularization strength is found through grid search and 5-fold cross-validation. Cross-validation is a statistical technique utilized to measure the performance of machine learning models. It is frequently employed in practical machine learning to assess and pick a suitable model for a specific task. This is due to its simplicity in comprehension and implementation, leading to skill evaluations (Brownlee, Jason. 2020). The Holdout method represents the most straightforward form of cross-validation. The dataset is divided into two sets: the training and test sets. Function approximators only construct functions from the training set. Subsequently, the task of the function approximator is to predict the output value for the data in the test set. The errors it generates are aggregated as described earlier, resulting in the mean absolute error for the test set. This metric is then used to evaluate the performance of the model (Brownlee, Jason. 2020). Meanwhile, as the distribution of the negative and positive classes is approximately equal, we gave the positive class the same weight as the negative class in the training process.

Figure 1. *Percentage of the negative class and positive class in the data set*



2.3 Model Validation

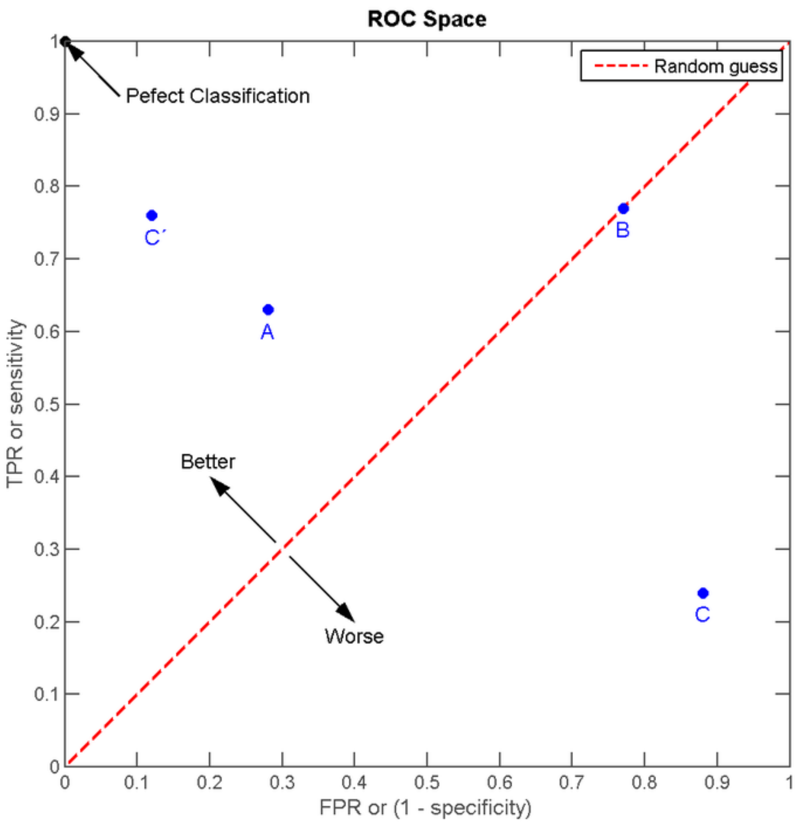
A confusion matrix is a table that visualizes the performance of an algorithm. Figure 2 is an example of the confusion matrix.

Figure 2. *Confusion matrix example*

		Predicted condition	
	Total population = P + N	Positive (PP)	Negative (PN)
Actual condition	Positive (P)	True positive (TP)	False negative (FN)
	Negative (N)	False positive (FP)	True negative (TN)

A receiver operating characteristic curve, or ROC curve, is a plot that visualizes a binary classifier's predicting power. A sample ROC plot is shown in Figure 3. Area Under Curve (AUC) can find the area under the ROC curve which can make model comparison easier.

Figure 3. *A sample ROC plot*

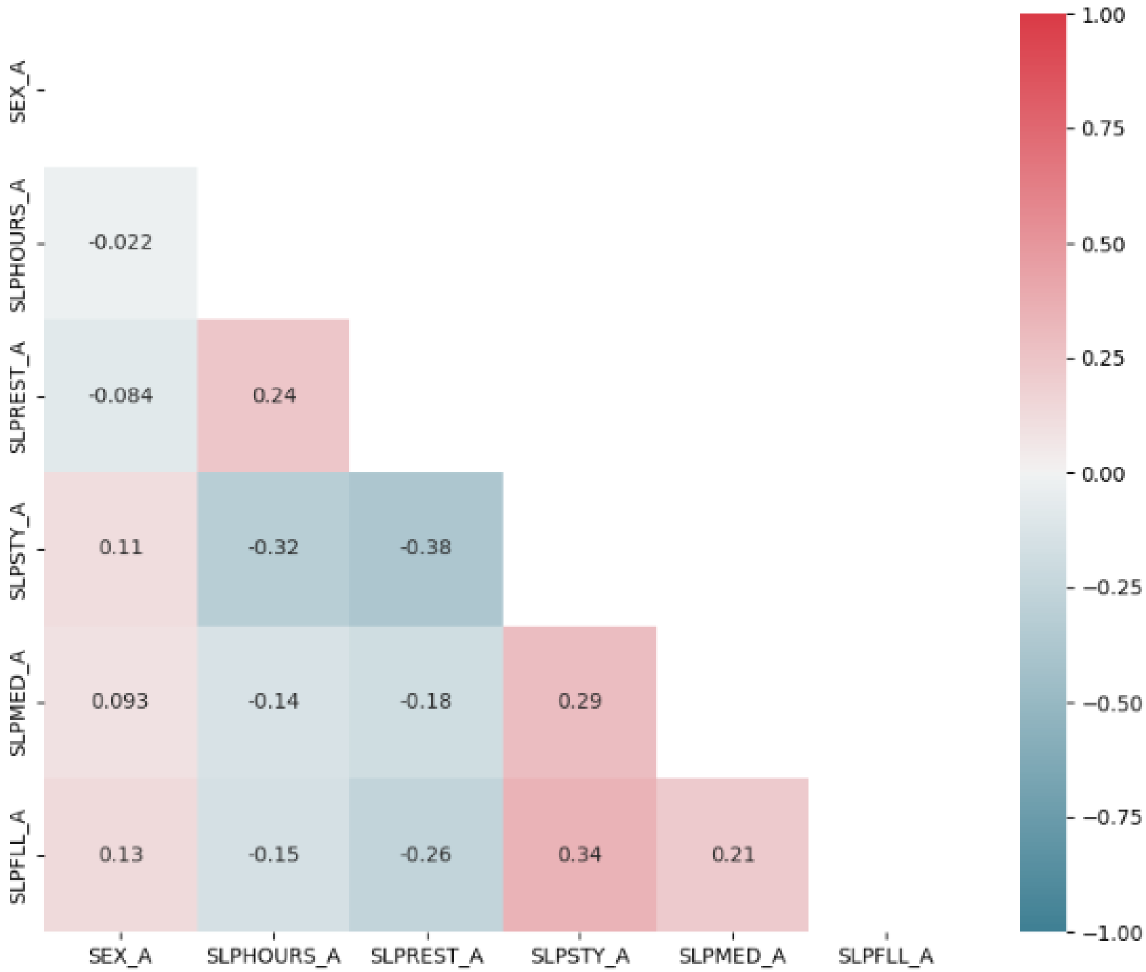


Results

3.1 Chorogram

Figure 4 is a chorogram that visualizes the correlation coefficients between variables. The dependent variable SLPFLL_A has a 0.34 positive correlation with the independent variable SLPSTY_A. It means insomnia is relatively incredibly related to having trouble staying asleep. The dependent variable SLPREST_A has a – 0.38 negative correlation with the dependent variable SLPSTY_A. It means waking up feeling well-rested or not is oppositely related to having trouble staying asleep.

Figure 4. *Correlation among variables*



3.2 Confusion matrix and ROC curve

Figure 5 is the confusion matrix of the trained logistic regression model. As shown in Figure 5, we can see that the logistic regression model has a relatively high (89.4%) true positive rate.

Figure 5. *Confusion matrix*

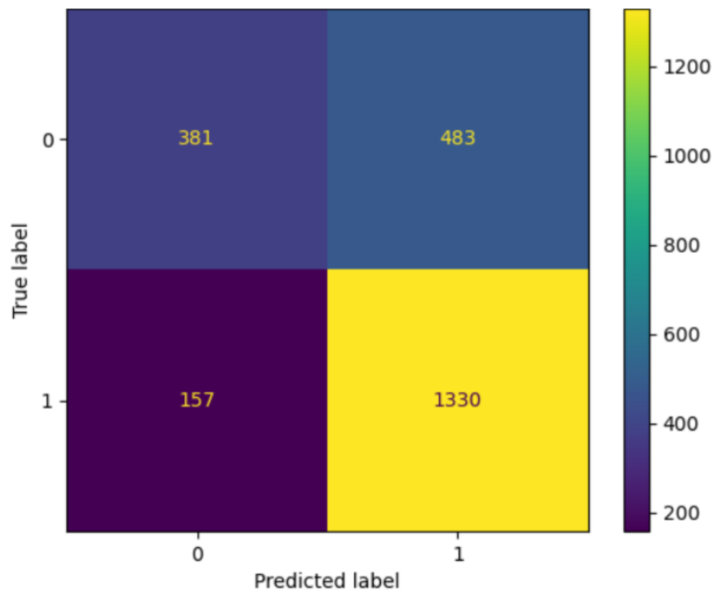


Figure 6 displays the ROC curve for the trained logistic regression model. It can be concluded that the model has results much better than random guessing (the diagonal in the ROC curve), and the AUROC score is 0.75.

Figure 6. *The ROC curve for the logistic regression model*

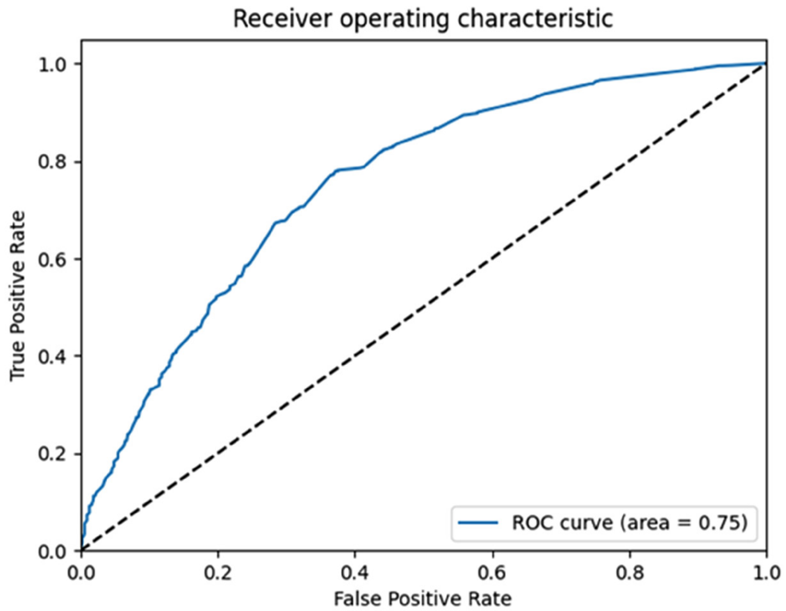
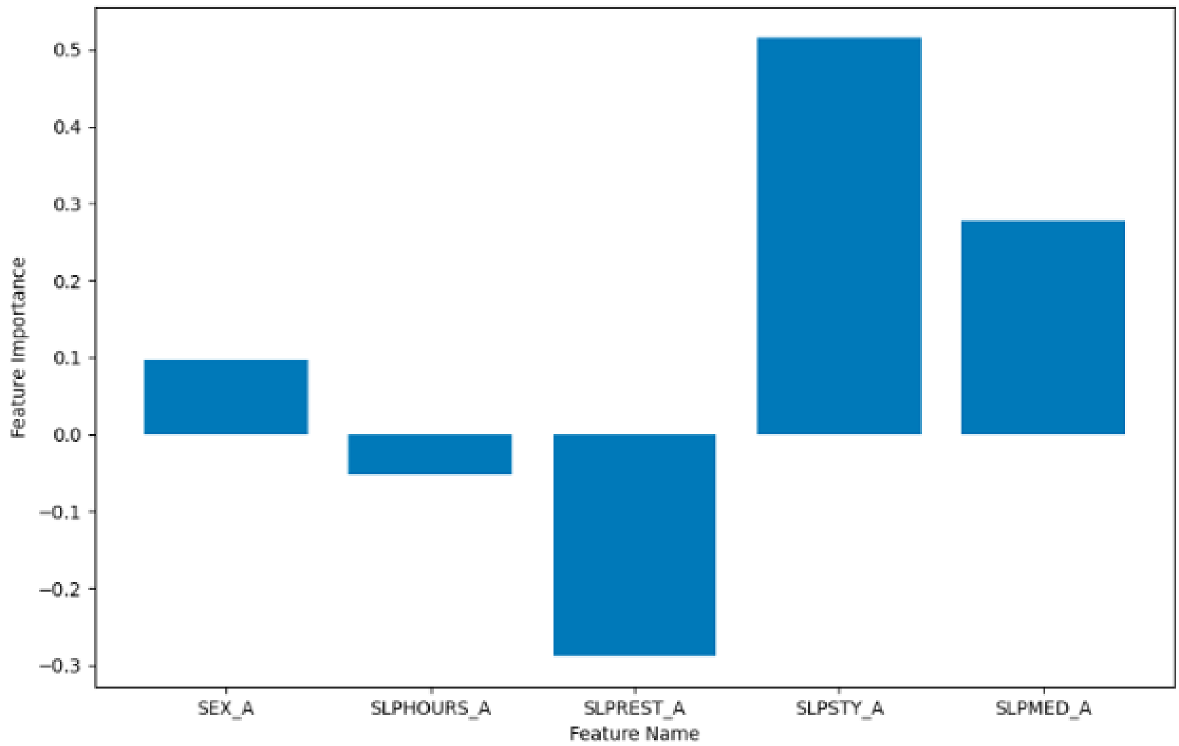


Figure 7. *Feature importance*



3.3 Feature Importance

On the feature importance graph (figure 7), SLPSTY_A has the biggest feature importance of 0.5. On the other hand, SLPREST_A shows minor feature importance of approximately –0.3.

Discussion

This paper discusses factors related to sleep disorders among adults using data from the National Health Interview Survey (NHIS) in 2022. Sleep deprivation, like insomnia, adversely affects mental and physical well-being. The study uses logistic regression to analyze the data, considering variables like sex, medication usage, trouble staying asleep, feeling well-rested, and hours of sleep. Logistic regression is applied with regularization and cross-validation. The results include a confusion matrix and ROC curve analysis. It shows the model's performance regarding true positives, false positives, and true negatives. The ROC curve indicates the model's ability to discriminate between cases and non-cases. The study also examines the correlation between variables and features' importance, highlighting variables like trouble staying asleep (SLPSTY_A) and feeling well-rested (SLPREST_A) as significant factors related to sleep disorders.

The study concluded by discussing the importance of features, emphasizing that variables such as sleep difficulties (SLPSTY_A) are significant, while waking up feeling well rested (SLPREST_A) is less critical. Overall, this article provides an overview of the research methods, findings, and factors related to adult sleep disorders.

References

"Brain Basics: Understanding Sleep." National Institute of Neurological Disorders and Stroke, www.ninds.nih.gov/health-information/public-education/brain-basics/brain-basics-understanding-sleep. Accessed: 17 July, 2023.

Centers for Disease Control and Prevention. (2022, March 20). NHIS – Questionnaires. URL: https://www.cdc.gov/nchs/nhis/quest_doc.htm.

Effect of Sleep Deprivation on the Working Memory-Related N2-P3 Components of the Event-Related Potential Waveform. URL: https://www.frontiersin.org/articles/10.3389/fnins.2020.00469/full

Brownlee, Jason. "A Gentle Introduction to K-Fold Cross-Validation". MachineLearningMastery.Com, 2 Aug. 2020. URL: https://machinelearningmastery.com/k-fold-cross-validation

submitted 02.02.2024;
accepted for publication 15.02.2024;
published 30.04.2024

Contact: yiq213@outlook.com

The European Journal of Technical and Natural Sciences 2024, No 2
ISSN 2414-2352

PREMIER Publishing
ppublishing.org

Section 4. Technical in general

DOI:10.29013/EJTNS-24-2-29-32

STUDYİNG THE FEATURES OF THE PROCESS OF "QUM-DƏNİZ" FIELD DEVELOPMENT

Tahirova Sevil Akif [1], ***Abusalimov Rasim Gulbaba*** [2]

[1] "Oil Gas Scientific Research Project" Institute of State Oil Company of Azerbaijan Republic (SOCAR)

[2] ASOIU, Faculty of Geological Exploration, Department of Oil and Gas Geology

Cite: *Tahirova S.A., Abusalimov R.G. (2024). Studying The Features of the Process of "Qum-Dəniz" Field Development. European Journal of Technical and Natural Sciences 2024, No 2.* https://doi.org/10.29013/EJTNS-24-2-29-32

Abstract

The problems that arose when assessing the efficiency of the development processes and new technological measures are especially relevant in offshore fields. Therefore, great attention is currently paid to the methods that can analyze the processes occuring in the formation systems by indirect processing of possible data of discharges, fields, horizons, etc. of individual wells.

Keywords: *process, field, development, wells, dynamics, volume, liquid, oil*

Introduction

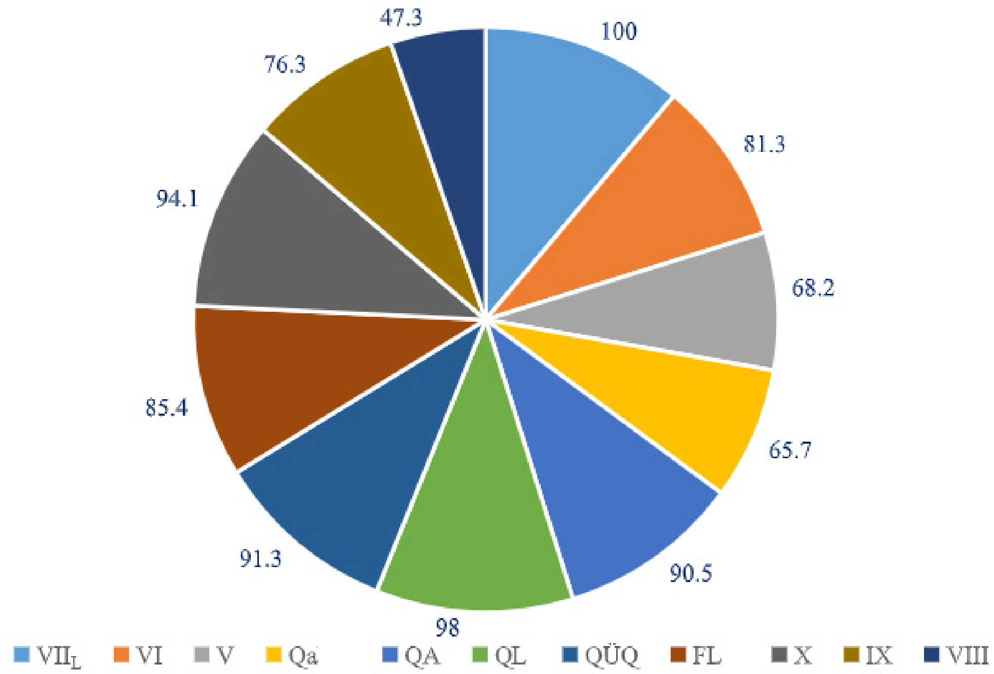
Most of the deposits, which are in the depleted stage of development, have 98% or more diluted, as well as a small initial oil saturation, are characterized by great inhomogeneity. High-permeability zones and fields differ from low-permeability deposits by 100 times or more. This leads to variable compression of the compression process, rapid dilution and less extraction of resources.

Thickeners, sediments and other chemical reagents are used to extract residual resources in 80% watered deposits. To increase oil recovery and compression ratio, as well as to cover the layer by watering, various chemical reagents are used. In most cases, increasing the coverage ratio as dilution increases reduces inhomogeneity, because it does not actively form an oil well but does not lead to significant oil production.

If oil is displaced from certain fields, the hydrophilic can dissipate in a porous medium without forming a stable oil shaft.

In the example of the Qum-dəniz field, it can be seen that in order to significantly increase the oil extraction ratio in the depleted stage of developing 100% watered deposits, methods that increase the oil compression ratio, such as the coverage rate with water injection, should be applied (Figure 1).

Figure 1. *Watering percentage of the "Qum-dəniz" field by horizons*

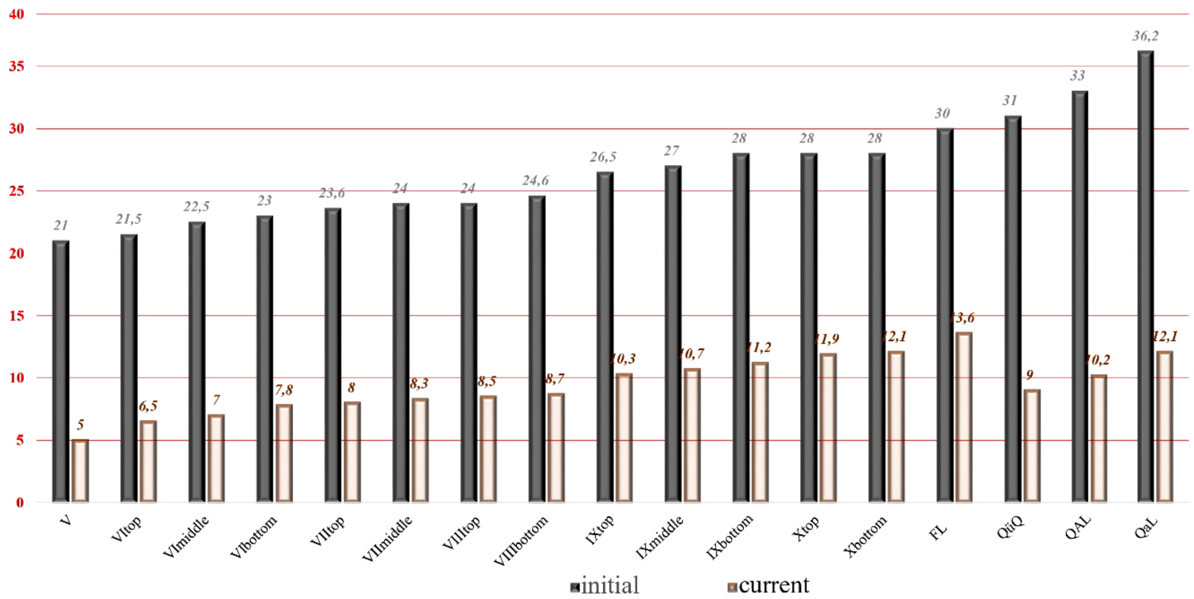


Saturated effective thicknesses, determined as a result of interpretation of materials from complex geophysical research materials carried out in drilled wells after calculating reserves and included in the report, fluctuate in the following interval.: oil saturated: 2,8 (VI$_L$) – 28,0 m (IX$_m$) and gas saturated 5,0 (VI$_{up}$) – 37,5 (VIII$_{up}$).

The porosity coefficients of productive horizons and layers were determined based on the results of data obtained as a result of laboratory studies of rock samples and interpretation of mining geophysical materials from wells.

After determining the amount of associated water in the pores of the collectors, this amount was subtracted from the unit to determine the oil and gas saturation coefficient for productive horizons. The associated amount of water was determined by calculation and centrifuge methods, considering the porosity (0,18–0,22), permeability, carbonate and clay coefficients of the reservoir rocks.

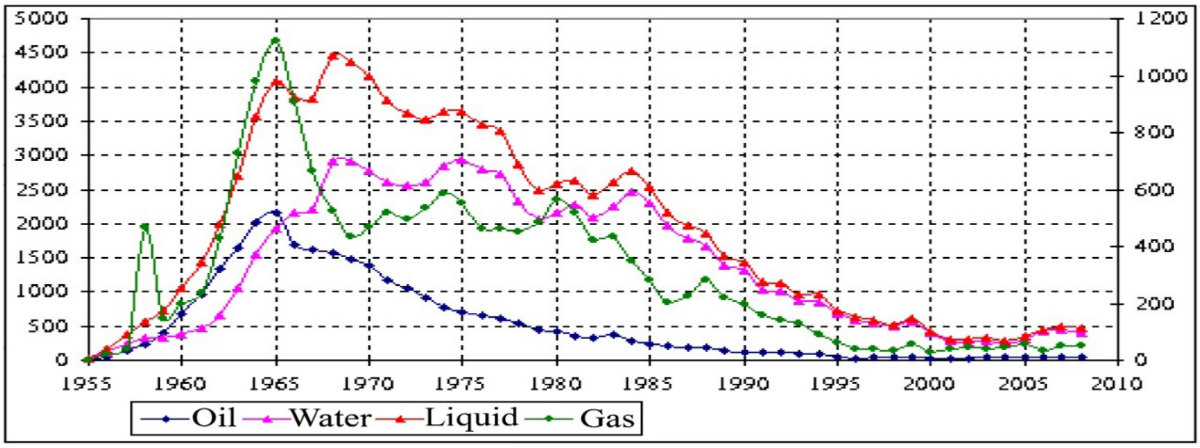
Figure 2. *Dynamics of initial and current formation pressures*



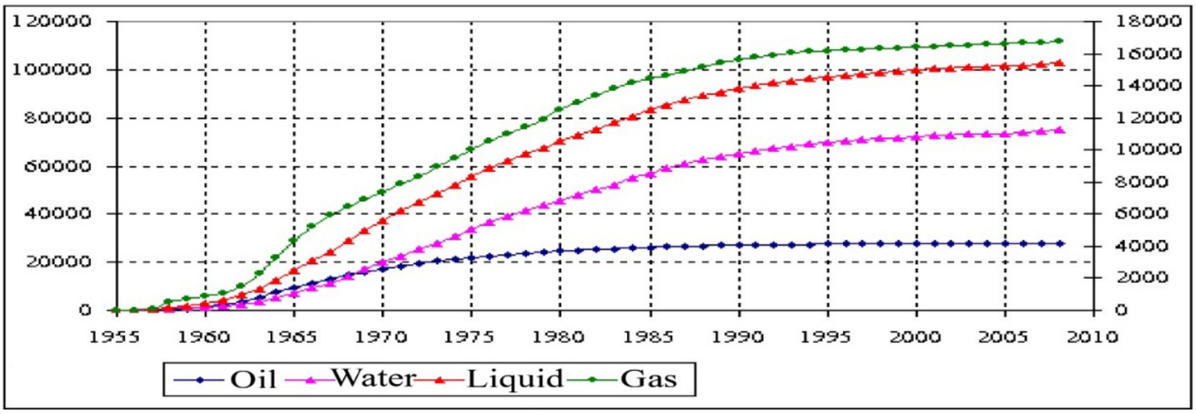
The density and volume coefficient of oil under standard conditions was studied based on the results of laboratory studies on oil samples taken from 74 wells located in different parts of the structure on the productive horizon and layer groups (РД 153–39.0–110–01. Methodical guidelines for geological and industrial analysis of development of oil and gas oil fields).

Figure 3. *The dynamics of technological indicators of development*

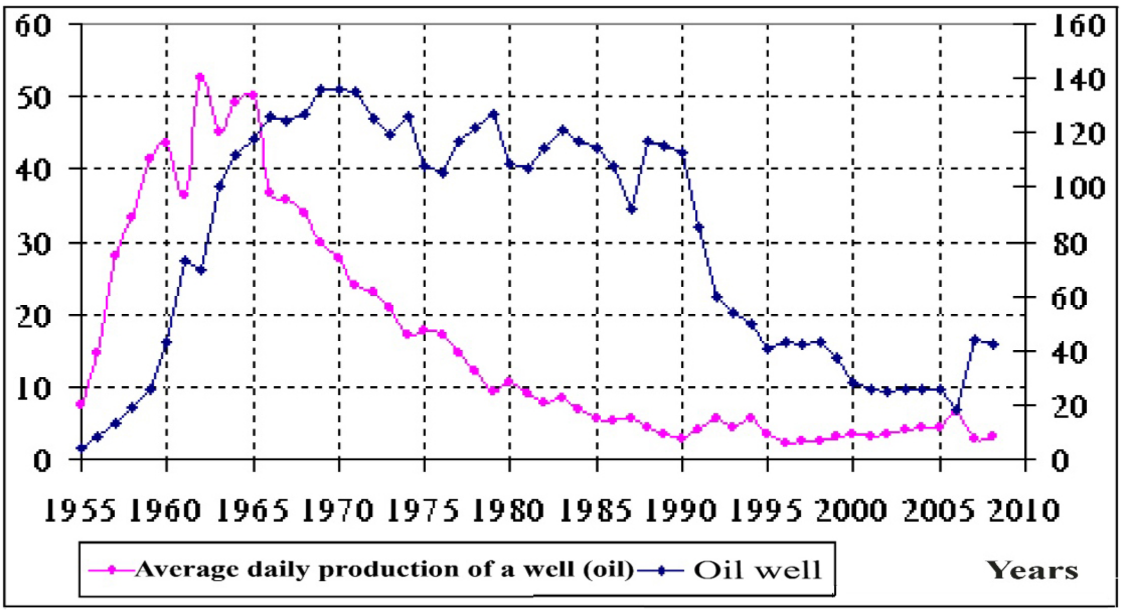
a)



b)



c)



The values of the density (0,798–0,874), of oil under standard conditions, the volume coefficient (1,290–1,440) of oil and the corresponding calculation coefficients for horizons and formations, as well as the amount of gas dissolved in oil, were determined based on the data of laboratory studies of oil samples taken from wells in the first days of the field's operation.

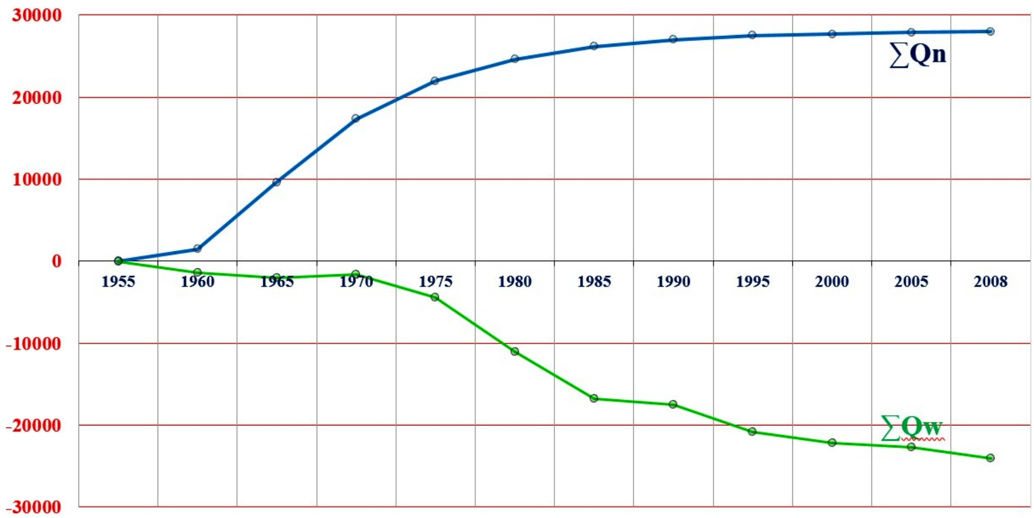
When studying the content of gas dissolved in oil based on thermodynamic studies of gas samples taken from wells, it was found that the content of gas is mainly methane (up to 96%).

The measurement of the initial and current layer pressures in the sand and sea deposit was also performed based on the hydrodynamic analysis of the wells. The dynamics are shown in figure 2.

The dynamics of the technological indicators of the development by years is given in figure 3.

Due to the reduction of formation pressure in the field and the activity of the contour area, a part of the water has moved to the boundaries of the oil part of the field. In the following years, the deposit was influenced by water, the collected "mobile" water ($\sum Q_w$) decreased in absolute quantity within the deposit during the last 15–20 years (Figure 4). This indicates that the volume of water inside the deposit is not enough, that is, the field development system is irrational.

Figure 4. *Change in accumulated oil production and "mobile" water by field*



References

Bagirov B. A. Geology of oil and gas mining / B. A. Bagirov.– Baku: ADNA,2011.– 311 p.

Mirzajanzade A. Kh., Aliyev, N. A., Yusifzadeh, Kh. B. и др. (1997). Fragments of development of marine oil and gas fields. Baku, 1997: Elm. 21.– 408 p.

РД 153–39.0–110–01. Methodical guidelines for geological and industrial analysis of development of oil and gas oil fields.

Tahirov C. N., Karimova A. Q., Tahirova S. A. "Monitoring the dynamics of changes in the properties and composition of reservoir oils of fields in long-term operation on the Absheron Peninsula and giving recommendations for efficient development of fields". Scientific Works of the Scientific Research Institute of Oil, Gas and Chemistry. – Baku, 2019.– Vol. XIX.– P. 181–200.

submitted 15.03.2024;
accepted for publication 02.04.2024;
published 30.04.2024

Contact: sevil.tairova16@gmail.com

Contents