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XORAZM VILOYATI SHAROITIDA PLATINASIZ (TO‘G‘ONSIZ) MIKRO GESLARNI LOYIHALASH ME’ZONLARINI ISHLAB CHIQISH

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Annotatsiya. Ushbu maqolada Xorazm viloyati sharoitida platinasiz (to‘g‘onsiz) mikro gidroelektr stansiyalarni (GES) loyihalashning ilmiy-texnik asoslari va me’zonlari ishlab chiqilgan. Tadqiqot hududning o‘ziga xos tabiiy-iqlimiy sharoitlari, xususan, Amudaryo havzasiga xos past nishablik, suv oqimining mavsumiy o‘zgaruvchanligi hamda sug‘orish kanallari tarmog‘ining kengligi inobatga olingan holda olib borildi. Ishda kichik suv oqimlaridan samarali foydalanish imkoniyatlari, gidravlik parametrlarni optimallashtirish, energiya ishlab chiqarish samaradorligini oshirish va ekologik xavfsizlikni ta’minlash masalalari kompleks tarzda tahlil qilindi. Shuningdek, maqolada mikro GESlarni joylashtirish uchun optimal uchastkalarni tanlash mezonlari, oqim tezligi va suv sarfiga asoslangan hisoblash usullari, energiya ishlab chiqarishning prognoz ko‘rsatkichlari hamda texnik-iqtisodiy samaradorlikni baholash yondashuvlari ishlab chiqildi. Taklif etilgan me’zonlar hududning mavjud irrigatsiya tizimlari bilan integratsiyalashgan holda, qo‘shimcha infratuzilma qurilishini minimal darajaga tushirish imkonini beradi. Natijalar Xorazm viloyatida qayta tiklanuvchi energiya manbalaridan foydalanishni kengaytirish, energiya ta’minoti barqarorligini oshirish va ekologik barqaror rivojlanishga erishishda muhim ahamiyat kasb etadi.

Kalit so‘zlar: mikro GES, platinasiz gidroelektr stansiya, Xorazm viloyati, sug‘orish kanallari, suv oqimi, gidravlik hisoblash, qayta tiklanuvchi energiya, energiya samaradorligi, ekologik xavfsizlik, texnik-iqtisodiy tahlil.

Аннотация. В данной статье разработаны научно-технические основы и критерии проектирования бесплатформенных (безплотинных) микрогидроэлектростанций (ГЭС) в условиях Хорезмской области. Исследование проводилось с учетом специфических природно-климатических условий региона, в частности, малой крутизны бассейна реки Амударья, сезонной изменчивости водного потока и ширины сети ирригационных каналов. В работе всесторонне проанализированы возможности эффективного использования малых водотоков, оптимизации гидравлических параметров, повышения эффективности производства энергии и обеспечения экологической безопасности. В статье также

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разработаны критерии выбора оптимальных мест для размещения микрогидроэлектростанций, методы расчета на основе расхода воды и водопотребления, прогнозные показатели производства энергии и подходы к оценке технико-экономической эффективности. Предложенные критерии, интегрированные с существующими ирригационными системами региона, позволяют минимизировать строительство дополнительной инфраструктуры. Результаты имеют большое значение для расширения использования возобновляемых источников энергии в Хорезмской области, повышения стабильности энергоснабжения и достижения экологически устойчивого развития.

Ключевые слова: микрогидроэлектростанция, бесплатиновая гидроэлектростанция, Хорезмская область, ирригационные каналы, водоток, гидравлический расчет, возобновляемая энергия, энергоэффективность, экологическая безопасность, технико-экономический анализ.

Abstract. This article develops scientific and technical foundations and criteria for the design of damless (non-dam) micro hydroelectric power plants (HPPs) in the Khorezm region. The study was conducted taking into account the specific natural and climatic conditions of the region, in particular, the low slope characteristic of the Amudarya basin, seasonal variability of water flow, and the width of the irrigation canal network. The work comprehensively analyzed the possibilities of effective use of small water flows, optimization of hydraulic parameters, increasing energy production efficiency, and ensuring environmental safety. The article also develops criteria for selecting optimal sites for the placement of micro hydroelectric power plants, calculation methods based on flow rate and water consumption, forecast indicators of energy production, and approaches to assessing technical and economic efficiency. The proposed criteria allow for integration with the existing irrigation systems of the region, minimizing the construction of additional infrastructure. The results are important for expanding the use of renewable energy sources in the Khorezm region, increasing the stability of energy supply, and achieving environmentally sustainable development.

Keywords: micro hydroelectric power plant, platinum-free hydroelectric power plant, Khorezm region, irrigation canals, water flow, hydraulic calculation, renewable energy, energy efficiency, environmental safety, feasibility study.

INTRODUCTION.

Currently, the growing demand for energy resources worldwide, the limited availability of traditional fuel sources, and the aggravation of environmental problems require the effective use of renewable energy sources. In this regard,

small-scale hydropower, in particular micro hydroelectric power plants (HPPs), are recognized as one of the promising areas of energy production. In particular, the construction of dam-free (plateau-free) micro hydroelectric power plants is significant because it does not require the construction of large-scale hydraulic structures, has a relatively low environmental impact, and can be put into operation in a short time.

The growing demand for electricity in the Republic of Uzbekistan, including in the Khorezm region, and the insufficient stability of existing energy sources create the need to diversify the regional energy supply. The Khorezm region is distinguished by its flat terrain, an extensive irrigation system formed by the Amu Darya River and its branches. However, the small natural height difference in the region limits the construction of large hydroelectric power plants. Therefore, the introduction of innovative solutions that allow for the most efficient use of existing water flows, in particular, the introduction of platinum-free micro hydroelectric power plants, is an urgent issue.

The purpose of this study is to develop scientifically based criteria for the design of platinum-free micro hydroelectric power plants in the conditions of the Khorezm region. To achieve this goal, the hydrological and hydraulic characteristics of the region are analyzed, methods are developed for selecting suitable sites for the placement of micro hydroelectric power plants, and technical solutions are proposed to increase the efficiency of energy production.

The research results will serve as a scientific and practical basis for identifying the potential of small hydropower at the regional level, rational use of existing irrigation infrastructure, and the widespread introduction of renewable energy sources.

Selecting the optimal location for the construction of a creative low-power hydroelectric power plant by analyzing the channels in the Khorezm region.

By analyzing the channels in the Khorezm region, we select the optimal channel for the construction of a creative low-power hydroelectric power plant. In order to select the optimal channel for a low-power hydroelectric power plant, we formulated the channel parameters that are important for creative hydro turbines as the main criteria:

- Water flow rate;
- Canal water consumption;
- Canal dimensions;
- Duration of freezing of the channel in winter;

Water flow rate. Distribution of velocities by river depth and width. Measuring the water flow rate is of great importance in determining water

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consumption, in the design and construction of hydraulic structures, as well as in solving a number of scientific and practical problems. The distance traveled by the water mass in the river bed per unit of time represents the water flow rate. The purpose of measuring the speed is to determine the water consumption, which is the main element of the water regime. It is also necessary to take into account the water flow rate when designing, constructing and operating various hydraulic and water management structures.

In a stream, the speed of water flow is smaller at the surface of the liquid, increases to a certain depth, and then decreases again. This distribution of speed over depth is caused by friction between the air and the water surface and friction between the moving water mass and the bottom of the stream.

Wind can increase or decrease the speed of the water surface. When the direction of the current coincides with the direction of the wind, the speed at the water surface increases, otherwise it decreases.

Currently, there are a large number of instruments and devices for measuring the speed of water flow, which can be conditionally divided into two large groups:

1) instruments that allow direct measurement of the speed of water flow (strains);

2) those that do not allow direct determination of the speed of water flow, but calculate the speed by determining some element of the water regime or the indicator of the device.

Measuring speed using a hydrometric vane is based on determining the number of revolutions of the vane per second.

Water consumption of the channel. Water consumption is measured in l/s, m3/s. The average daily, average monthly, average annual, maximum and minimum water consumption and the flow volume for a certain interval are calculated based on the measured water consumption. Existing methods for calculating water consumption are divided into two main groups.

1. Direct measurement of water consumption.
2. Indirect measurement of water consumption.

Direct measurement of water consumption includes the volumetric method. This method is most often used when the water consumption does not exceed 5-10 1/s. This method is used to measure spring water, when calibrating wet and water culverts. In this method, water consumption - Q is determined by the ratio of the volume of water in the measuring tank - W and the time taken to measure it - t:

$$Q = \frac{W}{t};(1.0)$$

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There are several methods for indirect measurement of water flow. All of them are based not on direct measurement of water flow, but on measuring some elements of the flow and then calculating the water flow. These include the following methods:

1. Determining water flow by measured velocities and cross-sectional area of the flow. This method is widely used in river hydrometry. The cross-sectional area of the flow is determined based on the results of depth measurements. The flow rate at certain points of the live water section is measured more often using a hydrometric turntable, and in some cases using other devices or plugs. This method also includes a method based on calculating water flow by the live cross-sectional area and the average flow rate of the flow according to the Shezi formula.

2. Determining water flow using measuring devices is mainly intended for measuring small rivers and streams, wet and culverts, and canals.

In addition, this method is used to determine the amount of water flowing through hydropower plants.

Mixing method: used in mountain rivers with a high flow rate, not very deep and with a complex relief. Determining the water flow rate based on the measured water flow rate and the cross-section of the stream. This method is abbreviated as the “velocity-area” method.

The methods for measuring water flow are described as follows:

1. Hydrometric methods. Some parts of the water flow model are measured in the field, and then the full flow is calculated using analytical, graph-analytical and graphical methods.

2. Hydraulic method. Based on determining the components of the water flow equation.

3. Hydrometric-hydraulic method.

4. Physical methods. This method is used to determine the water flow of mountain rivers with a high level of water velocity turbulence. In this case, measuring the speed and cross-section of water does not have high accuracy. In the physical method, electromagnetic, ultrasound, chemicals are mixed into the water.

5. Hydraulic methods. By measuring the thickness of precipitation in the river basin, water reserves can be determined and water consumption can be calculated. The accuracy of the hydrological method is up to 10-30%.

6. Volumetric method and weighing the weight of water in experimental conditions, filling a container with water and determining the time it takes to fill it.

The duration of freezing of the canal in winter. Considering the duration

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of freezing in winter of all 4 canals we selected, we came to the conclusion that they have a freezing duration of 3 months. Therefore, the micro hydroelectric power station we designed will be able to operate continuously for 9 months.

In particular, we analyzed data on the Polvon-Gazovot, Shovot, Toshsoqa and Klichbay canals and conducted studies. In this, we analyzed data on the slope, width, length, speed and water carrying capacity of the canals.

Table 1.1 presents the main parameters of the Polvon-Gazovot, Shovot, Toshsoqa and Klichbay canals that we analyzed.

1.1- Table.

Parametrs of analyzed channels.

№	Name	Slope, m	Width, m	Average speed, m/s	Length, km	Water permeability, m^3/s	Year of construction
1.	Polvon-G‘azovot	4-5	60	0,52	30,5	97	1941-yil
2.	Shovot	4-5	35-50	0,58	87,6	110	1927-yil
3.	Toshsoqa	12	110	0,71	32,1	375	1940-yil
4.	Klichbay	7	65	0,65	51,9	160	1942-yil

Damless micro hydropower plants and their design.



1.1- picture. General view of a damless micro hydropower plant.

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1.2- picture. The section of the Toshsoqa Canal where the micro hydroelectric power plant is planned.

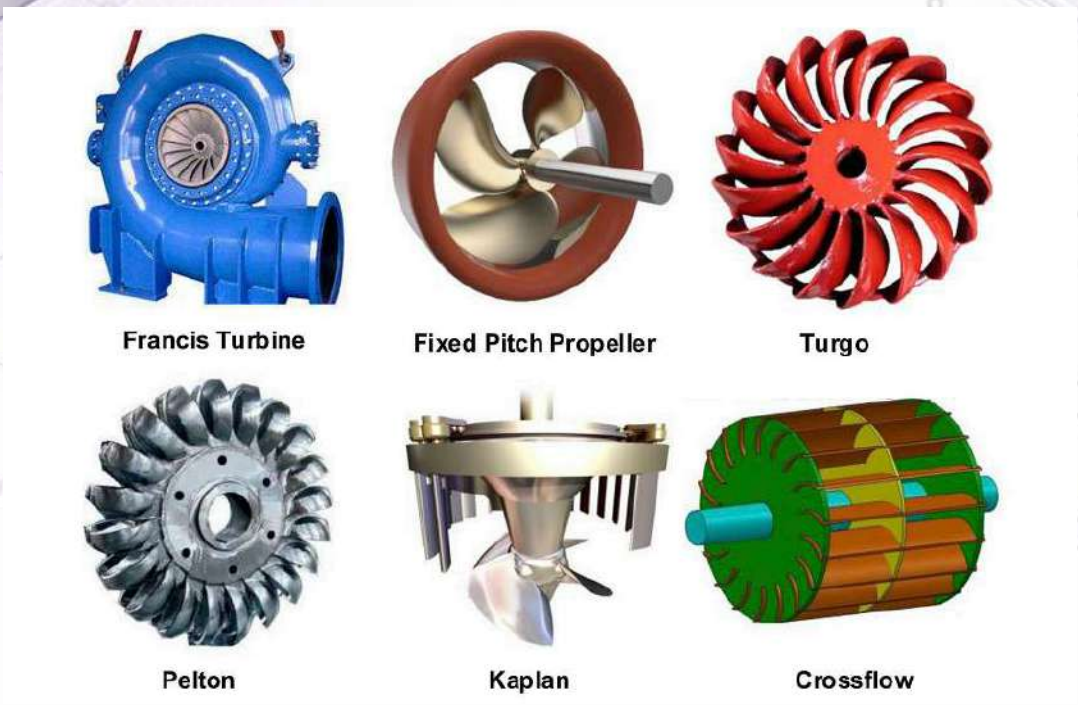
To increase the power of a micro-hydroelectric power plant, it is necessary to either increase the water flow or increase the diameter of the turbine impeller. The average speed of water flow in rivers and canals located on the plain is 1-1.5 m/s. Calculations show that to obtain 10 kW of power at a water flow speed of 1 m/s, the impeller diameter should be 10 m or 10 turbines with a diameter of 1 m are required.

Choosing the right inverter and generator.

According to the principle of operation, all hydraulic turbines are divided into two classes: active and reactive. The impeller of reactive turbines is completely immersed in the water flow, while in active turbines the impeller operates at atmospheric pressure and is driven by separate water flows. Most hydraulic turbines are active turbines, only bucket turbines are widely used, under certain conditions - at very high pressures.

Currently, the most common are axial turbines (rotary blade, propeller, double blade), radial-axis, diagonal and bucket turbines. Pump-turbine units installed in pumped storage power plants are located at some distance. By design, they are radial-axial and diagonal. Each type of turbine is optimal for a certain combination of water flow and pressure, although in some cases their ranges coincide, and accordingly, different types of turbines can be selected for one hydroelectric power plant.

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1.3- picture. The most commonly used types of turbines.

1.2- Table.

20 Characteristics of the PrD diagonal turbine.

№	Parameters	Micro Hydropower plant 20 PrD
1.	Power, kW	10-20
2.	Pressure, m	8-18
3.	Water consumption, m^3/s	0,08-0,17
4.	Turbine rotor rotation speed, min^{-1}	1500
5.	Rated voltage, V	230,400
6.	Nominal frequency of electric current, Gs	50

1.3- Table.

Radial-spindle turbine hydropower units.

№	Parameters	Types of hydropower units			
1.	Power, kW	950 until	550	3300	5600
2.	Pressure, m	30-100	25-55	70-120	100-160
3.	Water consumption, m^3/s	0,4-1,25	0,4-1,3	0,6-3,2	1,5-4,0
4.	Turbine rotor rotation speed, min^{-1}	1000; 1500	1000	600; 750; 1000	750; 1000
5.	Rated voltage, V	400; 6000	400; 6000	6000; 10000	6000; 10000

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6.	Nominal frequency of electric current, Gs	50	50	50	50

1.4- Table.

Micro hydropower plants with bucket turbines.

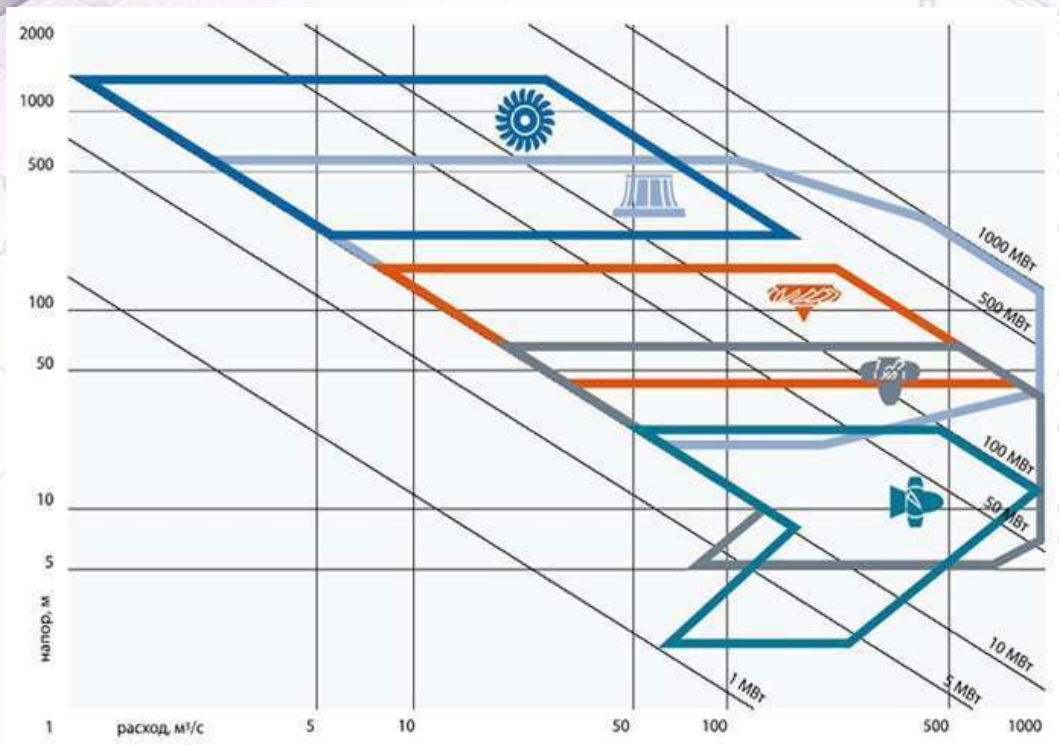
Parameters	**Types of micro hydropower plants**	
	Micro Hydropower Plant 100K	**Micro Hydropower Plant 200K**
Power, kW	100 until	180 until
Pressure, m	40-250	
Water consumption, m^3/s	0,015-0,060	0,025-0,100
Turbine rotor rotation speed, min^{-1}	750; 1000; 1500	
Rated voltage, V	230; 400	
Nominal frequency of electric current, Gs	50	

1.5- table.

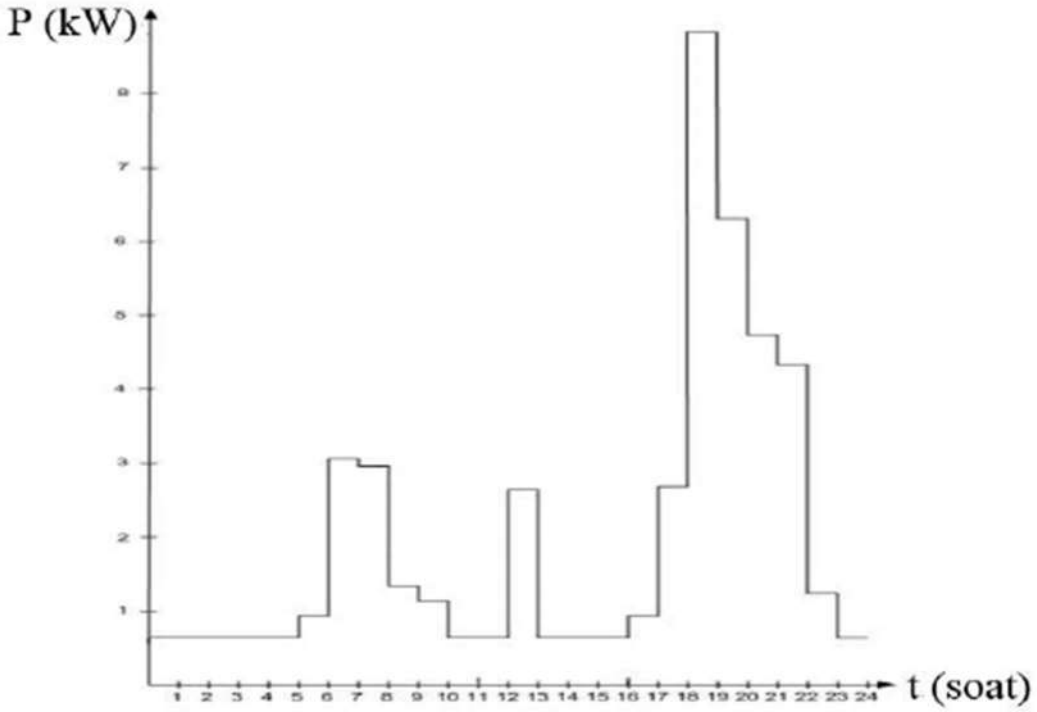
Bucket turbine hydropower units.

Parameters	**Types of hydropower units**	
	GA-5	**GA-10**
Power, kW	145-620	290-3300
Pressure, m	150-250	200-450
Water consumption, m^3/s	0,17-0,32	0,19-0,90
Turbine rotor rotation speed, min^{-1}	500; 600	600; 750; 1000
Rated voltage, V	400; 6000	400; 6000; 10000
Nominal frequency of electric current, Gs	50	50

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1.4- picture. Diagram for correct turbine selection.



1.5- picture. Daily load of micro hydropower plant.

There are types of micro hydroelectric power plants such as impeller, garland and propeller. We decided to choose the impeller type, which has been used for a long time. Because it has a number of advantages, such as ease of maintenance, wide possibilities for carrying out operational work, simplicity of construction, low costs for channel installation of the device, and the ability to achieve high efficiency even with low water pressure and low speed. The

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preliminary scientific research conducted showed that to date, many scientific problems have been solved on the construction of micro hydroelectric power plants operating using various types of impellers and increasing their efficiency. However, the optimal angle of the impeller-type micro hydroelectric power plant has not been determined, and the most efficient new model suitable for the conditions of the Khorezm region has not been developed. The initial stage is to determine the optimal angle of the impeller blades of the micro hydroelectric power plant. The determined optimal angle allows increasing the energy efficiency of the micro hydroelectric power plant.

When the micro hydroelectric power plant impeller rotates, the work of the water flow is performed due to the change in kinetic energy.

$$A = \frac{m*\vartheta_2^2}{2} - \frac{m*\vartheta_1^2}{2};(1.1)$$

where, A is the work of the water flow, Joul;
m - water mass acting on the blade, kg;
ϑ_1- initial velocity of water flow, m/s;
ϑ_2- final velocity of water flow, m/s;
Now let's look at the mass of water:

$$m = \rho * V;(1.2)$$

here, ρ- water density, kg/m^3;
V - water volume, m^3;

We define the angle between the blades of the wheel as α. The blade of the wheel consists of a prism with a triangular base along with its sides (l, b, c). In this case, we determine how much water (V) enters the blade.

$$V = H * S_{uchb} = H * b * c * sin\alpha;(1.3)$$

where, H is the height of the prism, m;
S - the face of a triangle that is the base of a prism, m^2;
l - The depth of the blade's immersion in water (one side of the triangle), m;
b and c are the second and third sides of the triangle (respectively), m;
$sin\alpha$ - The angle between sides b and c.
The following formula is formed:

$$m = \rho * H * b * c * sin\alpha;(1.4)$$

We assume that the initial velocity of the water flow is zero when the wheel starts rotating. In this case, the formula looks like this:

$$A = \frac{m*\vartheta^2}{2};(1.5)$$

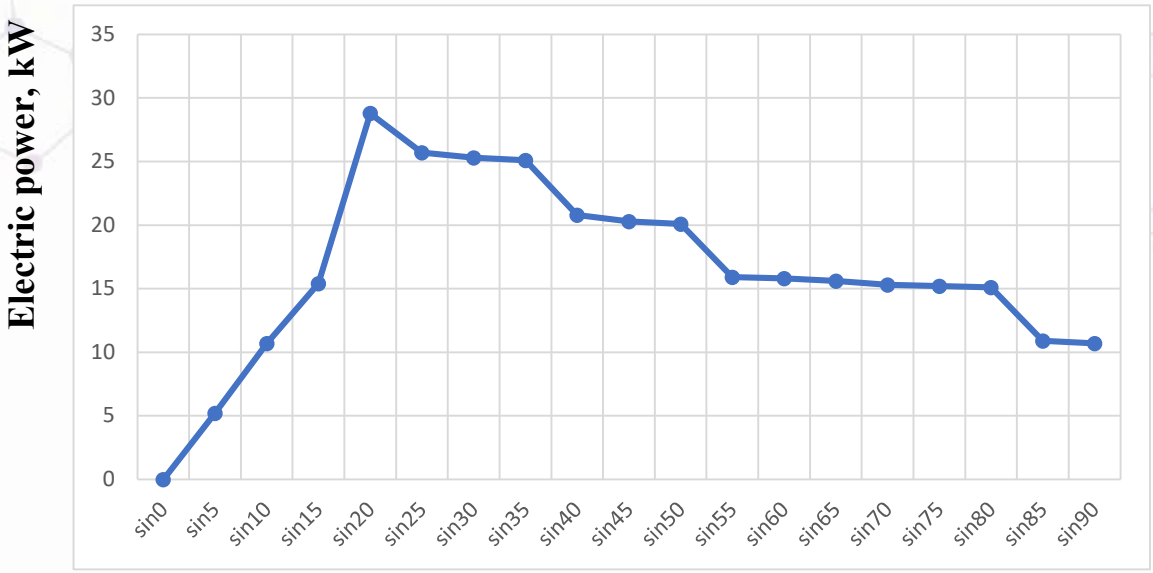
$$A = \frac{\rho*H*b*c*sin\alpha*\vartheta^2}{2};(1.6)$$

Now $sin\alpha$ we can express the angle.

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$$sin\alpha = \frac{2A}{\rho * H * b * c * \vartheta^2};(1.7)$$

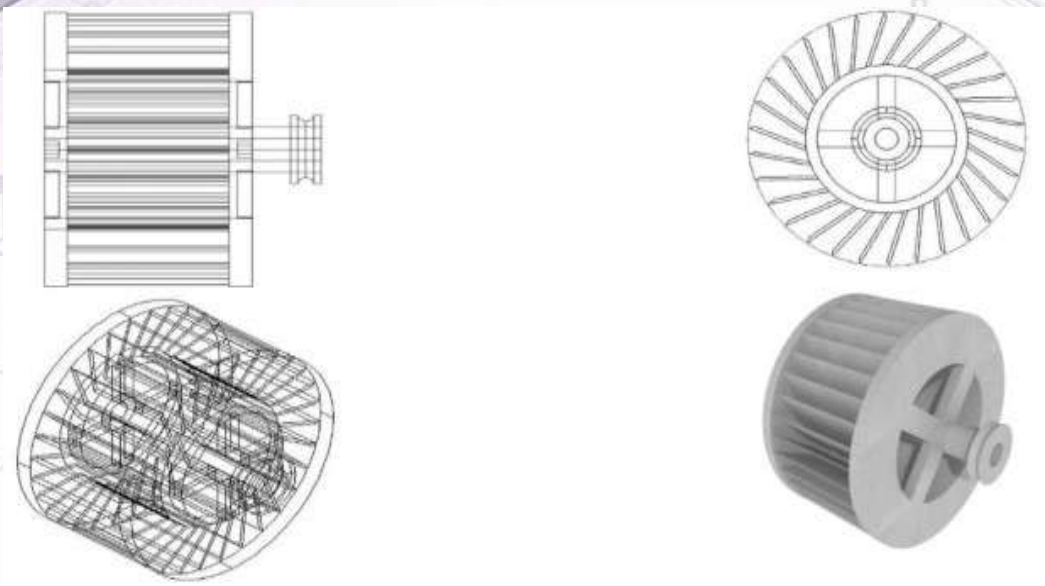
Therefore, the angle α we are looking for is directly proportional to the work (energy) done by the water flow and inversely proportional to the sides of the impeller blades. The results of a preliminary study to determine the optimal angle for a micro hydropower plant to produce a maximum of 5 kW to 30 kW of electricity per hour are presented in picture 1.6.



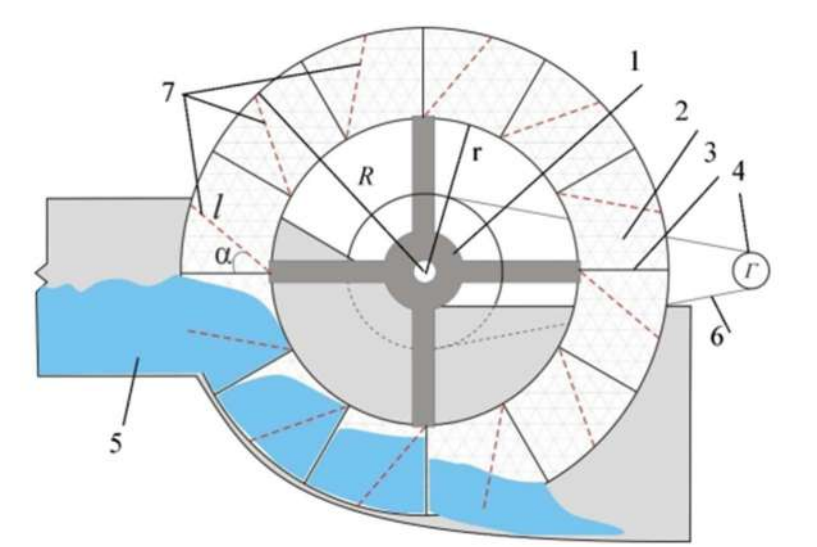
1.6-picture. The dependence of the electrical power generated by a micro hydroelectric power plant on the angle between the blades.

In conclusion, the optimal angle determined $\alpha = 22°$ was equal to. Because it is at this angle that the micro-hydroelectric power plant produces the maximum amount of electricity. Based on the determined optimal angle of the blade, the impeller of the micro-hydroelectric power plant was developed. This optimal angle allows to increase the energy efficiency of the micro-hydroelectric power plant.

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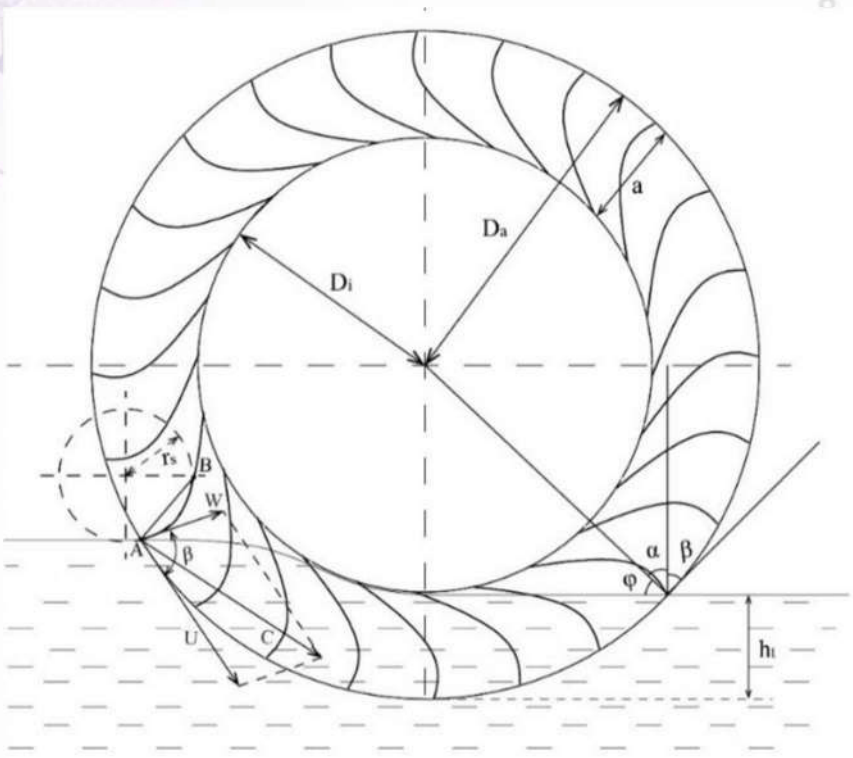


1.7- picture. Initial virtual model views of a micro hydroelectric power plant waterwheel.



1.8- picture. Developed micro hydropower water wheel model: R – outer radius; r – inner radius; l – wheel length; α – angle; 1 – shaft; 2 – wheel; 3 – blades (vanes); 4 – generator; 5 – water flow; 6 – moving belt;7 – blades with variable angle.

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1.9- picture. Diagram of geometric parameters of water wheel design.



1.10- picture. Developed micro hydroelectric power plant water wheel.

1.6-Table.

Designed flywheel parameters.

Width, sm	Inner radius, sm	Outer radius, sm	Diameter, sm	Number of wings	The angle between the wings
40	25	50	150	16	22°

1. We can calculate the surface area of one feather:

$$S_{par} = a * b = 40 * 50 = 2000sm^2 = 0{,}2m^2;(1.8)$$

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Assuming the total number of wings is 16,

$$S_{par.jami} = 2000 * 16 = 32000sm^2 = 3{,}2m^2(1.9)$$

2. We calculate the lengths of the small and large circles of the Ferris wheel:

$$r = R_1 + R_2 = 50 + 25 = 75sm;(1.10)$$

$$l_1 = 2\pi * R_1 = 2 * 3{,}14 * 75 = 471sm;(1.11)$$

$$l_2 = 2\pi * R_2 = 2 * 3{,}14 * 25 = 157sm;(1.12)$$

3. We calculate how much water flows through the wheels of the wheel in 1 second:

$$l = \vartheta * t;(1.13)$$

$$V = S_{par} * l = S_{par} * \vartheta * t = 0{,}2 * 0{,}71 * 1 = 0{,}142m^3;(1.14)$$

4. We determine how much mass of water affects the wheel:

$$m = \rho * v = 1000 * 0{,}142 = 142kg;(1.15)$$

5. We calculate the total surface area of the wheel:

$$S_{jami} = S_1 + S_2 = \pi * r^2 = \pi * (R_1 + R_2)^2 = 3{,}14 * 75^2 = 17662{,}5sm^2 = 1{,}76625m^2;(1.16)$$

$$S_2 = \pi * R_2^2 = 3{,}14 * 25^2 = 1962{,}5sm^2 = 0{,}19625m^2;(1.17)$$

$$S_1 = S_{jam} - S_2 = 1{,}76625 - 0{,}19625 = 1{,}57m^2;(1.18)$$

6. We can calculate the kinetic energy:

$$E_{kin} = \frac{m*\vartheta^2}{2} = \frac{142*0{,}71^2}{2} = 35{,}7911\,J;(1.19)$$

7. $\eta = 0{,}5$ We can calculate the useful energy when:

$$E_f = \eta * E_{kin} = 0{,}5 * 35{,}7911 = 17{,}89555\,J;(1.20)$$

8. The average length of the canal to spinning wheel ϑ behind the wheel after the speed is affected ϑ_1 we can calculate the speed:

$$\vartheta_1 = \sqrt{\frac{2*E_f}{m}} = \sqrt{\frac{2*17{,}89555}{142}} = 0{,}5\,m/s;(1.21)$$

9. We can calculate the acceleration of the wheel:

$$a = \frac{\vartheta - \vartheta_1}{t} = \frac{0{,}71-0{,}5}{1} = 0{,}21\,m/s^2;(1.22)$$

10. We can find the force acting on the wheel:

$$F = m * a = 142 * 0{,}21 = 29{,}82\,N;(1.23)$$

11. We can find the work done by the flywheel, i.e. its power:

$$A = N * t = m * g * h * t = 142 * 9.81 * 0.55 * 1 = 766{,}161\,J;(1.24)$$

12. We calculate the distance traveled by the wheel in 1 s:

$$l_3 = \vartheta_0 * t + \frac{a*t^2}{2} = 0{,}5 * 1 + \frac{0{,}21*1}{2} = 0{,}605m;(1.25)$$

13. Ferris wheel rotation time:

$$t_{ayl.vaq} = \frac{\frac{l_1+l_2}{2}}{l_3} = \frac{\frac{4{,}71+1{,}57}{2}}{0{,}605} = 5{,}19\,s;(1.26)$$

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14. We can find the rotational speed of the wheel:

$$\vartheta_{ayl.tez} = \frac{1\,(ayl)}{t_{ayl.vaq}} = \frac{1}{5{,}19} = 0{,}192\ ayl/s = 11{,}52\ ayl/daq;(1.27)$$

15. We calculate the torque of the flywheel:

$$M_{bur} = F * l = m * a * S_{par} * l = 142 * 0{,}21 * 0{,}2 * 0{,}55 = 3{,}2802\ N * m;(1.28)$$

16. We can calculate the nominal power of the flywheel per second:

$$M = 9{,}55 * \frac{P_{nom}}{n_{ayl}};(1.29)$$

$$P_{nom} = \frac{M * n_{ayl}}{9{,}55} = \frac{3{,}2802 * 0{,}192}{9{,}55} = 0{,}065\ W;(1.30)$$

17. We can determine the mechanical power that 1 flywheel produces in 1 hour:

$$\frac{0{,}065 * 3600}{1000} = 0{,}234\ kW * soat;(1.31)$$

1 piece windmill can produce 0.234*24=5.6 kW*h of electricity in 24 hours.

1 piece windmill can produce 5.6*270=1512 kW*hours of electricity in 1 year.

A reducer is a mechanical transmission of energy through rotation, converting rotational speed and torque into magnitude. A reducer is a “reducer”, the main function of a mechanical gearbox is to reduce, that is, to reduce the force required to drive a device that converts the transmitted mechanical energy into useful work - that is, the gearbox reduces the rotational speed and increases the torque transmitted to any device. A gear reducer is a device that is the opposite of a mechanical gearbox - it increases the rotational speed, reduces the torque. The canonical type of mechanical gearbox is a gear, in which the driving gear is smaller and the driven gear is larger. In addition to gear gears, worm, planetary and helical gears can also perform the functions of a mechanical gearbox.

We have a single-stage worm gearbox CUBEX 9Ч -130 we chose a series reducer. Features 9Ч-130, weight (without lubrication, connecting and mounting elements) is 59.0 kg.

1.7-Table.

Reducer selection catalog.

i	n_1=2800 rpm				n_1=1400 rpm				n_1=900 rpm			
	n_2	M	P	RD	n_2	M	P	RD	n_2	M	P	RD
	rpm	Nm	kVt	%	rpm	Nm	kVt	%	rpm	Nm	kVt	%
7,5	373	571	24	93	187	782	16,8	91	120	935	13,2	89

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10	280	606	19,3	92	140	817	13,3	90	90	980	10,5	88
15	187	668	14,5	90	93	872	9,8	87	60	1015	7,5	85
20	140	735	12,1	89	70	950	8,1	86	45	1092	6,2	83
25	112	645	8,4	90	56	797	5,5	85	36	914	4,2	82
30	93	652	7,5	85	47	688	4,2	80	30	735	3	77
40	70	781	6,9	83	35	958	4,5	78	23	1114	3,5	75
50	56	787	5,7	81	28	985	3,8	76	18	1084	2,8	73
60	47	753	4,6	80	23	952	3,1	75	15	1040	2,3	71
80	35	648	3,3	72	18	804	2,2	67	11	938	1,7	65
100	28	605	2,5	71	14	765	1,7	66	9	855	1,3	62

Calculation of the economic efficiency of the designed micro hydroelectric power plant.

The following factors are of particular importance for a correct assessment of the efficiency of the construction of micro hydroelectric power plants:

a) fuel consumption, which is the main energy resource. The efficiency of hydropower sources, which allows saving costs associated with extraction, processing and transportation. Currently, the efficiency due to fuel savings in micro hydroelectric power plants constitutes a significant part of the overall economic efficiency and is growing from year to year.

b) environmental friendliness of hydropower sources. Currently, due to environmental degradation, requirements are being tightened to regulate the emission of harmful substances into the atmosphere during the operation of fuel-using plants. Ensuring the operation of these plants in accordance with these requirements requires significant funds, which negatively affects their economic efficiency.

c) energy shortage. Frequent interruptions in centralized energy supply due to energy restrictions. Manufacturers, especially small and medium-sized businesses, suffer losses tens of times greater than the cost of undelivered energy. It is very important to take this factor into account when determining the economic efficiency of CHP plants operating in accordance with the energy consumption schedule of economic entities.

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The approach based on the criterion of determining the minimum costs for the economic justification of the objects under construction has been widely used for a long time. It is worth noting that in the conditions of centralized economic management, such an approach played an important role in increasing the scientific validity of economic solutions and was used based on the global goals of economic development.

Using the results of modern scientific research, we can generate additional electricity by designing and installing micro hydroelectric power plants without dams, and we can also create opportunities to save traditional energy sources.

Water management, settlements and cluster enterprises will be provided with additional electricity. 6 jobs will be created when designing and installing one micro hydroelectric power plant without dams. We designed a creative micro hydroelectric power plant, the optimal use of which is in the conditions of the Khorezm region, and determined its economic efficiency for 1 day, 1 month, 1 year.

1 piece The mechanical power produced by a spinning wheel in 1 hour 0,234 $kW * hour$ considering that:

1 piece Ferris wheel 24 hours a day 0,234*24=5,6 kW*hour can generate electricity.

1 piece Ferris wheel in 1 month 5,6*30=168 kW*hour can generate electricity.

1 piece Ferris wheel in 1 year 5,6*270=1512 kW*hour can generate electricity.

We decided to install 150 windmills, taking into account that the width of the Toshsoqa canal is 110 m. Considering that the width of the windmill is 0.4 m, the length of the windmills will be 60 m. The distance between each windmill will be 3.75 m. Considering that the slope of the Toshsoqa canal is 12 meters and its length is 32.1 km, in the future we will be able to design about 10 micro hydroelectric power plants.

150 piece a wheelbarrow in 1 hour 0,234*150=35,1 kW*hour produces electricity.

150 piece a wheelbarrow in 24 hour 150*5,6=840 kW*hour can generate electricity.

150 piece a wheelbarrow 1 month 840*30=25200 kW*hour can generate electricity.

150 piece a wheelbarrow 1 year 840*270=226800 kW*hour we will be able to generate electricity. The designed micro hydroelectric power plant will pay for itself in 1.5 years.

CONCLUSION.

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The results of this study showed that there are scientific and practical foundations for the design and implementation of damless (non-dam) micro hydroelectric power plants in the Khorezm region. Despite the flat terrain of the region and the low slope of water flows, it was found that the stable water flows formed in irrigation canals and collector-drainage networks have sufficient potential for the placement of small-capacity hydropower plants.

The design criteria developed during the study allow for a comprehensive assessment of water consumption, flow rate, hydraulic losses, the ability to use existing structures, and environmental safety requirements when placing micro hydroelectric power plants. Also, based on the proposed approaches, it was possible to increase the efficiency of energy production, reduce construction and operating costs, and operate with minimal intervention in existing irrigation systems.

The results obtained show that the introduction of platinum-free micro-hydropower plants in the Khorezm region will help to increase the reliability of electricity supply, partially make remote areas independent from centralized networks, and increase the share of renewable energy sources. At the same time, this technology will have a positive impact on ensuring environmental sustainability, rational use of water resources, and socio-economic development of the region.

In future studies, it is advisable to optimize the exact locations of micro hydropower plants based on GIS technologies, compare the efficiency of different types of hydroturbines, and conduct in-depth analysis of test results in real-world operating conditions.

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