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DEVELOPMENT AND PRODUCTION OF MOBILE HYDROELECTRIC POWER STATION

The review of the operation, design, and operation features of the mini-hydro power plant that can provide electricity to a private household or a separate private house. A project has been developed to supply the private sector with electricity from a mobile hydroelectric power station. To accommodate the hydropower plant, it was decided to install the DN500 pipeline. The selected water flow rate and the difference in the location of the channel and the location of the turbine installation allow you to provide the required power.

The novelty of the work consists of electrifying a private economy using a mobile hydroelectric power station and establishing the advantages and disadvantages of this solution with an assessment of the impact of all design parameters on the output parameters.

The research results can be applied for the manufacture of the mobile hydroelectric power station to their usage in the peasant farms, to save electricity, as well as in the development of experimental-industrial samples of electrical installations for various purposes.

Keywords: hydropower plant, household, private economy, pipeline, electricity.

INTRODUCTION

Nowadays, when the reserves of traditional energy sources, such as oil, gas, and coal, are decreasing and their price is high enough, it leads to the greenhouse effect on the planet and more countries are thinking about alternative (renewable) energy sources.

Renewable energy sources (RES) are sources that are used as renewable energy. This is a great substitute for traditional sources, also mostly they cannot be comparable with in terms of power generated (except for hydroelectric power plants).

The idea of using alternative energy sources has come a long way, But more recently it has been considered to be a substitute for traditional power plants.

The energy of the future is an ambiguous concept. The area has been strongly developed in various directions. Some of them are at the stage of laboratory tests, or already used in practice [1–5].

MATERIALS AND METHODS

In this regard, consideration of issues related to alternative energy sources and their usage is relevant in our time. Today, the inefficient consumption of fuel and energy is

the most common problem. This problem is getting more and more intense every year. There are plenty of ways to solve this problem.

It is necessary to erect additional power plants and treatment facilities, with accompanying design work in getting power supply and wastewater treatment in villages, cottage settlements, and even individual buildings. In most cases, after deterioration or obsolescence, these stations need to be repaired, reconstructed, or mothballed, followed by the construction of a new station. The development and reconstruction of urban infrastructure are impossible without the reconstruction and modernization of life support systems. At the same time, the reconstruction and technical re-equipment of power supply, heating, and hot water supply systems are one of the most difficult engineering tasks.

To achieve this goal, the following tasks are proposed for solving the problem [6-10]:

– consideration of alternative energy sources used in the national economy, which carry out their work based on water energy;

– analysis of climatic and orohydrographic conditions of Ust-Kamenogorsk, East Kazakhstan region of the Republic of Kazakhstan, as a location for a mobile HPP;

– development of a project for a mobile hydroelectric power station.

RESULTS AND DISCUSSING

The mobile hydroelectric power station is designed to provide power supply to a private economy, located 18 km from Ust-Kamenogorsk in the East Kazakhstan region. The private farm is about 300 m from the Irtysh River. It is isolated from other settlements by steppe regions. It has no access to the Irtysh. However, about 10 m from the farm there is a channel that belongs to the floodplain of the Irtysh River. The channel is about 14.0 m wide.

there is a peninsula formed by the right branch of the Irtysh River and the right channel 23 m from the private farm.

Agricultural land (fields) is located on the southeast side of the private farm.

The R-24 Ust-Kamenogorsk – Tavricheskoe East Kazakhstan highway stretching over 900 m to the west

The width of the Irtysh River in this area is 246.2 m, the depth is 5.6 m. The river in this section is navigable.

A private farm can simultaneously accommodate 6 people who are engaged in the processing of fields near the farm.

There are no power lines. Consequently, an autonomous energy source is required.

Such a source is a diesel power plant with a nominal power of 5.0 kW. It is an emergency source. The main source is proposed to take a mobile hydroelectric power station.

Let’s take a look at the electrical loads that exist in a private household, which includes the following buildings and structures:

House

– pumping station for supplying water from a shallow watercourse to the house and for watering the garden plot;

– electric stove;
– electric heaters in the amount of 8 pcs;
– TV sets – 4 pcs;
– personal computers – 3 pcs;
– household equipment (irons, coffee maker, microwave oven, electric kettle, washing machine) – 6 pcs;
– lighting.
Garage:
– electric heaters in the amount of 2 pcs;
– compressor for pumping wheels – 1 pc;
– welding unit – 1 piece;
– lighting.
Greenhouse:
– electric heaters in the amount of 16 pcs;
– electric fan – 1 piece;
– pump for irrigation – 1 piece;
– lighting. Personal plot:
– electric gates – 1 piece;
– electric saw – 1 piece;

Table 2.1 shows the calculation of the power of the above devices and their utilization factor.

The calculation is fulfilled according to the formulas below.

For the power consumers indicated in Table 2.1, we define the active power (kW) by the formula:

For the power consumers indicated in Table 2.1,
we define the active power (kW) by the formula:

$$P_p = \sum P_{\text{н}} \cdot k_c \qquad (1)$$

Table 1 shows the main characteristics of the selected mini hydroelectric power station.

A gate valve is installed in front of the turbine on the supply pipeline, which is necessary to ensure the start and stop of the turbine. Power equipment: ballast load block, automatic control device is placed in a metal block-box measuring 3.0x5.0 m. The block-box is equipped with heating and ventilation.

Table 1 – the main characteristic of the mini hydroelectric power station

Parameter	**Value**
Head, m	4…12
Water consumption, m^3 / s	0,4…0,9
Generated power, kW	50

Voltage, V	230/400
Rotation frequency, rpm	750…1000
Current frequency, Hz	50
Number of phases, pcs	3
Phase connection	U
Turbine impeller diameter, mm	460
Power unit weight, kg	1400…2000
Block weight with ballast load, kg	85/190
Weight of automatic control device,	200
Block dimensions, m (wxdxh)	3,0x5,0x2,5

CONCLUSION

In this article, the principle of operation, design, and features of the operation of mini hydroelectric power plants, which can provide electricity to a private economy or a separate private house, is considered. Also, at present, there are models of hydroelectric power plants that can work in the field, providing electricity to portable devices to organize their charging.

The work has developed a project for the supply of private households with electricity from a mobile hydroelectric power station. he private farm is located in the floodplain of the Irtysh River in the vicinity of the city of Ust-Kamenogorosk, East Kazakhstan region.

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ҚУАТТЫ МОБИЛЬДІ ГИДРОЭЛЕКТРОСТАНЦИЯЛАРДЫ ҚҰРАСТЫРУ ЖӘНЕ ЖАСАУ

Жеке шаруашылық немесе жеке меншік үйді электр энергиясымен қамтамасыз ете алатын шағын ГЭС жұмысының ерекшеліктері, конструкциясы, әрекет ету принципін қарау орындалды. Жеке шаруашылықты ұтқыр ГЭС электр энергиясымен жабдықтау жобасы әзірленді. ГЭС орналастыру үшін DN500 құбырын төсеу туралы шешім қабылданды. Таңдалған су шығыны және турбинаны орнату орны ағынының орналасу белгілерінің айырмашылығы қажетті арынды және ГЭС қажетті қуатын қамтамасыз етуге мүмкіндік береді. Орындалған техникалық-экономикалық талдау жобаның экономикалық тиімділігін көрсетті.

Жұмыстың жаңалығы мобильді ГЭС қолдану арқылы жеке шаруашылықты электрлендіруден және барлық конструктивті параметрлердің шығу параметрлеріне әсерін бағалай отырып, осы шешімнің артықшылықтары мен кемшіліктерін белгілеуден тұрады.

Зерттеу нәтижелері мобильді ГЭС дайындау үшін, оларды фермер, шаруа қожалықтары жағдайында, жеке аулаларда электр энергиясын үнемдеу мақсатында, сондай-ақ әртүрлі мақсаттағы электр қондырғыларының тәжірибелік-өнеркәсіптік үлгілерін әзірлеу кезінде қолданылуы мүмкін.

Негізгі сөздер: жылжымалы, ГЭС , құбыр, энергетика, экономика.

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РАЗРАБОТКА И ИЗГОТОВЛЕНИЕ МОБИЛЬНОЙ ГЭС

Выполнено рассмотрение принципа действия, конструкции, особенностей работы мини ГЭС, которые могут обеспечивать электроэнергией частное хозяйство или отдельный частный дом. Разработан проект снабжения частного хозяйства электроэнергией от мобильной ГЭС. Для размещения ГЭС принято решение выполнить укладку трубопровода DN500. Выбранный расход воды и разность отметок расположения протоки места установки турбины позволяют обеспечить необходимый напор и требуемую мощность ГЭС. Выполненный технико-экономический анализ показал экономическую эффективность проекта.

Новизна работы состоит в электрификации частного хозяйства с использованием мобильной ГЭС и установлении достоинств и недостатков данного решения с оценкой влияния всех конструктивных параметров на выходные параметры.

Результаты исследования могут быть применены для изготовления мобильных ГЭС с их использованием в условиях фермерских, крестьянских хозяйств, на частных подворьях с целью экономии электроэнергии, а также при разработке опытно-промышленных образцов электроустановок различного назначения.

Ключевые слова: мобильная, ГЭС, трубопровод, мощность, хозяйство.

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