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Key Usage Trendspico- and Micro Hydroturbines

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Absract: This work is devoted to the analysis of the capabilities of small units of hydraulic turbines for operation in conditions of the presence of water flows with low flow velocities and low slope angles of the terrain, and also provides information regarding developments on this topic in Europe. The designs and possibilities of new developments for pico - and micro-hydraulic turbines are considered.

Keywords: Submersible hydraulic turbine, hydraulic potential, flow speed, kinetic energy, water pressure, hydraulic turbine efficiency.

Today, the problem of providing electricity to consumers (industrial sector, population) is becoming the most important economic component of the problem of regional development. One of the ways to solve it is to use the capabilities of renewable energy sources. The bulk of water sources are considered suitable for peak hydroelectric and micro hydroelectric power plants. It is believed that the energy sources for hydropower are fast-flowing water streams. In this area, there are many works devoted to highlighting the possibilities of hydropower in mountainous areas in Central Asia (meaning the Republic of Kyrgyzstan and Tajikistan). These countries have greater hydraulic potential compared to other countries in the region. The number of works covering the state of this profile relative to the European continent and in German is very rare . These works have received little attention from our researchers.

The source of energy obtained using peak o- andmicro hydro turbines are considered to be the kinetic energy of the water flow and the pressure on the blades rotating under the influence of the water flow. This type of water sources makes up the bulk (up to 80-90% of the total) among water sources.

The purpose of this work is to study information about new developments and projects in the field of using peak and micro hydro turbines in European countries.

The possibilities of using hydropower (meaning peak and micro hydropower devices) have been studied in [1-3] . Particular attention was paid in the work [3], where it was proposed to install hydropower devices in the places indicated similarly in the works [4-7]. The only difference is that the water source in [3] has a higher slope relative to the source given in [4-7], and the throughput is almost equal (respectively 7 –8m^3/s and 4 – 6m^3/s).

The main emphasis is on studying the practical use in practice of the capabilities of peak and micro hydro turbines to provide electricity to consumers. On the other hand, this area of hydropower is now becoming relevant.

It is possible to obtain electricity using flows with low water flow rates (1-1.5 m/s), i.e. water sources with indicators of 4-7 m^3 / s and a terrain slope of 5-10 degrees. Such work is being carried out in Europe with submersible hydraulic turbines. Thus, in Sweden, the Sunnutek

company created a submersible hydraulic turbine with various modifications (Fig. 1). It is protected from snags, branches and other large elements found in currents and water.

The power varies from 1 kW to 12 kW and the weight of the equipment corresponds to the indicated power (Table 1).

Fig.1. Submersible hydraulic turbine.

Table No. 1. Parameters of submersible hydraulic turbines

Power, kWt)	Number of networks	Maximum power (mains)	Output per day (kW)	Weight, kg)
One floating buoy				
1	1	1	14.4	62
2	1	2	14.4/28.8	64/116
3	1	3	14.4	68
3	2	3	28.8/43.2	120/173
Two floating buoys				
5	2	5	28.8	123
5	4	5	57.6	226
5	6	5	86.4	333
8	4	8	57.6	233
8	7/10	8	100.8/144	391/548
12	5	12	72	297
Support platform				
12	8	12	115.2	454
12	12	12	172.8	664
12	15	12	216	822

This configuration makes it possible to provide remotely located consumers with electricity [4]. With their help, it is possible to create a network of hydraulic turbines of this type to provide electricity to an individual consumer (industrial facility or populated area), which will be provided with uninterrupted electricity. The main trend is the networking of hydropower devices.

The disadvantages of this design of hydraulic turbines include the following:

- Too massive design
- Expensive maintenance costs.

Fig.2. General view of a pico turbine on a pontoon base.

This design allows you to work with water sources with low water flow speed. Its disadvantages are low efficiency, lack of protection from various floating interference, limited power of the hydraulic turbine, and dependence on the presence of whirlpools [5].

Fig.3. General view of a submersible hydraulic turbine with general guide nozzle [8]

It allows you to work with water currents with low speeds of water flow, collected through a nozzle and directed to a hydraulic turbine. The structure is supported by the current using tension cables.

Some improvements are applied here: the catchment area directed to the submersible hydraulic turbine has been increased and the hydraulic turbine can operate even in winter.

Disadvantages: lack of protection from interference and fish, requires a stable level of water flow, without whirlpools, or installation on a specially created platform.

Research in this direction was carried out in the UK in 2021. Prototypes of hydraulic turbines were placed in the river Thames. They had a power of 25 kW. The Thames has strong tidal and slightly weak ebb currents with a length of 2-3 hours, which passed with maximum pressure in the middle of the river bed. At this moment, the efficiency was about 95%, and during the rest of the day it was 40-45% relative to the rated power value . The consumer used coastal cafes, i.e. power supply was directed to their work. The hydraulic turbines could rotate on an axis and the total weight of the entire structure of the submersible micro hydroelectric power station ranged from 4-5 tons. Maintenance was only possible using a pontoon installation.

Submersible hydraulic turbines with an additional surface for collecting and directing water flow and without these elements operate under the following general conditions:

- The presence of a directed water flow with a constant flow rate,
- Absence of floating obstacles for the hydraulic turbine (tree branches, snags, debris).

In conclusion, we note that the development of the hydropower sector in the field of pico- and micro-hydropower to improve the provision and create a new power supply network remote from

the central power supply line will provide an opportunity to obtain economic profit and create good conditions for the population.

Conclusions:

- Create a uniform network of peak and micro hydro turbines to cover the costs of creating this network,
- To interest representatives of small and medium-sized businesses in the use of hydraulic turbines of this type to provide electricity.

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