

## TECHNICAL DEVICES FOR USE A HYDROKINETIC ENERGY OF RIVER AND SEA FLOWS

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### **Анотація.**

*У роботі представлено огляд основних світових розробок гідротурбін та інших конструкційних засобів для використання гідрокінетичної енергії річкових та морських потоків, пропонується використання розробленої авторами турбіни Дар'є у річковому потоці. Представлено результати експериментальних досліджень такої турбіни з прямими керованими лопатями у водному та повітряному потоках.*

**Ключові слова:** відновлювана енергетика, гідроенергетика, конструкції гідротурбін, турбіни Дар'є.

### **Abstract.**

*The work presents an overview of the main global developments of hydroturbines and others structural means for the use of river and sea hydrokinetic energy flows, it is proposed to use the Darier turbine developed by the authors in the river streams The results of experimental studies of such a turbine are presented direct controlled blades in water and air flows.*

**Keywords:** renewable energy, hydropower, hydro turbine designs, Darier turbines.

### **Introduction**

The change in the climate of our planet has become an obvious fact, certified by the Paris Agreement 2015. Global warming in 2021 from the level of 2000 was already 1.2°C, while the afore mentioned agreement calls for limiting the rise in the Earth's average annual temperature until the end this century by no more than 2oC. And, for example, on the territory of Ukraine, this warming is already more than 3.5°C, in the Arctic basin - all 6°C. The main reason for these changes on Earth is excessive emission of greenhouse gases, the main emitters of which are energy and industry and transport, mainly due to the burning of fossil fuels.

Therefore, the need to transition the world's energy to clean sources has become urgent energy. Most of these requirements are met by such renewable sources as wind and sun.

Today, clean energy includes large-scale hydropower, which uses potential energy of water. And although this type of energy has many advantages, the construction of high-rise buildings dam, especially on lowland rivers, leads to withdrawal from agricultural or industrial use of significant territories, creates other infrastructural, social, ecological problems.

At the same time, large masses of water moving at the speed of the current contain a huge store of kinetic energy. Installations for utilization of this energy can significantly help in obtaining ecologically clean energy, which is already being done in some countries.

### **Research results**

Traditional designs of hydrokinetic turbines use the usual wind power scheme – a three-bladed horizontal axis rotor perpendicularly flow For example, the company SIMEC Atlantis Energy at the MeyGen tidal power station in Scotland has been operating 1.5 MW AR1500 turbines for several years. Turbine installed on the seabed, weighs about 200 tons, support height 15m, length blades 9 m, working cross-sectional area 254 sq. m. The indicated power of the turbine reaches at current speed of about 3 m/sec. Similar schemes of hydroturbines are used by Nova companies Innovation (two-bladed rotor), Verdant Power (whose turbines are already operating at the bottom of the East River in New York) and HydroWing. Multi-bladed rotors in their turbine designs are used by MAKO Turbines, Sabella and Scotrenewables Tidal Power. Two-bladed the P66 turbine with a rotor in an annular nozzle with a capacity of 3.5 KW was presented by the Guinard company Energies. A number of companies for placing hydro turbines create floating hulls that can deliver, anchor and use where necessary.

In recent years, several designs of hydroturbines using a rotor have appeared Darius. Companies Energy and HydroQuest offer similar hydraulic installations in the form of a rectangle box with two chambers, in which Darier rotors with straight blades are placed. Hydro turbine "RivGen" has two Darier rotors with bent blades and with a horizontal axis across the flow.

Two companies have already announced the use of Darier rotors in their hydraulic installations blade control mechanism. The hydraulic installation of the GKinetic company has good flow a floating hull with two Darier rotors on the sides, and control of the rotor blades performed using the patented Blade Pitch Control System. Company Water2Energy has developed a Darier rotor hydro turbine that is planned to be installed in the lock in the Port of Flushing in early 2022. It is also claimed to be used in construction hydraulic rotor of the blade control mechanism.

The authors' research, started back in 2010, showed that with optimal laws control of the position (angle of attack) of the Darier rotor blade along its circular trajectory it is possible to increase the efficiency of such a hydro turbine by more than 1.5 times. The authors developed five units with a Darier rotor of different designs and sizes and tested them in water and air flows.

Maximum power on the rotor shaft at all air flow speeds ( $V=3\div 11$  m/s) obtained at low rotation speeds. Suggested management blades made it possible to obtain a torque on the shaft that was three times greater than the moment created by the same rotor with rigidly fixed blades. The rotor itself started already at a wind speed of 1.8-2.2 m/s. A reduced model of the same rotor worked successfully in the hydrotray even at a water flow speed of 0.3 m/s. Best coefficient of flow energy utilization, which was obtained during tests on different regimes, amounted to  $C_p=0.45$ .

### Conclusions

Climate change has become a fact, but achieving the goals of the Paris Agreement is becoming more difficult. Warming exceeds permissible limits, the main cause of which is the emission of greenhouse gases. The transition to clean energy is urgent. Darier rotor hydroturbines are efficient sources of electricity. They can help reduce dependence on fossil fuels and reduce greenhouse gas emissions.

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