Studies about Economy of Energy Obtained Using Sea Waves Forces

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Abstract: The renewable energy sources (wind, solar energy, hydroelectric energy, the oceans, geothermal energy, biomass and biofuels) offer alternative to fossil fuels which contribute to the reduction of greenhouse gas emissions. The European Commission proposed, in 2020, a lens that 20% of the energy consumption of the EU to originate from renewable sources of energy (Directiva 2009/28/CE). The power of sea waves could constitute a major source of renewable energy. The energy of the surf is operated when the electricity producers are placed on the surface of the oceans or seas. The energy provided is most often used in the Desalter installations. The theoretical potential global is 8x105 TWh/year, which is 100 times the amount of energy that could be produced annually by conventional hidroenergeticefacilities.

Keywords: renewable energy; wind force; solar power

1. Introduction

The energy source like sun, wind energy, geothermal energy etc. practically shall not be consumed and are called renewable energies, being known, and those alternative sources or of unconventional photos. The renewable energies is based mainly on the great nuclear fusion reactor that is the sun energy, another renewable energy is based on the kinetic energy of the wind, another is geothermal energy that is based on hot core of the earth etc. All renewable energies produce far fewer emissions, reduce pollution chemical, thermal, radioactive and are available, virtually anywhere in the world.

In the White Paper on Renewable Energy Sources, the EU set itself targets of using renewable energy sources (RES) to meet 12% of energy consumption and 22.1% of electricity consumption needs by 2010. Subsequent evaluations noted the lack of progress in meeting the 2010 targets and the consequent adoption of a more comprehensive legislative framework. (COM(1997) 0599)

The existing Renewable Energy Directive (Directiva 2009/28/CE), established that a mandatory 20% share of EU energy consumption must come from RES by 2020.

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The Directive defines national renewable energy targets for each country, from at least 10% (Malta) to a maximum of 49% (Sweden), in relation to the overall potential for renewable energy sources. In this context, the energy policy of the EU Member States is translated into national renewable energy action plans. The results achieved in meeting national targets are evaluated every two years when EU Member States publish the national renewable energy renewable energy interim reports (Gouardères; McWatt & Fleuret, 2018).

On 20 January 2014, in the Communication entitled "Blue Energy. Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond" (COM(2014)0008), The Commission has set up an action plan to support the development of the exploitation of ocean energy, including wave energy, tidal energy, heat conversion and salinity gradient energy (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2014:0008:FIN:EN:PDF)

At the end of 2016, the Commission presented the package of legislative proposals entitled "Clean Energy for All Europeans" (COM (2016) 0860) to ensure that the EU achieves the target of at least 27% of total energy by 2030 consumed at the EU level to come from renewable sources and the EU to become a world leader in RES.

2. About Marine Wave Energy

Marine waves are the result of the combination of the action of the winds, gravitation and surface tension on the surface of the sea.

The existence of different marine currents and heating of large masses of water from the ocean planetary drive and of the land surface leads to the appearance of the winds.

The winds blew over vast expanses of water shall forward a part of their energy, generating waves formed at the surface of the seas and oceans and on their way to the shore. The energy production is determined by the height of the tides, wave speed, wave length, and density of the water. Up to now, there are only a few of the experimental center in operation in the whole world.

The oceans and seas occupy 71 % of the surface of the Earth, and, in addition, possess a resource inexhaustible: the waves. The energy of the seas and oceans is in the form of mechanical and thermal energy. Planetary Ocean waters have a huge energy potential which can be exploited for the production of electricity. The difficulty of design of a device to capture the energy of the tides, have broken efforts to use this source for the production of electrical energy.

The conversion technologies and capture the energy of the surf was designed to be installed near the shore, beyond the shore or on the high seas.

Thus, it has been calculated that an ocean current with a width of about 100 m, 10 m deep and a speed of 1 m/s, for a period of one year could provide a kinetic energy of

about 2 million kWh.

The waves are a form of storage of energy transmitted by the wind, energy calculable probabilities and worthy to be taken into consideration. The calculations have revealed that the waves with a height of 1 m, a length of 40 m and the period of 5 seconds, have a power available approximately 5 kW on a battlefield of 1 m width of the veil.

Researches were focusing on oceanothermical conversion efficiency for obtaining electricity by take in account the difference in temperature between the water surface and on the high depth of water. They use pumps (for example the use to a closed cycle of the turbine volatile liquids such as propane freonul or ammonia) for extracting the energy from temperature difference of surface water to deep water. The temperature differences of the structures of sea water create thermal energy - stored in the form of heat. Heat the contents of the different between surface and bottom waters of depth shows a difference of about 30^0C.

In the case of the coasts of the steep and with large depths, as well as we take in account the hydrotechnicque building (vertically wall). For marine waves there are a combination between tide and the waves with large amplitude, whose noise is considerable and whose crest rose to heights (even up to 60 m). In some sectors, the ribs are subject to huge disruption caused by these waves of broken

It was noted that the waves spreads on the distinct groups, who succeed at intervals of approximately equal and between which the great seems less agitated. The waves in each group have different heights, their speeds of propagation being unequal conditions. For this reason occurs the phenomenon of interference, which causes a progressive increase in height. In the light of experience and observations of many centuries of seafarers has reached the conclusion that the ninth and tenth wave within a group is higher and more dangerous than the other (http://www.energiialternative.net/hidro2.htm).

Research in the field of energy waves is known worldwide oamploare in the past few years. But the achievement of power plants based on the energy of the surf still requires efforts, in the present while pursuing an activity in many countries of the world.

With the increase in depth, the energy is transmitted to the hydraulic path. As this energy is manifested in the interval time equal to the period T of the veil, power P is equal to the ratio between the energy Ep or EC and the time t, as in the catchment processes shall be taken over only one of the two forms of energy of the veil, the expression of raw power available is presented in formula (1):

$$P = K \times h^2 \times L \times \lambda / T \qquad (1)$$

Where: the power of the waves P, is expressed kW/m; h representing the height of the wave, expressed in meters and T representing the wave period, expressed in

seconds h is wave high; λ is lengh between two waves; L is wave lengh in m and k is an overload coefficient.

The most interest now is to achieve microcentrals to be located on a jetty currently on the shore of the Black Sea.

The frequency of strong winds on the Black Sea is 38%, and those with the speed of less than 1 m/s are 0.5%, the winds from largfiindpreponderente in comparison with those from dry. Normally intended intervals with maximum agitation of the sea are located in the month of January, and save as minimum agitation in the months of May, June and July can obtain approximately 40 000- 50 000 kWh/year or 8 - 10 TWh/year. Only 30 %, the value of the potential of energy-efficient as possible should be approximately 2.4- 3 TWh/year (Bejan; Bălan & Bejan, 2015).

3. Research to Production of Electricity with Proposed Installation

Electric power generated can be stored or can be distributed directly into the existing network diagram. The estimated weight (aprox. 363 kg) can generate about 2Cp for a wave height of 4.2 m and about 8 Cp for a wave of 1.3 m height. A device above could generate a much greater power while the storm or adverse weather. An estimate of the average power debited per day is between 25 and 100 Kwh. Platform will be built from composite material ultra resistant to the marine environment and we propose to installed up of thie platform a wind or solar technology to increase efficiency of electric current produce.

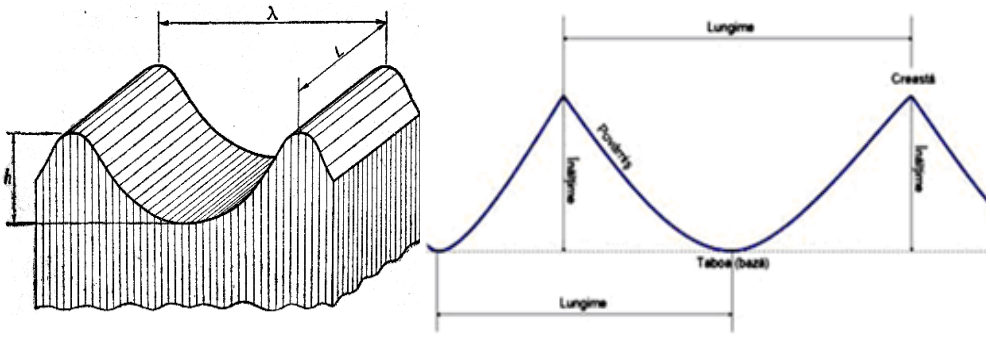

Figure 1.Wave shape: h. high; λ. lengh between two waves; L. wave lengh

A global view thrown on the monthly average values of maximum heights recorded by the waves to two posts comments from us (Table 1) indicate are generally 1 m, though accidentally in the Romanian right coasts waves have occurred up to 9,80 m height.

Table 1. The average of the maximum height of the wave, in m, for the year 2017

Place	Month (2017year)

	I	II	III	IV	V	VI
Constanta	0.91	0.44	0.59	0.45	0.21	0.32
Mangalia	0.6	0.27	0.38	0.2	0.08	0.11

Place	Month (2017 year)					
	VII	VIII	IX	X	XI	XII
Constanta	0.26	0.52	0.53	0.61	0.34	0.42
Mangalia	0.09	0.15	0.23	0.32	0.16	0.16

Those listed will lead to the first finding that the devices for containment must be so designed as to be able to process a greater range of waves and, in particular, in the category of small waves, which are more frequently. Out of the experiences of laboratory testing results for these waves are small, efficient sensors plutitori, with direct action on large linear consumers.

The total energy of the surf mobile at the surface of the water is composed half of the kinetic energy and half of the potential energy.

Of the total energy of the tides, the kinetic energy is highlighted by the orbital movement of particles of water around their point of rest.

The potential energy is highlighted by the variation in the level of the surface of the water-free produced by the propagation of the profile or the shape of the veil, while the kinetic energy is relatively stationary, due to the movement of the water particles around a fixed point, the energy potential spreads horizontally due to the horizontal motion profile veil, giving rise to a horizontal energy flow in the direction of waves propagation.

The kinetic energy of the veil is that part of the energy veil due to the speed of the particles of water associated with the spread of the veil.

The potential energy of the veil appears due to the fact that part of the earth fluids, driven in the yaw angle through the propagation of the veil, can be found in the form of full wave above the average level of water.

The total energy of a wave is the sum of the kinetic energy and his potential energy.

A different size linked to the energy potential of the waves, which is particularly interested in the mechanical power of surf. In hidrodynamic is known the fact that power, which means the work carried out in the time, may be calculated by reference to the scale of the force and the setpoint speed for the application of force

Therefore, for the simplified engineering calculations, it can use the relationship (2):

$$P = h^2 \times T \qquad (2)$$

Where: the power of the waves P, is expressed kW/m; h representing the height of the wave, expressed in meters and T is the wave period, expressed in seconds.

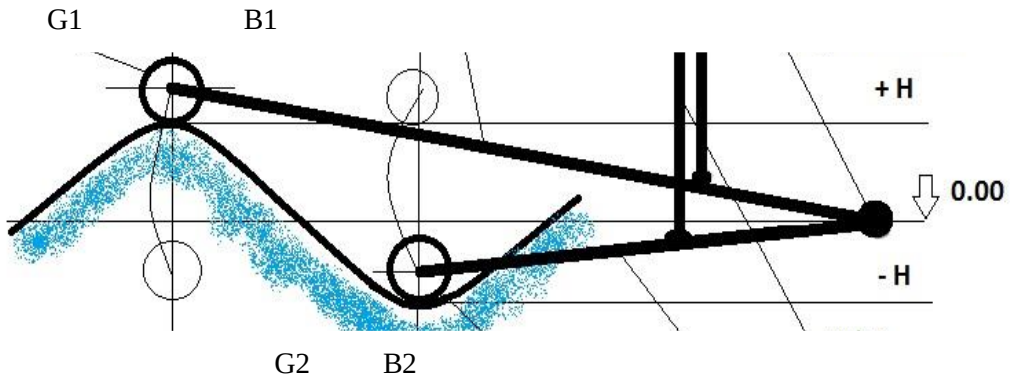

Figure 2. The kinematic chain of the proposed system: G1, G2. Floater; B1, B2. Steel arm

By lowering the bare rhythmic float partially or totally, the system sends pulses to a dynamic balanced wheel that is linkage which stores the mechanical work energy which returning it in the pauses each cycle. Her tasks are to uniformise the rotationmovement. As we see in figure 2, each lever operates simultaneously two pistons. The movement is transmitted from the lever on the pads of the support rod, through the kinematic couplers of translation and rotation. In order to avoid the request to the torsion damper crank float and the further request of fracture the piston rods, it was designed transmitting the forces on each piston from the crank float by two pads.

As regards the stability of the column support, the calculations have been made in the assumptions of unfavorable construction at the request of the dynamics of the veil. It was considered that when batardoul is fitted all the action of the external forces shall be forwarded to the structure.

Two situations may be worthy to be taken into account:

- The veil approached the column with a minimum making it possible to suck up the construction with possible sliping in the sea direction.

- The wave approached the column with a maximum making it possible for pushing the construction with lunecarea prevented digul old and with the tip under special conditions to the port possible, but limited in the right edge of the dimension - 3.15 m (up where provision is made for filling with stone behind the steering column).

This dublet allows a convenient placement enter a space relatively closely to the fitting of such machines with hydraulic efficiency of the catchment increased. The flywheel has the role to balance the con rod crank. The flywheel converts the movement of the two irregular crank rods, received from the two floaters in a uniform rotation movement.

Flywheel shaft is engaged with the energy generator that produces the electrical

current.

In the framework of the structural solutions for a marine mycrocentrale, has been analyzed and column support with an ellipsoid desk section.

The location of mycroelectric power centrale is on a dig built on the seafront that would constitute, in addition to a specific application, and accumulation of a valuable experience with a view to the completion of installations in the future, as an integral part of the Jetties protection from the concrete chesoane which will build for the protection of the Black Sea coast.

Mycroelectric power centrale is based on the formation of swinging columns in an enclosure and vehiculare a air from the turbine enclosure through a passage. In Phase 1, the raising of the column swinging drawbar, a part of the wave energy introduced into the enclosure shall be converted into kinetic energy, which drives the turbine, another part is transformed into pressure energy, due to the pressure which shall be exercised on the pivot column, and another part is transformed into energy potential, through the column reaches the height at which the drawbar. In Phase 2, the lower pivot column, the energy potential gained in the first phase shall be converted into kinetic energy, which acts still turbine installation. So microcentrala operate without taking account of the alternate surf (due to the turbine is equipped with a check valve).

A receptor sitting in the path of the waves was said to have certain catchment efficiency in the sense that it takes a certain percentage of the energy of water in motion. Therefore, a part of the hydraulic energy will pass on the receptor, and the rest will dissipate or will stay on in water, in various forms.

The power which has passed from the water on the receptor Pcapt, represents in fact the drive power Pmotor, which will generate useful power P_{util}, will cover the losses of the machine components and accessories (losses in the bearings, bearing, etc.), so will compensate for the power lost Pp , will win the power resulting from the forces of gravity P_G when will be the case, or will supplement with her when these forces will foster the movement, but will also cover the power Pi increase the kinetic energy of the elements of the moving parts, or will supplement with this when moving masses gives energy. Therefore it may write the relationship (3):

$$Pcapt = Pmot = Putil + Pp + Pg + Pi \quad (3)$$

On the basis of the formulae presented above, it was designed an algorithm to compute and a special program with which they have determined the power unit and the energy average, over a period of five years, the waves on the Romanian seaside of the Black Sea, at 10 m depth, in this way have been calculated numerical data which, expressed in kWh/(m.year) energy unit of the surf (l m length of the crest of the wave), and potential cumulative total, both on the steps of the height of the separate waves and wave average periods.

4. Determination of the Energy Produced in a Year of the Proposed Installation

The power plant at an amplitude of the waves of 1m is P_{max}=2.16Mw If we accept an annual average of wave height of 0.1 m, the power will be: Mycro central power $P_m=P_{max}/10$=0.216 MW, because the power is basically proportional to the wave height, the annual energy produced by the plant will be: $E_{year}=P_{max}$ .t_{year}=216.103Kw . 8760hours/year=1840.106 Kwore/year.

The total potential energy per unit (and kinetics) on the same is about 31943 m isobath kWh/(m.year) with the oscillation between 23800 kWh/(m-year) in Constanta and 40980 kWh/(m-year) in Mangalia. With all the powers of the unitary maximum waves on the coastline of the Black Sea coast to the three-point analysis, are approximately equal, however, there are differences between the energy sensitive potential of gross of waves in the three points explained by particularitatilefizica-geographical specific to each stations in hand, in comparison with the area of Constanta, Mangalia raw energy potential of the waves is higher, just like in the case of potential of the wind.

5. Conclusions

The study was that the objectives:

- develop a plan for the protection of the southern part of the Romanian seaside;

- the carrying out of preliminary actions to promote the preliminary projects transfer of knowledge and technologies in the field of the protection and management of coastal area by the Romanian side.

As mentioned in the study, the causes of the phenomenon of coastal erosion are multiple and varied:

- The Extension to the widely jetties at the mouth of a river Sulina arm, has led to divert the flow of alluvial deposits from the Chilia arm and the removal of the aluviunilordebusare point in the right Sulina channel;

- The works of expansion and modernization of the ports of Midia, Constanta, Mangalia, which have generated deflection to wide waveform litorali currents which ensures the supply of sand ranges from southern coastal areas.

The advantages of the use of energy waves are:

1. It is a form of renewable energy, inexhaustible and environmentally friendly;

2. The tide of stores a vast energy potential;

3. Is free, it can be used by anyone, anywhere on the surface of the ocean planetary drive;

4. Do not require significant expenditure of transport and distribution before being used;

5. It is stored in the 1400 million billion tons of water that covers two-thirds of the earth's surface;

6. The achievement of the marine power plants do not involve disposal of agricultural land, industrial or settlements, using virtually neintrebuintate such areas.

The disadvantages of energy waves:

Has a random character, manifested through the continuous variation of the characteristic elements of the surf;

It is dependent on the season and the site approval;

Has, for the time being, a high price in comparison with conventional sources of energy;

Has a visually and physically impact on the marine habitat.

The potential of the world, expressed as power available, is decirca 2 TW, with 320 GW in Europe. In this theoretical potential it could be recovered in the form of electrical energy about 10-12%. But even under these circumstances, the energy of the surf marine everything would be sufficient to cover the planetary needs of electricity.The use of plants for the producer of electrical current to reduce the emission of CO_2 with 60,000 tonnes per year, as compared with conventional fossil fuels.

5. References

Bejan, M.; Bălan, I. & Bejan, B. (2015). Valorificarea energiei valurilor. *Buletin Ştiinţific AGIR*, nr. 3/2015. Bucureşti.

Gouardères, F.; McWatt, V. & Fleuret L. (2018). http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_2.4.9.htm. 01/2018.

Grupul Energii Alternative (2010). http://www.energiialternative.net/hidro2.htm.

*** European Commission, White Paper for a Community Strategy and Action Plan, Energy for the Future: Renewable Sources of Energy. (COM(1997)0599).

*** European Commission. Brussels (2014). Blue Energy. Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond. 20.1.2014.

*** COM(2014) 8 final. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2014:0008:FIN:EN:PDF.