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POSSIBILITIES TO CAPITALIZE THE WATER ENERGY ON THE TĂRCĂIȚA VALLEY COURSE

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Abstract

A maximum interest must be given to capitalize the hydroenergetic potential of the Romanian streams in such a way that production be oriented to cheap and non-polluting sources. The hydro energy production can answer many of the modern society requests among which we can mention cheap costs, a high safety in the functioning of the energetic systems and the impact over the surrounding environment (Popa, B., Paraschivescu, A. V.,2007). Due tot the importance of water for industry, agriculture and forestry it is necesary that, when using these hydroenergetic resources, all these needs be taken into consideration in order to ensure a complex and integral capitalization of the water courses in the mountain area.

Key words: *power, energy, hydropower potential, turbine*

INTRODUCTION

The industrial, agricultural and forestry development needs more and more energy thus reanalyzing the possibilities of exploiting new energy sources is a must (after Tănăsescu F.T., 1986). Any water course represents a hydroenergetic potential and as a consequence a great attention must be paid in order to capitalize it (De Azagara A.M., Hevia J.N.,1996). In this way, a few energetic features were analyzed, like: the available power, the maximum possible power and the maximum potential power which represents the technical fundament for using a low power micro-hydrocentral (up to 30kW0) on the Tărcăița Valley.

In this case study we shall analyze aspects related to the technical feasibility for arranging a microhydrocentral on Tărcăița Valley situated in the Codru-Moma mountains and using it in a trout nursery in order to ensure energetic independence. On the basis of the absolute 3D coordinates of the sections from the water course and of the flows resulted in these sections, the following had been done: a representation of the hydroenergetic cadastre from the valley, the situation of the available power and the powers generated by the turbines (types of turbines Francis, Banki, Kaplan), the maximum potential power and the maximum possible power which can value the small flows and falls in such a way that one may deduce from a graphic representaion the type of the mhc aggrehgate which can, in its turn be considered enough to ensure energetic independence for a trout nursery or for some other objective.

MATERIAL AND METHODS

The Tărcăița Valley is formed at the confluence of Şesuța and Râpoasa Valleys from the Codru-Moma mountains; downstream it has as a left side tributary the Chicera valley. It has a length of 19 km, spread in a basin with a surface of 51 km^2 (after *** 1) and it is approximately parallel with the Finiş Valley; the average slope of the longitude profile is of 26 ‰; it merges in the Black River, as well, as a left tributary, too. The hydroenergetic potential of the river appears from the relatively small variations of the water flow and it represents an advantage that can be easily capitalized through introducing a microhydrocentral which can transform the potential energy of the water in electric power (Flavin,C., Lenssen,N.,1996).

For the beginning we take into consideration the following water flow divided, with the help of three sections, in two sectors, their limits being numbered as follows: upstream 2, upstream section, mhc (micro hydrocentral) location, downstream section, upstream 1 being an intermediary section which divides the river in two sectors. The annual minimum water flows, the Q, quotas towards the black Sea level – Z and the lengths towards the mhc location sector (downstream) L are known in each characteristic section: in the mhc location, in upstream 1, in upstream 2. The water flows are considered as introductory data as well as the absolute 3D coordinates of the section points in which they had been determined (table1).

Table 1.

The 3D coordinates of the sections considered on the water flow where the mhc is intended to be built

The coordinates of the section points	X(m)	Y(m)	Z(m)
Location	571749,825	296719,788	267,300
Upstream 1	571545,684	296350,772	244,500
Upstream 2	571494,055	295972,193	234,383

The calculus relation of the hydaulic power (theoretical and rough)) P_h for a hydroenergetic outfit is:

$P_h = 9{,}81\ Q\ H_b$ [kW].

The hydraulic power P_h is transfrormed by the turbine in mechanical power P_m, called power to the turbine tree and it is calculated with:

$P_m = P_h \cdot \eta_h \cdot \eta_t = 9{,}81 \cdot Q \cdot H_b \cdot \eta_h \cdot \eta_t$ [kW]

where η_h şi η_t stands for the hydraulic efficiency and of the turbine respectively (Seteanu I. et al., 2000).

A lot of losses take place during the process of the hydraulic transformation: losses in the collecting and supllying water system, both in the turbine as well as in the generating set (Smuda E., Mugea N.,2001), so that the output must be taken into consideration for the situations in which the losses are maximum.

The characterictic powers of a hydroelectric power station that are important in its fitting out and which outline the exploitation conditions of the fitting out are defined as follows:

- *the installed power* – represents the sum of the nominal powers of the hydroaggregates installed (the nominal power of each group can be read on the generating set plate) ;
- *the available power* – represents the maximum power that the fitting out can develop at a certain time, on condition that there is enough water flow and water falls different from the calculus ; the availabe power can only be less or at least equal to the installed power, the difference representing the so called *unavailable power* given by the unavailability coefficient of the aggregate (due too the usage, flow or fall deficit) ;
- *the guaranteed power* –is the power with a certain guarantee, usually between 75% and 95% according to the type of the fitting out, guarntee that can be read on the standing curve of the powers (analogous to the flow standing curve) (Câmpian,V.C.,2003);

RESULTS AND DISCUSSION

The 1st, the 2nd, and the 3rd drawings have been done for the comparative analysis in which we tried to see the fesability or the unfesability for installing a mhc reported to the energy consumption from two functional trout nursery ponds and to the natural conditions existant.

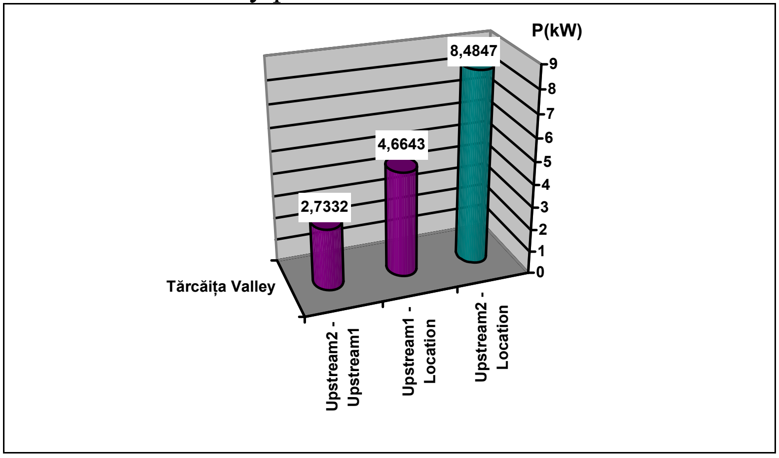

Fig. 1 The comparative graphic representatrion of the available power on each sector,P[kW], for the two sector cases

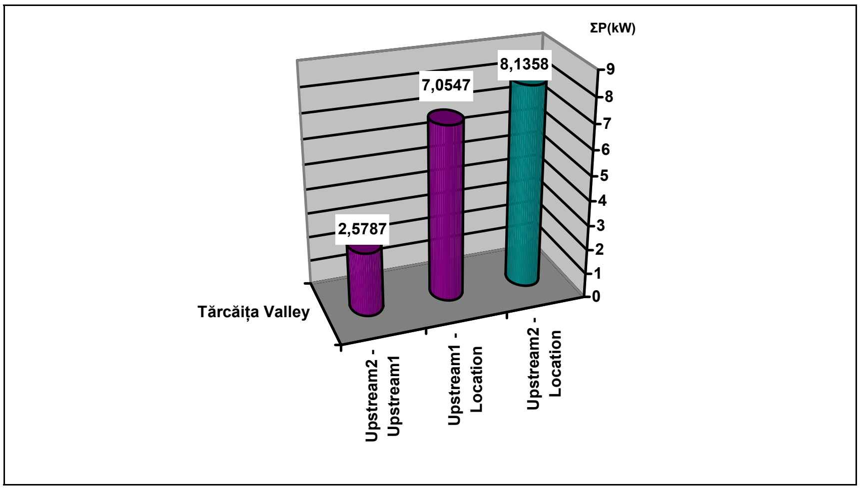

Fig. 2 The comparative graphic representation of the available power summed on the whole water flow, ΣP[kW], for the two sector cases

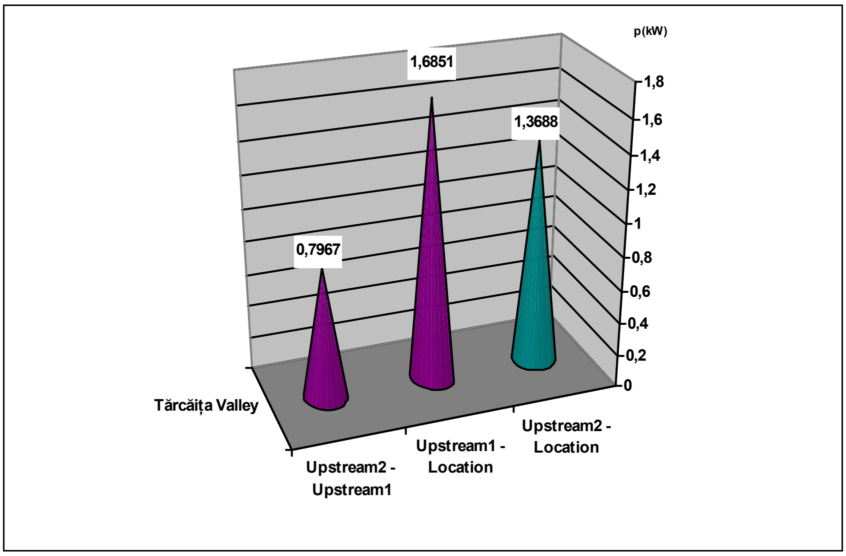

Fig. 3 The comparative graphic representation of the specific lineary power, p[kW],for the two sector cases

In figure 1 it can be noticed that all the variants are reliable from the point of view of the available power (P [kW]), and from drawing 2 it can be noticed that all the variants are reliable from the point of view of the summed available power (ΣP [kW]). In drawing 3 we find the specific lineary powers, p [kW], to which the cost for fitting out an mhc is conversely proportional. From this point of view it can be noticed that the fitting outs can be considered reliable as available power on all the studied sectors.

Figure 4 presents the maximum potential power, marked with green and calculated with the value of the flow processing coefficient (ε) de 0,25 and with the maximum possible power marked with violet, in the ideal case where ε = 1 (with the total processing of the flow and with no losses). From this nomogram it can be noticed that for the results obtained from the study of the Finis Valley it is worth installing functional turbines based on the Banki or Kaplan principle, that correspond to the water flows and falls existing in that area.

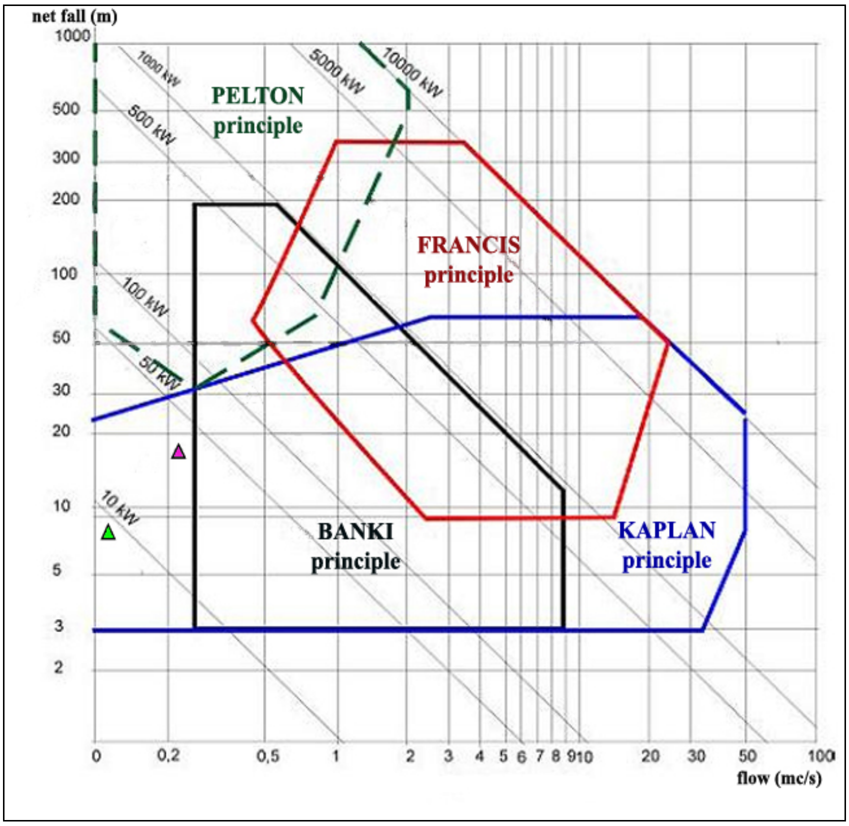

Fig. 4 The nomogram of the maximum potential power and of the maximum possible power generated by different types of turbines, in coordinates (H [m]; Q [m^3/s]) (Popa B., Paraschivescu A. V.,2007)

CONCLUSIONS

The low power hydro energy, a component of the regenerating energies, has a first place in the preoccupations related to the energy production on the basis of the technical, economical and ecological arguments (after Voia I.,1996)

The need to arrange a microhydrocentral comes from the from the bigger and bigger necessity for energy (Pîrvulescu C.,1978); this necessity comes from the economy as well as from the people in general and they all need the cheapest and the less polluting energy and of course this energy must be available in hard accessible areas.

The functioning of a microhydrocentral on mountain river flows, near trout nursery ponds, can contribute in a substantial way to an increasing trout production besides insurring the electric power needed for other activities related to trout breeding. In case in which the water flow used to put the installation in function is afterwards orientated towards the basin admission and supply canals then it can highly ensure an oxygenated water so necessary for the trouts especially during the summer period, when an increased water temperature leads to a decrease of the diluted oxygen quantity.

Establishing the location of the microhydrocentral is done after studying the hydroenergetic micropotential from the hydrographic basins not-included in the big hydroenergetic arrangements and in accordance with the priorities resulted from the study: economy making, easy to build and availability of materials and equipment.

REFERENCES

1.Câmpian,V.C.,2003- Turbine hidraulice de mică putere şi microturbine-Principii de funcţionare.Soluţii constructive, Editura Orizonturi Universitare, Timişoara, 88p.

2.De Azagara A.M., Hevia J.N.,1996- Hidrología Forestal-El ciclo hidrológico, Secretariado De 14.Publicaciones E Intercambio Editorial Universidad De Valladolid, 286 p.

3.Flavin,C.,Lenssen,N.,1996- Valul energetic-*Ghid pentru iminenta revoluţie energetică*, Editura Tehnică, Bucureşti, 188 p.

4.Pîrvulescu C.,1978- Economisirea şi valorificarea intensivă a apelor, Editura Ceres, Bucureşti, 196 p.

5.Popa, B., Paraschivescu, A. V.,2007 Introducere în utilizarea energiei apelor, Editura Politehnica Press, Bucureşti, ISBN 978-973-7838-36-0, 226p.

6.Seteanu I., Rădulescu V., Broboană D. 2000- Basic hydraulics, Editura BREN, Bucureşti, 214 p.

7.Smuda E., Mugea N.,2001-Realizarea unei microhidrocentrale cu puterea electrică de 22 kW, destinată alimentării cu energie a unor aşezări izolate, Revista Mecanizarea Agriculturii, nr.11

8.Tănăsescu F.T., 1986- Conversia energiei - Tehnici neconvenţionale, Editura Tehnică, Bucureşti, 179 p.

9.Voia I.,1996- Micii producători de hidroelectricitate în România. Necesitate şi şansă. Revista Energetica nr.2, pp.80-87

10.*** 1 Atlas Cadastral, Apele Române, Direcţia Apelor Crişuri