# The project for a dig out installation of the geothermal water with the help of solar energy

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***Abstract*** *- This installation realives the water pumping from a well or fountain, in a feight vesse, with a centrifugal pump trained by an continuous, alternate electrical engine, depending on the users preferences, feed from a solar battery through a system of stabilizers and respectively of inverter of electrical tension.*

***Keywords:*** *geothermal water, solar energy*

### I. Description of the installation

This installation realize the water pumping from a well or fountain, in a height vessel, with a centrifugal pump trained by an continuous, alternate electrical engine, depending on the users preferences, feed from a solar battery through a system of stabilizers and respectively of inverter of electrical tension.

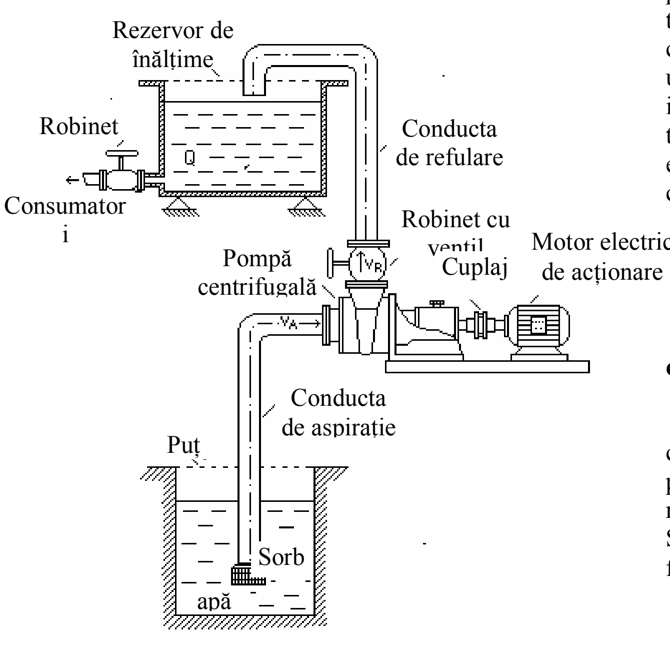


Fig. 1. Scheme for hydraulic installation

The installation is composed from two main units: the hydraulic installation and the installation of feeding with electrical power.

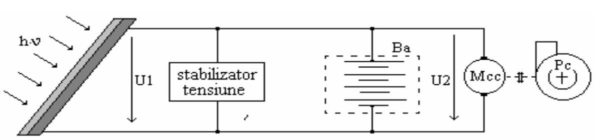


Fig.2 The block plan of an electrical installation

The electrical installation is composed from the energy source, which is composed from a photovoltaic generator (solar battery), continuous tension stabilizer, accumulators battery and the continuous electrical energy engine (Fig .2), and when using alternating electrical energy engines the installation includes also a inverter of electrical tension, monophase or triphase depending on how the engine works which serves at the training of the centrifugal pump.

The price of the investment is rather big but it ; paid off quickly and counting that the solar energy is ·ee this solution it proves to be very efficient.

### II.The determination of the installation characteristics

The determination of the installation characteristics suppose the establishment of the parameters on which it will be made the sizing respective the election of the installation components. Specific flows for the main sanitary objects armature feed from the pump are:

- 0,20 l/s = 1E- for the basin, shower, bath with local preparation of the hot water;
- 0, 10 l/s = 0,5 E- for the closet tank.

The common relation of the flow estimation is:

$$q_c=b(a\cdot 0,2\sqrt{E}+c\cdot E) \quad (1)$$

For smaller values of E (valid case for the presented installation), it can be used the next relation:

$$Qc=0,2\sqrt{E} \quad (2)$$

Table1. Estimation flow in l/s for the water installation from buildings depending on the sum of the equivalents.

| E | qc | E | qc | E | qc |
|---|---|---|---|---|---|
| 0,2 | 0,04 | 2 | 0,29 | 7 | 0,54 |
| 0,4 | 0,08 | 2,5 | 0,32 | 8 | 0,58 |
| 0,6 | 0,12 | 3 | 0,35 | 9 | 0,62 |
| 0,8 | 0,16 | 3,5 | 0,38 | 10 | 0,65 |
| 1 | 0,2 | 4 | 0,41 | 11 | 0,69 |
| 1,2 | 0,22 | 4,5 | 0,43 | 12 | 0,72 |
| 1,4 | 0,24 | 5 | 0,46 | 13 | 0,75 |
| 1,6 | 0,26 | 5,5 | 0,48 | 14 | 0,78 |
| 1,8 | 0,27 | 6 | 0,50 | 15 | 0,81 |

The necesary flow is determined with the relation:

$$q_{nec}=q_m+q_i+q_t[l/s] \quad (4)$$

$$q_m=\sum\alpha\cdot q_c[l/s] \quad (5)$$

where: $q_m$ – is the water flow for covering the housekeeping consumption

$q_i$ – identically, for the fire consumption (it is not our case);

$q_t$ – identically, for the technological consumption(it is not our case);;

α –coefficient of the consumption variation;

$q_c$ – the estimation flow, determined with the (1) relation;

α – coefficient of the consumption variation (α=1), results:

$$q_p=q_{nec}=q_c=0,2\cdot\sqrt{E}\;;[l/s] \quad (6)$$

**III. The sizing of the water pipes**

The sizing of the water pipes, is made depending on the estimation flow qc and in correlation with the leaking speed v and the looses of unitary pressure, having leaking in a forced way.

The interior size of the pipes it is calculating with the equation:

$$d=\sqrt{\frac{4Q}{\pi\cdot V}}\;;\quad [m] \quad (7)$$

in which: *d* – represents the interior diameter of the pipe, in (m );

*v* – the medium speed of liquid leaking, in (*m/s*);

*Q* – is the flow realized by the pump in ($m^3/s$).

The usual values of leaking speed for water are:

Table 2. The value of the diameter determined in this way it is framing then in the standardized dimensions of the pipes, choosing the superior limit.

| *Conducta* | **Viteza de curgere** (m/s) |
|---|---|
| aspirație | 1÷2 |
| refulare | 1,5÷3 |

For determination of the leaking regime it has been established an dimensionless criterion, known under the name of "number Reynolds", noted with the symbol $R_e$ and whom value is estimating with the relation:

$$R_e=\frac{v\cdot d}{\nu} \quad (8)$$

in which: v – represents the medium speed of leaking(m/s);

d – the interior diameter of the pipe, in (m);

ν – the kinematics stickiness of the liquid, in ($m/s^2$).

For values of Re < 2200...2500 the leaking regime is laminal.

In laminal regime, the speed of the medium speed is**:**

$$V_{med}=\frac{v_{max}}{2} \quad (9)$$

The relations for determination of the charges looses are serving at the estimation of the route and to the dimension of the pipes. .

These relations are the next ones:

-For linear looses in laminal regime:

$$h_r=\lambda\cdot\frac{l\cdot v^2}{d\cdot 2\cdot g}\;;[m] \quad (10)$$

in which: $l=l_{ef}+l_e$

$l_{ef}$ =the real length of the pipe in (m);

$l_e$ =the equivalent length corresponding to the local looses, in (m);

λ it is a resistance coefficient of the pipe and it has the value :

$$\lambda=\frac{64}{Re}\ldots\frac{90}{Re}$$

For straight pipes, it is considered: λ = 75/Re.

For turbulent leaking, the rubbing coefficient λ depends on the walls roughens, their variation being represented through a bundle of straight lines depending on the nature of the objects. In the figure 3.4 are been represented 2 curves for plane pipes and for pipes with a big roughens. For water, in case of turbulent leaking it can be taken with approximation, the value λ=0,03.

Charge looses due to local resistances are estimating with next relation:

$$h_l=\xi\cdot\frac{v^2}{2g};[m] \qquad (11)$$

in which ξ is a coefficient of local resistance induced on an experimental way.

In the specialty works values of $l_e$ are given in tables of programs. This way from table 3 are given values of $l_e$ for different arming.

$l_e$ value it is estimating with the relation:

$$\sum\xi\cdot\frac{v^2}{2g}= \lambda\cdot\frac{l_e}{d}\cdot\frac{v^2}{2\cdot g} \qquad (14)$$

Equivalent length $l_e$ appears like a product between the pipe interior diameter $d$ and an $n$ number which depends on the way of the considered hydraulic resistance (table2):

$$l_e=n\cdot d \qquad (15)$$

The values of the coefficient of local resistance ξ are being determined with some formulas, table or diagrams which are being found in specialty literature. In table 4 are given the values of the resistance coefficient for some hydraulics obstacles.

Table 3. The values of the coefficient ξ

| *Description of the local resistance* | ξ |
|---|---|
| Elbow by 90º right | 1,1-1,3 |
| Curve by tube | 0,14 |
| Valve:<br>- open to an angle by 30-40º<br>- full-open | <br>4-11<br>0,2 |
| Gate:<br>- ajar<br>- full-open | <br>2,8<br>0,1 |
| Faucet | 2,5-5,5 |

The pressure, expressed in meters column of liquid, which the pump has to realize for moving the liquid into the installation, it is composing of the pressure necessary for lifting the liquid at the respective geodetic highness, the pressure necessary for defeating the extra resistant charge at the end of the rejection pipe, as well as from the necessary pressure for defeating the hydraulic resistances of the installation.

**IV. Height dimensions**

The height tank has the role of stowing the water pumped by the pump, for later use.

In the common case the capacity of the height tank is being determined with the relation:

$$V=\frac{\rho_p}{4\cdot n}\cdot 3600; \qquad (16)$$

Where: $q_p$ –is the flow of the pump;

$n$ – syllabus number of pumps starting;

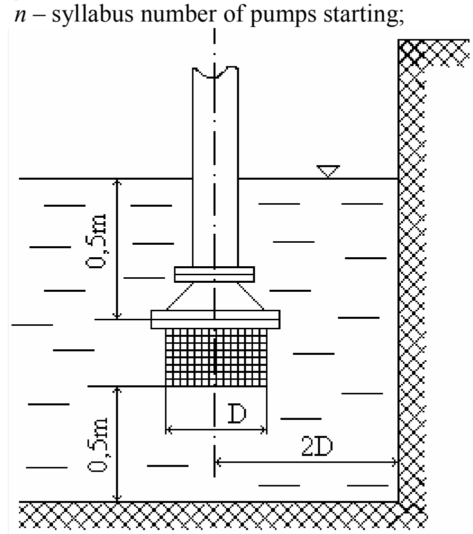


Fig 3.Pump

In a hydraulic installation, the pump represents the motor element oh this, why the endowing of the installation with proper type of pump it is of an essential importance for properly work.

The measurements effectuated on the stands proofs of engineering words are made, in most case, with water (with γ=1000 Kgf/m$^3$) and at the environment temperature.

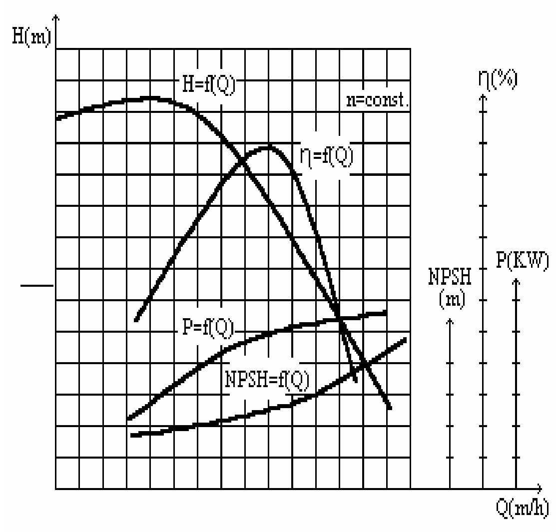


Figure 4. Characteristic diagram of centrifugal pump

In figure 4 is presented a diagram that contains characteristic curves of centrifugal pump. From the diagram presented in figure is noticed the point of sailing of characteristic curves of centrifugal pump, point of sailing that represent variation direction of functional parameter based on debit variation.

The characteristic curves presented in the diagram from figure 5 are determinate at a certain rotative speed "n", that has a constant value. Rotative speed variation triggers the characteristic curve variation of the pump. Was proved, and the experiments confirmed, the theory after which the bad curves F=f(Q) are congruence parable of which axis is parallel with abscise, therefore by having the determinate curve for a certain rotative speed, it can achieve the adequate curve of another rotative speed by collateral disalignment of the first curve.

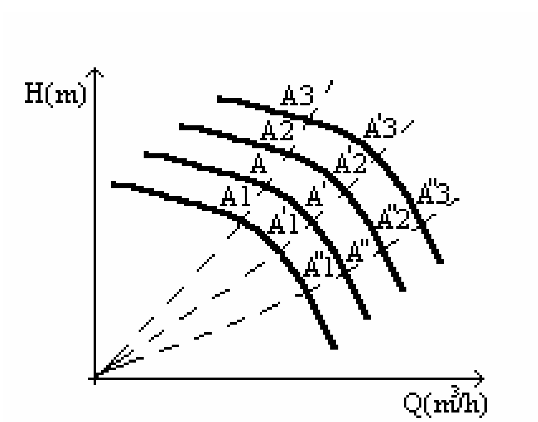


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Figure 5. The diagram H=f(Q) for different rotative speed

In figure 5 are presence the load curve of an centrifugal pump, at different rotative speed.

The points A1…A3, A1'…A3', A1"…A3", are find situated witch on a parable of step II, and their coordinate are obtain with the next relation:

$$\frac{Q_1}{Q_2} = \left(\frac{n_1}{n_2}\right); \quad \frac{H_1}{H_2} = \left(\frac{n_1}{n_2}\right)^2;$$

$$\frac{P_1}{P_2} = \left(\frac{n_1}{n_2}\right)^3; \qquad (17)$$

From this intercourse result as the debit *Q* are direct proportionally with the rotative speed, the height of the pumping *H* are proportionally with the quarter of the rotative speed, and the pump power *P* are proportionally with the cube of the rotative speed.

The functionality point of the pump is determined in diagrammatic way, thus:

In a diagram choice at a conventionally step are scribing a curve C, the conduct characteristic, in that diagram are conduct the characteristic curve of the pump *Q-H*, too. The intersection point, x, are the operation point of the pump.

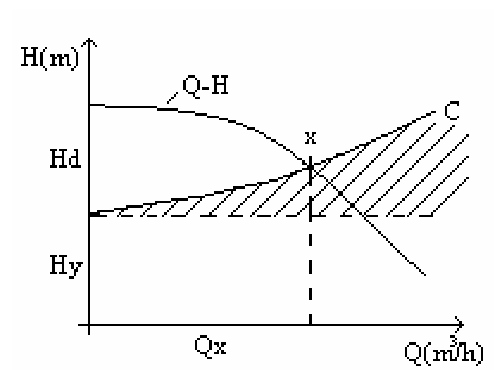


Figure 6. The determination of the movement point in the installation of an centrifugal pump

In diagram was scribed the curve H =f(Q), η=f(Q), η=f(H).

In figure 7 are present the functionally scheme of the pumping installation how are utile for define the pump parameter.

Thus:

Q – is the pump debit;

Hg – the geodetic distance between the level of the liquid from the inferior basin and the level of the liquid from the superior basin;

HgA – distance between the suction of the collar axis of the pump and the level of the liquid from the inferior basin;

HR – distance between the upset of the collar face and the level of the superior basin;

Z - distance between the suction of the collar axis of the pump and the upset of the collar face;

pA and pR – relative pressure measure on the level of the suction collar, respectively the upset of the pump;

vA and vR – speed of the liquid, on the suction collar entry, respectively to lead out from the upset;

p1 and p2 – relative pressure to the liquid surface from those two basin (inferior and superior);

hrA and hrB – losses of the undertaking in aspiration tube, respectively of upset.

$$H_{tot}=\frac{p_2-p_1}{\gamma}+H_g+h_r \quad (18)$$

Were: $\gamma$=1000 (Kgf/m$^3$) – water density;

$$H_{tot}=H_g+h_r+\frac{c^2}{2g} \quad (19)$$

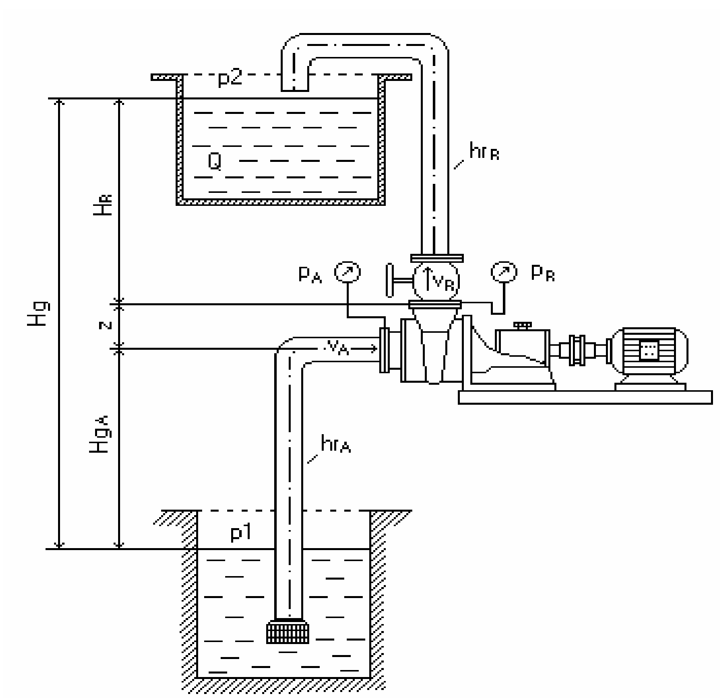


Fig.7 Functionally scheme of the pumping installation

$h_r = h_{Ra} + h_{rB}$ - represent the sum losses of the undertaking through the route of the aspiration and upset tubes;

c – are the water speed to lead out from the upset tube.

For the pump to can function in cavitations out side, are necessary as *NPSHavailable > NHSPnecessaries.* Practically, to projection of hydraulic installation allow for so *NPSHavailable* to be elder with certain 0,5 meter by *NHSPnecessaries.*

$$NPSH_{DISP}=\frac{p_0+p_1}{\gamma}-(H_{gA}+h_{rA})-\frac{p_v}{\gamma} \quad (21)$$

- represent the absolute hydraulic-pressure head to entry in aspiration tube;

HGa+hRa – represent absorptive height HA.

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