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Solar Boiler for an Energy Saving In Maradi, Republic Of Niger

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----------ABSTRACT----------
Alternative energy is the base of the survival of the humanity on Earth. The purpose of this study is to develop the use of the renewable energies in the world and in Republic of Niger in particular, to be capable of having elementary energy resources sufficient, to fight against the poverty and also continue to protect the environment in a efficient way. The thermal solar energy is one of the most plentiful renewable form of energy in Niger. The construction of a solar boiler to adapt for a use in Niger will allow reducing the expenses in the households. So the improvement of this technology is expected for simplicity of use in Niger.

KEY WORDS: *Solar water heater, boiler, Niger Solar hot water, Niger Solar boiler, Solar hot water*

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I. INTRODUCTION

The republic of Niger is a Sahelian country of West Africa enclosed, cover a surface of 1 267 000 km^2 (among which desert 2/3) and count a population of 17 129 076 inhabitants with a rate of annual average global increase of 3,9 %. This population is mainly rural. The energy situation of the country is characterized by a low energy consumption which is 0,14 tep / living compared with the African and world averages which are respectively 0,5 tep / living and 1,2 tep / living. This situation translates an access limited by the populations to the various modern forms of energy. Furthermore, the country presents a strong dependence towards the outside for the satisfaction of its energy needs while it arranges important energy resources (river Niger, oil, coal mineral, uranium, sun…).[1]

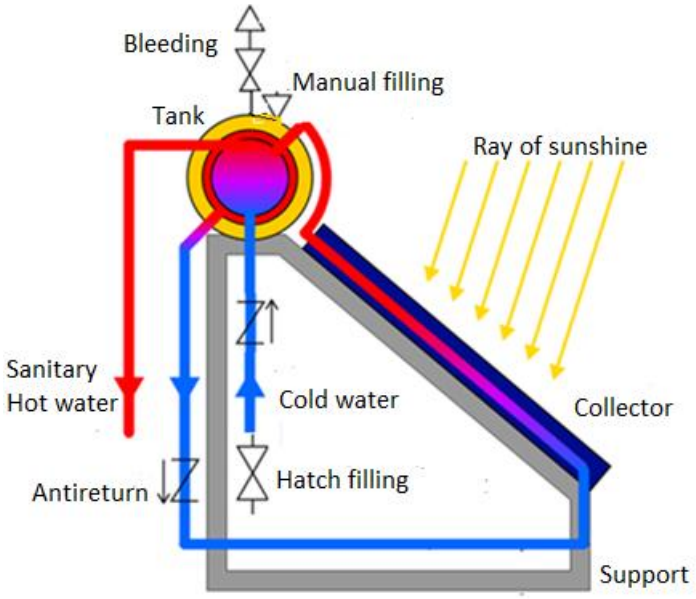
The energy is one of determining factors for the survival of the populations. It is necessary and essential for the satisfaction of the daily needs (health, food, water…). The firewood which remains the energy most in homes is one of cause major of the deforestation and some rare forest are still directly threatened by the domestic use daily taking. We consider at more than 98 % of the population of Niger which makes call up to the wood for the cooking of food, [2] but this so much to the fat reduction in the oil refining to Zinder by a Chinese company. But to fight effectively against this plague, the use of the solar energy, the clean renewable energy, the sun especially as inexhaustible in the human scale, stays a most ecological solution, that to build a coal-fired power plant, a gas, a diesel or nuclear power with fatal environmental consequences. The renewable energies can also participate in the economic development and create jobs, thus income. The thermal solar energy is an alternative, among others as the other renewable sources of energy which are to be proposed and to be promoted especially better, so that all the populations can reach it. A big advantage is that the traffic stops during the night, without needs for a device anti-return, for a pump and for a system of control. The inconvenience is that the debit is much reduced with regard to the forced traffic, reducing clearly the efficiency of the system. The simplicity buys itself by a loss of yield.

II. EQUIPMENTS AND METHODS

In the health centers of Africa, in particular those of the villages of sub-Saharan Africa, do not arrange reliable domestic hot water. The firewood sets a lot of time to warm the water, and the other fuels as the gas or the electricity are not in it carried by everybody. So the solar supplied boiler a hot water in any time and at a lower cost.

The choice of the technology: It exists, of part the world several technologies of solar boiler, the basic technology is always the same: the thermal collector and the balloon of storage are the main elements. Niger has an important period of sunshine. The accessibility to the hot water is not thing easy. A solar boiler in it carried by all the stock exchanges would be welcome. We use the available materials and the hand of work premises. A good sizing is imperative. Because of a good period of sunshine, the necessary surface of the thermal sensors is only in office of the size of the balloon. The latter must be isolated foam polyurethane and glass wool contribute to very strongly to keep the temperature. Pipes at the level of the collector must be copper to decrease the risks

of corrosion, the stainless steel for the rest of piping is desirable. The use is autonomous without supplement the supply is in certain case is intermittent (villages without water conveyance)..



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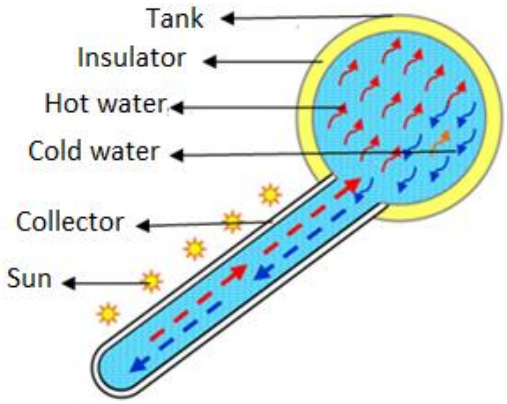

b-

Picture 1:a-Plan solar boiler typifies thermosiphon and b- her collector [3]

Thermal calculation for a solar boiler

We separate the uses in 3 slices:

- The range corresponding to the needs from 1 to 4 people, a solar balloon of 200 liters
- The range corresponding to the needs from 4 to 10 people, a solar balloon from 400 to 600 liters
- The range corresponding to a collective use, an example health center or boarding school, a solar balloon from 600 to 1000 liters

The solar balloons are built steel carbon or simply of linen leaf of steel with a cover of an alloy to answer the sanitary standards of storage of the domestic hot water. In the field of the storage of the domestic hot water a number of sanitary conditions must be respected. First of all, the treatment (processing) of bacteria. This one proliferates abundantly in circles the temperature of which is situated between 25 ° in 42 °. To eliminate these bacteria, it is necessary to plan to maintain the hot water contained in a sanitary solar ball(balloon) in 60 ° during 2 hours a day. This measure is made compulsory for all the storage water heaters toilet.

The equation of the distribution of the heat in a homogeneous plate:

$$\frac{\partial u}{\partial t} = \frac{k}{c\rho}\frac{\partial^2 u}{\partial x^2} \Leftrightarrow \frac{\partial u}{\partial t} = a^2\frac{\partial^2 u}{\partial x^2} \qquad (2.1)$$

with

$$a^2 = \frac{k}{c\rho}$$

(a is the coefficient of diffusivity thermal expressed in $m^2.s^{-1}$).

In a small volume (V) in the space bounded by a surface S the quantity of heat passing by during the time dt will be then:

$$Q = -dt\int_S k(\mathbf{n}.\mathbf{grad}\ u)ds \qquad (2.2)$$

If the heat penetrates in V, V warms up, if it leaves V, this one cools.

$$\int_V c\rho \frac{\partial u}{\partial t} dv = \int_S k(\mathbf{n}.\mathbf{grad}\ u)ds \qquad (2.3)$$

Where from the equation of state of the volume V:

Sunstroke through the passage of the sun. If a plane surface constantly directed in the sun, its irradiation averages ($W.m^{-2}$) :

$$<P> = \frac{1}{T}\int_{tr}^{ts} Psdt \qquad (2.4)$$

Where ts and tr - respectively the time of sunrise and slept by the sun. T - The duration of the day (24 hours) and Ps - The power density of solar irradiation, this depends on time of the day and on the metrological condition. The sunstroke immediate on a plan with an angle of inclination with the horizontal ε and azimuth ξ .

$$P = Ps\left[\cos\ \varepsilon \cos\ \chi + \sin\ \varepsilon \sin\ \chi \cos\ (\xi - \zeta)\right] \qquad (2.5)$$

ε - Is always positive

χ - The angle between the local vertical line and the line connecting the point of observation with the sun.

ξ - The azimuth: the angle between the north direction and the direction of the sun, considering the sense of the watch hand.

ζ - The azimuth of a motionless system [4]

When a thermal sensor is submitted to differences of temperature within it, he is born a flow of heat q which aims at the balance of the temperatures. This flow of heat depends on the difference between the temperatures and the characteristics of the material:

$$q = c\ .\ (T_1 - T_2). \qquad (2.6)$$

The constant of proportionality c depends on the thickness e of the wall between both given temperatures and the thermal conductivity? This measures the clean capacity of the material to lead the heat:

$$c = \frac{\lambda}{e} \qquad (2.7)$$

Consequently, the more the thickness of the material is important, the more c decrease. On the other hand, the more the thermal conductivity increases the more c increase.

The thermal conductivity expresses the quantity of heat which crosses one meter in thickness of this material per second and per square meter surface when the difference of temperature between both faces of the material is 1 K. She expresses himself in W/m. K.

The surface thermal decrease of walls k measures the capacity of a wall to allow to pass the heat.

It expresses himself in W / m^2K.

When two faces of a wall are subjected(submitted) to differences of temperature, he is born a flow of heat q which aims at the balance of the temperatures. This flow of heat depends on the difference between the temperatures and on the power isolating from the wall:

$$q = k\,(T_{int} - T_{ext}). \qquad (2.8)$$

We define generally k as the opposite of a resistance, what simplifies the writing of the calculations. Let us use all these equations let us obtain the graph which follows, for the region of Maradi, Republic of Niger. [5]
The face 1 shows us at which instant of the day the temperature is higher in the solar boiler in Niger.

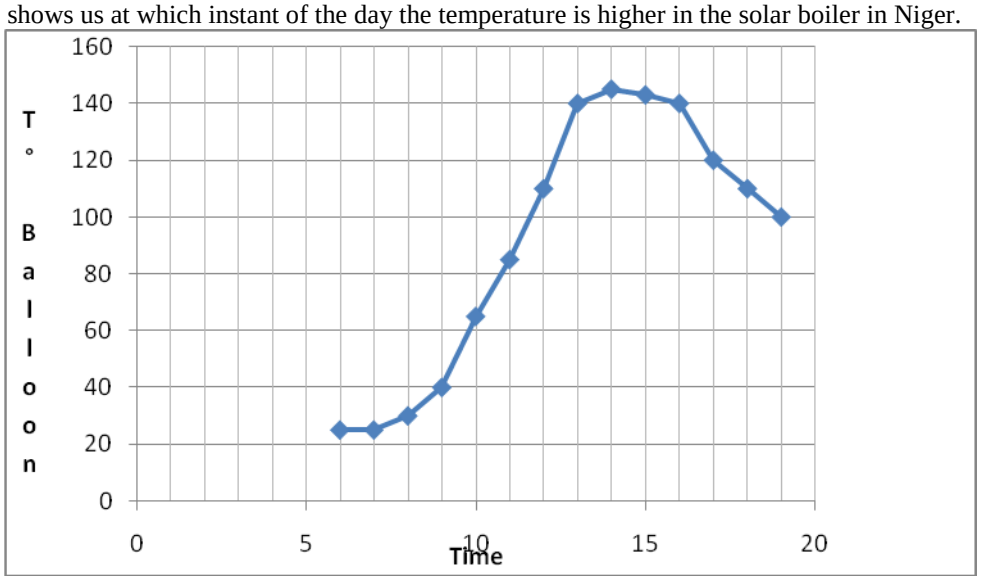

Figure 1: variation of the temperature in the tank according to the hours of the day in Maradi.

Economy and advantage of one of the solar boiler : Another advantageous factor of the solar boiler with regard to(compared with) the electric boiler, the gas range or the oil and the traditional foyer with wood it is the one of the life expectancy. A solar boiler is designed to work approximately 25 years while we have all the experience of the other devices the life expectancy of which is sad has to exceed 5 or 10 years. And in more They require daily spending while the sun is free. In the households as the winter is very short in Niger, the major part of hot water is used for the domestic spot and the cooking of food. Instead of boiling the water before preparing, by using the hot water we can save the wood, the gas or the electricity. Considering daily increase in energy prices globally, couple with attractive features of solar energy in terms of its cost-free nature, minimum degradation to the environment, it stand a better alternative. Niger is blessed with abundant amount of sunshine due to its strategic position in the tropics. [6]

III. CONCLUSION

Our solar boiler will contribute to the fight against the deforestation. In the sanitary districts the high demand of hot water is in the morning, that is at the moment or the temperature of the sun is still low (figure 1), but to solve this problem, we thought of strengthening the heat insulation at the level of the tank.

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REFERENCE

[1] Given by the last one RGPH 2012
[2] Annual report SIE-Niger on 2005
[3] http://www.alterenergies.fr/cesi_thermosiphon.html
[4] Fundamentals of Renewable Energy Processes Aldo Vieara da Roza 2005 Elsevier pp.317-354. ISBN 978-0-12-088510-7
[5] Solar Energy Vissanrionov V.I. ; Deriogina G.V. ; Kuznesova V.A.; Milinin H. K. Moscow Edition Home MEI 2011 pp.140-144. ISBN 978-5-383-00608-5
[6] Nigerian Journal of Renewable Energy Vol. 15 N° 1 pp. 125 – 134 , Solar Energy as a Remedy to Environmental and Safety by A. Uba, S. Baki, S. Buda and A. A. Tijjani, 2010 , ISSN 1115 – 0610.