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Spherical Thermical Reservoir

A Viable Social Environmental Solution for Brazilian Popular Buildings

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***Abstract*— This research obtained results of the evaluation of the thermal performance of three reservoirs used for heating of water with solar energy. Being a cylindrical metal one, a spherical in thermofix compound with fiberglass and a cylindrical in compound fixed term with fiberglass. Nowadays the job of cylindrical reservoirs is the constant one due to the easiness of execution, however this cylinder isn't the most efficient anymore, which is shown in this study. Once defined that the most appropriate shape was the spherical one, were started series of tests aiming at the practical proof in service and the viability of his use in low costs residences. The work done permitted to identify and to affirm that spherical reservoirs are most indicated one for this aim, presenting less loss of heat and consequently reduction in the operational and manufacturing costs allied to less quantity of raw material.**

***Keywords*— Cylinder; Spherical reservoir; Thermosolar system.**

I. Introduction

There is an interest by the Brazilian public policies in social nature works and local laws to introduce significantly, durable thermosolar systems, certified and guaranteed by the manufacturer [1]. The conventional cylindrical shape has some easiness to be placed in any space for the manufacture, accommodation and transportation, and it is used in Brazil as a paradigm difficult to change [2]. However this is not the most economic geometry when we relate the raw material consumption and the conservation of water heat, considering the area of heat exchange with the external environment since the spherical shape has the largest volume with the lowest matter involved in the manufacture of its form [3]. Facing this situation, it is proposed to investigate how much the spherical geometry is able to lose heat to the external environment compared to the traditional cylindrical shape and thus, design an interesting solution for buildings with lower income.

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II. Experimental

The experiments were performed under identical pressure conditions, power, loss of hydraulic load, and also flat solar collectors of the same area, inclination and orientation. Figure 1 shows in the middle, a common reservoir of cold drinking water and two reservoirs near the extremities that were in fact observed with the measurement system Sitrad from Full Gauge Controls and two stations (TI 33Ri-plus), responsible for power and data transmission to a PC. Two experiments were executed: one is comparing the conventional cylindrical shape to reserve 218 liters of hot water manufactured in Inox steel 316L properly insulated with 30mm of expanded polyurethane and with polished aluminum finishing (left side of figure 1). Against another 224 liters reservoir in spherical shape manufactured in thermofix compound with fiberglass properly additivated to resist hot water and also insulated with 30mm of expanded polyurethane with external finishing also in fiberglass treated to withstand the weather (right side of figure 1). Another experiment was performed with the same 224 liters sphere and with a cylinder also in thermofix compound for 205 liters, in order to measure the superiority of the results of the spherical shape, either if compared to the reservoir of traditional commercial line Inox steel or to the same material, but with different geometrical shapes (sphere and cylinder).

Figure 1. Open experimental bench

III. Results and Discussions

In the first experiment it was shown that on average the spherical shape lost 9.7% of heat in the evening against 14.26% of cylindrical shape in Inox. On the second experiment it was shown that on average the spherical shape in

thermofix compound lost 10.28% of heat in the evening against 12.53% of the cylindrical shape also in thermoset.

IV. Conclusions

The spherical shape and the material tested show superiority in energy conservation in heat aggregated to the reserved water in natural cooling processes, in addition, the material and manual manufacturing process used to build the sphere found a 15% reduction in operating costs when compared to the manufacturing cost of the material of stainless steel 316L. Thus, this is shown to be an interesting proposition for technical performance and for reducing environmental impacts resulting from material's waste.

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