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Optimization of Energy and Water Management of Swimming Pools. A case study in Thessaloniki, Greece

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Abstract

Improvement of living standards and increased demand for consumer goods have as consequence the increase of energy and water consumption. At the same time, increasing awareness of the respective environmental impact has prompted the European Union (E.U.) to issue a list of Directives for the Member States that promote conservation of natural resources. Moreover, this environment-friendly attitude may alleviate the impact of the economic crisis, since energy and water savings result in saving money.

In the present paper, some ways to improve sustainability of swimming pools through reducing energy and water consumption, are analyzed and compared. An open municipal swimming pool in Thessaloniki, Greece, is used as case study. Research is focused on heating energy, where more savings can be achieved. Especially, installation of solar thermal collectors, geothermal heat pumps, or photovoltaic panels and construction of a light roof are analyzed. Moreover, some recommendations are made, concerning the general improvement of a swimming pool and its surroundings. The goal is to reduce the operation expenses of the pool and, if possible, to increase the income, so that it can be economically viable throughout the year.

Finally, several suggestions are evaluated by means of the RETScreen software, in order to find out which investments are reasonable. For the evaluation a Cost – Benefit Analysis has been carried out, using the Net Present Value criterion, the Internal Rate of Return criterion and the Benefit – Cost ratio. Finally, a SWOT analysis is performed and a policy is suggested, which should be followed by the administration of the swimming pool.

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Keywords: Swimming pool; Energy saving; Water saving; Investment evaluation; Cost-benefit analysis; RETScreen

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1. Introduction

This paper deals with improving energy and water use in swimming pools. It presents a case study in Thessaloniki, Greece. The swimming complex is located in the Toumba neighborhood, near a church, a municipal cultural center, a major football field and a school, as shown in the map of Fig. 1. The pool belongs to the Municipality of Thessaloniki and was launched at in 2008, and once again on the 21st of September, 2009.

The pool complex includes an open pool of Olympic dimensions (21 m x 50 m = 1050 m^2 and eight swimming lanes) and accompanying installations, such as dressing rooms, W.C., offices, warehouses, etc and three tanks on the basement. The total area of the swimming complex is almost 2500 m^2, while the total closed area of ground floor is 354.3 m^2.

The pool water is continuously recycled and at the same time disinfected with chlorine gas through a recirculation system. The fuel that heats the swimming pool area and also its water is natural gas. So, there are two boilers of 1100 KW, three recirculation pumps and four chlorine gas cylinders of 65 kg.

The total operating expenses for the first 3 years of operation of the swimming pool are presented in the table below:

Table 1. Annual cost of operation of the swimming pool of Toumba[1]

Expenses (Euro)	1st year (2010)	2nd year (2011)	3rd year (2012)
Heating (natural gas)	171974	155692	84441
Chlorination	24424	24424	24424
Electricity	48500	45500	32794
Water	26807	28692	30222
Unpredictable expenses	2000	2000	2000
Total expenses	273705	256308	173882

2. Proposed solutions for energy and water use optimization

2.1. Energy use optimization

Many successful examples of swimming pool upgrading can be found in the literature[1, 2]. Most of them, though, have been realized in countries with colder climate than that of Mediterranean countries, such as Greece[3]. Evaluation of upgrading measures, based on amortization period and cost-benefit analysis, could lead then in different results. Actually, milder climatic conditions are supposed to lead at least to smaller amortization periods, as in the case of the swimming pool of Ilioupoli, Athens[4].

Maybe the simplest technique of energy saving for open swimming pools is addition of a pool water cover. At the swimming pool of Toumba during the third year of operation, a removable pool water cover was bought and used. Results are encouraging as shown in the Table of annual costs (Table 1).

The proposed solutions that are considered and presented in this paper are the following:

- Construction of permanent roof
- Installation of solar collectors
- Installation of photovoltaics
- Installation of ground heat pump

The possibility of heating the swimming pool using the waste heat from the surrounding district has been also considered. It was rejected, though, since the swimming pool neighbours, namely a church, a football field and a cultural centre, do not reject large amounts of heat.

[1] The swimming pool was closed for almost one month during the second year and for four months during the third year. Moreover, a pool water cover was added during the third year.