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Analysis of energy consumption: a case study of an Italian winery

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Abstract

The European Directives promote the energy consumption assessment in residential and industrial sectors in order to identify specific measures for getting energy savings. This paper presents the results of the energy use analysis, carried out for a wine manufacturing firm located in Southern Italy. The energy consumptions of the main wine production processes are investigated, showing that the cooling is the most energy-intensive user. Potential actions as thermal insulation of storage tanks and integration of solar cooling system are proposed and analyzed in terms of energy saving to improve energy efficiency of the refrigeration process in the winery.

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1. Introduction

The global warming and climate change issues involves the whole world. Policies to reduce the greenhouse emissions are one of the priorities for the European Union (EU). The Europe 2020 strategy aims to increase the share of energy from renewable sources to 20%; to reduce the primary energy consumption up to 20% by improving energy efficiency and to reduce the greenhouse gas emissions by 20%, compared to the levels in the year 1990 [1]. The EU countries are required to achieve the energy savings, from production to final consumption and in any sectors as residential, industrial and transport. An analysis of the energy final use performed during the years from 1990 to 2014 in the EU-28 countries identified the industrial sector as one of the major electricity consumer with 1

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million GWh, about 25.9% of whole electricity consumptions [2]. Recent studies highlight the success of the energy saving policies in the industrial sector, mainly consisting of the energy efficiency certificate system also called white certificates system [3]. The small and medium-sized enterprises (SMEs) are generally driven by economic reasons to implement energy efficiency strategies, which lead a decreasing of the energy costs and also an increasing of the company competitiveness.

The wine sector is a strategic economic sector for the EU. The 2016 global economic vitiviniculture data fixes the European wine production at the most significant production level. Italy (48.8 mhl) confirms its position as the leading world producer, followed by France (41.9 mhl) and Spain (37.8 mhl) [4]. In the EU winemaking sector, the electricity represents the primary energy source 92%, followed by fossil sources as gas, diesel and fuel oil (8%) for a total energy consumption of around 1.750 million kWh per year [5], demonstrating the wine production sector is highly energy-intensive.

In this context, the energy audit represents a powerful tool to evaluate energy consumption in the wine production in order to identify the energy saving actions. The EN 16247 [6] is the European standard that defines how to carry out high quality energy audit, providing requirements, common methodology and defining output of energy audits. It is generally applicable to all types of companies and sectors, to all types of energy and all their uses.

Furthermore an energy audit can also provide energy indicators which link the total energy consumption and the typical outputs of the company. They represent a performance measurement in the energy use and able the comparisons with other companies in the same field [7]. Previous studies [5] declared the facilities with wine production higher than 50.000 hl/year (big winery) presented electricity consumption of about 4 kWh/hl, while facilities with wine production lower than 25.000 hl/year (small winery) showed electrical consumption of about 16 kWh/hl.

The main objective of this study is to present an analysis of energy consumptions for an important winery of the south Italy, in order to know the amount of energy that is used and how could it be reduced by providing different solutions of energy saving. On the based on data collecting, the energy consumptions are analyzed to identify the processes in which undertaken improvements which can reduce energy costs. Potential energy efficiency measures are individuated and assessed in term of energy saving. The main results are also useful to establish reference energy indicators for the winery located in the Mediterranean climate and characterized by a wine production per year higher than 25.000 hl/year.

2. Methodology

The wine making is a very complex process. It starts with the reception of the grapes in the winery, where the must is mainly extracted by using augers and electric motors. During the destemming and crushing processes, the grapes are separated from the stems and broken to obtain the pulp and the juice. They involve mechanical destemmers, rollers and electric motors. Afterward the pulp and the must are moved by pumping and electrical motors to tanks where alcoholic fermentation takes place. Within tanks the solid elements are removed from the product of the alcoholic fermentation by the maintaining of low temperature, pumping and electrical motors. Bottling and storage are final stages, which require mainly a cooling systems and electrical motors as depalettizzer, bottle drying and filling machine, corker, labeller and, palettizzer. In addition to the wine production processes, auxiliary services as lighting, air conditioning for human comfort and office to be considered.

The winery investigated in this paper is the "Cantine Paolo Leo" [8]. It is located in the municipality of San Donaci, (Latitude 40°27'N, Longitude 17°55'E) in the Puglia region of Italy, characterized by the Mediterranean climate. The winery occupies an area of about 70.000 m² and is compounded of several buildings, each of them fulfils different stage of the whole wine production process, and therefore they present different characteristics in terms of electrical and thermal systems. All buildings were involved in the present energy audit. The layout of the whole factory is given in **Fig. 1**.

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