Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 112 (2017) 134 – 141

Energy Procedia

Sustainable Solutions for Energy and Environment, EENVIRO 2016, 26-28 October 2016, Bucharest, Romania

Selecting the number and size of boilers used within the heating units of the residential complexes

Ioan Giurca[a,*], Gheorghe Badea[a], Ioan Aşchilean[b], George Sebastian Naghiu[c], Emanuel Megyesi[c]

[a]*Technical University of Cluj-Napoca, Faculty of Building Services Engineering, St. December 21, no. 128-130, Cluj-Napoca, 400604, Romania*
[b]*SC ACI Cluj SA, Avenue Dorobanţilor, no. 70, Cluj-Napoca, 400609, Romania*[c]*S. C. Klever System S.R.L., str. 1 Decembrie, no. 30 A, Bistriţa, 420080, Romania*

Abstract

This paper focuses on the selection of number and size of boilers required for the heating units of the residential complexes. In this case study we proposed the selection of number and dimension of boilers for a heating unit of a residential complex located in Tirgu-Mures, Romania. The conclusion of this study is that the operational safety of the heating unit increases once the number of boilers increases, together with the decrease of thermal energy consumption and the increase of investment costs respectively. Based on our calculations, we recommend that the heating unit should be equipped with seven boilers, and should be provided with a controller for managing them in cascade. The method proposed in this paper can be used within the feasibility studies related to heating units of the residential complexes.

Peer-review under responsibility of the organizing committee of the international conference on Sustainable Solutions for Energy and Environment 2016

*Keywords:*boilers; heating units; residential complex; optimization; real ranking method.

* Corresponding author. Tel.: +40-0723 371 760; fax: +40-0258 841 127.
*E-mail address:*giurca_ioan@yahoo.com

Peer-review under responsibility of the organizing committee of the international conference on Sustainable Solutions for Energy and Environment 2016
doi:10.1016/j.egypro.2017.03.1074

1. Introduction

a) Context. Within the European Union, 40% of the total energy consumption goes to buildings. In the context of the energy crisis and environmental degradation, the reduction of operational energy in buildings is particularly important [1].The subject of rehabilitation and regeneration of the collective residential ensembles, characterized by a high level of physical and ethical wear and tear, has been the subject of interest for the contemporary society and not soon after 1990's represents a matter of interests for Eastern Europe itself.

Considering this, it is required to increase the energy performance of buildings, to decrease the heat loss of the heating networks and, in the same time, to increase the total efficiency of the heating units.

In order to decrease the thermal energy losses of the heating units it is both necessary to select boilers having the highest thermal efficiency and to perform the automation of the heating units in order to decrease the energy waste.

b) Present state of research in the world. Several international studies appeared, concerning certain matters related to the topics presented in this paper [2,3,4].

c) Present state of research in Romania. Nowadays, there are no published papers regarding the detailed analysis of the selection of number and size of boilers for a heating unit, though there still are several papers partially analyzing this matter [5,6,7].

d) Purpose of the paper. The purpose of this paper is to present a methodology concerning the selection of the number and size of boilers for the heating unit of a residential complex.

e) Contributions of the paper. The method proposed in this paper can be used within the feasibility studies related to heating units of the residential complexes.

2. Materials and methods

2.1. Materials

Both the designers and the beneficiaries have to deal nowadays with the issue of selecting the type and size of boilers used in the heating units of the residential complexes.

The boilers that equip the heating units of the residential complexes are usually made of steel or cast iron. Most of the times, when the heating units are located in basements, people use to select cast iron boilers made of dismountable parts, hence they can be easily put in the heating units placed in the buildings' basements.

The boilers prepare the heat carrier having a temperature of 90/70 ^{o}C or 95/75 ^{o}C. The temperature of the burnt gases is higher in case of classic boilers, and lower in case of modern and condensing boilers. The use of condensing boilers is obviously recommended only when high demanding hot running water consumers are connected to the heating unit, such as blocks of flats, floor heating systems, as well as buildings that require a low thermal energy consumption for heating, of about 40-75 kWh/(m^2 • an).

The fuel usually used in the towns with natural gas distribution networks is methane and the heaters have burners operating with stages regulation or with modulating regulation.According to the degree of automation of the boiler, the heating units can be employed with cascade boilers systems or without.

Considering both the various technical solutions available to put into practice and the lack of a clear methodology regarding the selection of the type, size and number of boilers, one may consider that the specialists in central heating systems face a real challenge in this respect.

2.2. Methods

In order to apply a calculation method for the selection of number and size of the boilers within the heating unit of a residential complex, one has to take the following steps: assessment of installed power of the heating unit, calculation of the number of boilers, assessment of size of the boilers, assessment of assurance rating of the heating unit's load, assessment of energy savings, assessment of investment costs, ranking of the alternatives using the real ranks method.

Assessment of installed power of the heating unit. The power of the heating unit is calculated considering the installed power of the consumers and their simultaneous operation. Calculating the power of heating unit by simply