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Economic and environmental benefits of thermal insulation of building external walls

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ABSTRACT

Thermal modernization is viewed by its users in Poland mainly in terms of economic benefits. Nevertheless, it does not reduce the significant role of thermal modernization in lowering the environmental impact at the phase of a building use. The paper presents economic and environmental benefits due to thermal insulation of building external walls.

Thermal insulation of building walls has a significant effect on the reduction of thermal energy consumption in buildings that leads to the reduction of CO_2 emissions. Making a thermal insulation of a building external wall can in terms of economic aspects be approached as an investment. In this investment the cost is related to the purchase, transport and laying the insulation, whereas the profits are linked to the reduction of thermal energy consumption necessary to heat a building. The author determines the optimum thickness of the insulating layer that gives the maximum net present value of thermal insulation investment.

Several versions of thermal insulation are presented. The following criteria were taken into account: energy sources, wall constructional materials and insulating materials. Bearing the sustainable development paradigm in mind, the best possible thermal insulation versions were determined by means of a two-criteria optimization for the economic and environmental criterion.

1. Introduction

Thermal insulation is one of the most effective ways of saving energy used for heating and cooling buildings. In a moderate climate, the fact of heating air inside buildings, especially in winter, but also in transitory periods (autumn and spring) is significant as far as thermal energy demand is concerned. Therefore, determining and selecting the optimum thickness of insulation is the main objective of many research works [1–7].

Consumption of final energy in Poland in household sector makes almost 31%, and 71% of this energy is used for heating buildings (Chief Statistics Office [8]). Owing to the energy consumption of this sector both in Poland and worldwide, the opportunities of reducing energy use are in demand. At present the standard value of the heat transfer coefficient cannot exceed 0.3 W/(m^2 K). In Poland, due to big negligence[2] in the construction sector in the 20th century, there is great potential of primary energy savings, the use of which does not mean great financial investments, as it occurs in other developed countries [9]. It appears that in Poland a technically simple solution is thermal modernization of building external walls and/or modernization of an individual boiler house.

The importance of thermal modernization of the existing housing resources is also stressed by the fact that the consumption of primary energy has been increasing recently (years 2003–2007) [8] and that it becomes necessary to implement the provisions of the EU regulations concerning the Directive 2006/32/WE[3] of May 17th, 2006. This Directive imposes on Poland an obligation to take action in order to reduce consumption of the final energy by final users in the successive nine years it is in force commencing on January 1st, 2008. According to the Directive member states accept the national indicative goal in terms of energy savings of 9% of the average consumption in the years 2001–2005 and aim at achieving it in the ninth year of applying the Directive. The Ministry of Economy elaborated in 2007 the National Action Plan concerning energy efficiency, providing the goal for 2016 calculated according

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[2] The orientation coefficient of thermal energy consumption in Poland in the 70-ties was 240–280 kWh/(m^2year), and in the 80-ties it ranged from 160 to 200 kWh/(m^2year).

[3] The Directive 2006/32/WE concerning the efficiency of the final energy and energy service consumption.

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