An Experimental Study on XPS and Insulation Paint in Buildings

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ABSTRACT

The depletion of energy resources consumed in all areas of daily life, the introduction of new energy sources, energy savings, research for the efficient use of energy became a priority. Made of thermal insulation for energy efficiency in buildings also has been made compulsory by the relevant standards. For energy efficiency; What kind of project would be implemented in an insulation material should be decided on and implemented in the construction phase. Thermal insulation materials used in building and developing diversity is increasing day by day. Containing ceramic thermal insulation coatings developed recently was able to take part in practice. There are lots of uncertainty since the new method found. Thermal performance of thermal insulation material widely used industry newcomer XPS heat insulation coating material made under this study is to shed light on these doubts were compared experimentally.

Three model building was produced as a testing apparatus which has 2x2m2 floor area and 2.5m height. One of the models is applied no insulation to make reference. One of the other models; 5 cm thick thermal insulation made using the XPS, the other heat-insulating coating material is applied. Temperature changes in all models in a first stage of the experiment were recorded at 10 min intervals for 10 days. In the second step of the test series, the same power in all models was heated for 5 hours between 19:20 to 00:20 hours heat sources placed, then allowed to cool. External environment and temperature variations of the model were followed by periods of 10 minutes and recorded. As a result of experimental studies; XPS heat insulation thermal performance while expected, the model does not apply any paint applied to insulated thermal insulation of the model; led to nearly the same thermal performance values.

Keywords: *Insulation, XPS, Insulating Paint, Transfer of temperature, Thermal Performance*

INTRODUCTION

One of the most important sources of 21th century, we live in information and communication age is energy, too. Energy consumption is concerned at each stage regarding human life. In the developed countries ranking; energy production and amount of per capita consumption are used as a measure of development. In terms of sustainable development and environmental pollution; Reducing the energy losses has a place in great importance in addition to increasing the energy source. Insulation must be made to reduce energy loss in buildings. Insulation means of minimizing the energy flow by putting insulation material between the two environments. A significant temperature difference is expected between the models which are applied heat insulation materials and the other models which are not applied heat in**s**ulation. New technologies and method are being developed day by day about the execution of heat insulation to the buildings.

Coating materials, containing ceramic, heat-insulating that is being spread in recent years is a product of these developments. The fact that ceramic dust particles are vacuumed into

spheres and have a very high value in dye in terms of volume is claimed to provide better insulation than XPS and is applied to some buildings on the market. It seems to be a need for a research about insulated paint materials containing ceramic and thermal insulation in the buildings. Tests, performed only in the laboratory in a special material on this material can give misleading results. It is clear that the real value will be possible just by following the thermal insulation performance in the applied buildings.

Within the scope of this labor, Extruded Polystyrene foam (polystyrene), commonly used as insulation material in our country and heat-insulated coating materials containing ceramic are compared in terms of thermal insulation performance in the light of experimental data on the model building.

EXPERIMENTAL STUDIES

1. PRODUCTION OF EXPERIMENTAL MODEL

3 building models with the base of single span and masonry carrier system whose floors are 2x2m and height is 2.5m have been built in the courtyard of Pamukkale University Earthquake and Building Technology Research Laboratory. Models in terms of reflecting the widespread practice in Turkey, are intertwined with the hollow bricks in the 19x19x13, 5cm dimensions shown in Figure1, then are plastered with cement-lime plaster mortar mix. The doors, 80x200cm are used in all three models. Model settlements are considered to receive the same amount of sunlight and their shadows' don't affect each other. (Figure 1).

Figure 1: Test model production and placement

Before the insulation is applied, the temperature changes in the models are measured at intervals of 10 minutes, recorded during the three days and the temperature difference is shown equivalent between 00.00 and 15.00.

INSULATION APPLICATION

One of the three models is not applied any thermal insulation material that is determined by reference, the other two models are applied thermal insulation with two different types of insulation material (Figure 2).

Figure 2 Sort left to right Model 1.1, Model 2.1, Model 3.1

EXPERIMENTAL METHODS

2.1 Thermal Insulation Test Setup

The temperature changes in the models, directly exposed to sunlight, away from laboratory conditions to represent a real building and air temperature are measured and recorded simultaneously with 10 minute periods for 15days. TH10 USB temperature gauges were used to measure temperature changes.

Model 1.1: The model in the thickness of 5cm of XPS, the most preferred in Turkey as thermal insulation material..

Model 2.1: The reference model which is not applied any thermal insulation materials.

Model 3.1: The model which is applied new entrants to the sector heat insulated Coating material containing ceramic in 300 micron thickness.

2.2 Insulated And Heated Internal Test Setup

In the heat conduction, heat transfer, convection and radiation rules are valid. Because radiation doesn't occur by the sun goes down, only heat conduction and convection are effective. With this step, at the time of no radiation, thermal performance of the materials is intended to observe. After the losing the effect of the sun during the winter months when the heating system is turned on and, it was decided that the method of this stage, considering that the heating system is turned off after midnight. Three models in this test phase, are heated internally by the heat sources on the same power for 5hours between the hours of 19:20 and 00:20. After the midnight, by closing the heat sources, temperature changes of indoor and outdoor has been followed and recorded 10minute periods.

TEST RESULTS

1. THERMAL INSULATION TEST RESULTS

The average of variations in the air temperature, air temperature was taken for the models, measured temperature changes for 15 days. According to the data Model 1.1 applied to 5 cm XPS , the ambient temperature during the day without being influenced by changes in the

temperature hardly has maintained between 24.9 ° C to 23.8 ° C. The temperature changes graphics of Model 2.1, not applied any heat insulating material to be reference and Model 3. 1, applied thermal insulating coating material has been moving to parallel and depending on the air temperature increases and decreases. (Figure 3).

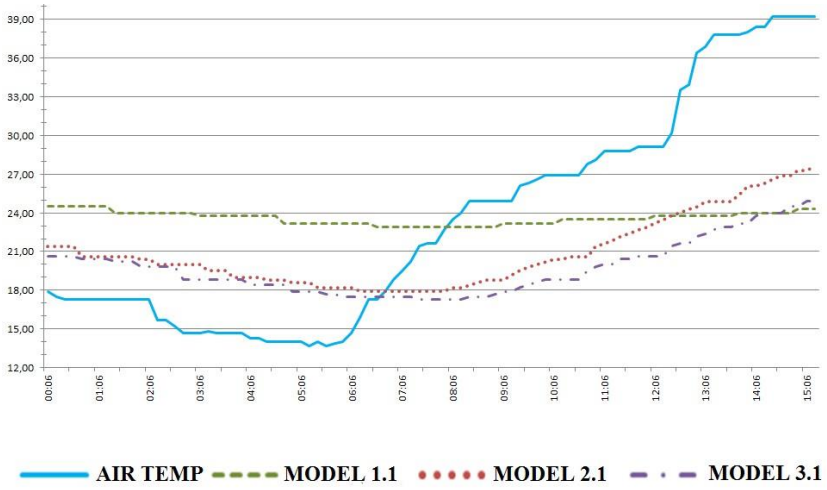

Figure 3 Air and models of temperature changes

The highest and lowest temperature of three models and outside temperature and the differences between these values are given in Table 1.

Table 1. Highest and lowest temperature changes

	AIR TEMP	MODEL 1.2	MODEL 2.1	MODEL 3.1
Highest	42,9	24,9	28,1	25,4
Lowest	15	23,8	20	18,8
Temp Difference	29,7	1,1	8,1	6,6

Due to changes in air temperature during the day, while only 1.1 ° C difference formed in Model 1.1, in Model 2.1 and Model 3.1 respectively 8.1 ° C and 6.6 ° C differences have been occurred. The fact that the temperature differences of Model 2.1 and Model 3.1 are close to each other shows that heat-insulating coating material doesn't provide expected thermal performance from him.

2. Insulated and Heated Internal Experiment Findings

Three models, heated with heaters on equal power during 5hours (19.00- 00.00) of the temperature reached 48.6 ° C. After the heat source is turned off within the first 2.5 hours, there has been a rapid temperature drop. At 02:40 the temperature of each of three models were read 36.4 ° C value. As of this this hour, while Model 1.2,applied 5cm XPS maintains 36.4 ° C temperature during the day, the temperature drop of Model 2.2, not applied any heat insulation and Model 3.2,applied heat-insulation coating material continued up to 8.20 and was respectively 27.3 ° C and 29.1 ° C. After 8:20, with the effect of sun, while the temperature of Model2.2 and Model 3.2 began to rise, the temperature of Model 1.3 didn't change. It was also observed that the Model 2.2 and Model 3.2 temperature change graphics in the cooling phase is almost coincident (Figure 4).

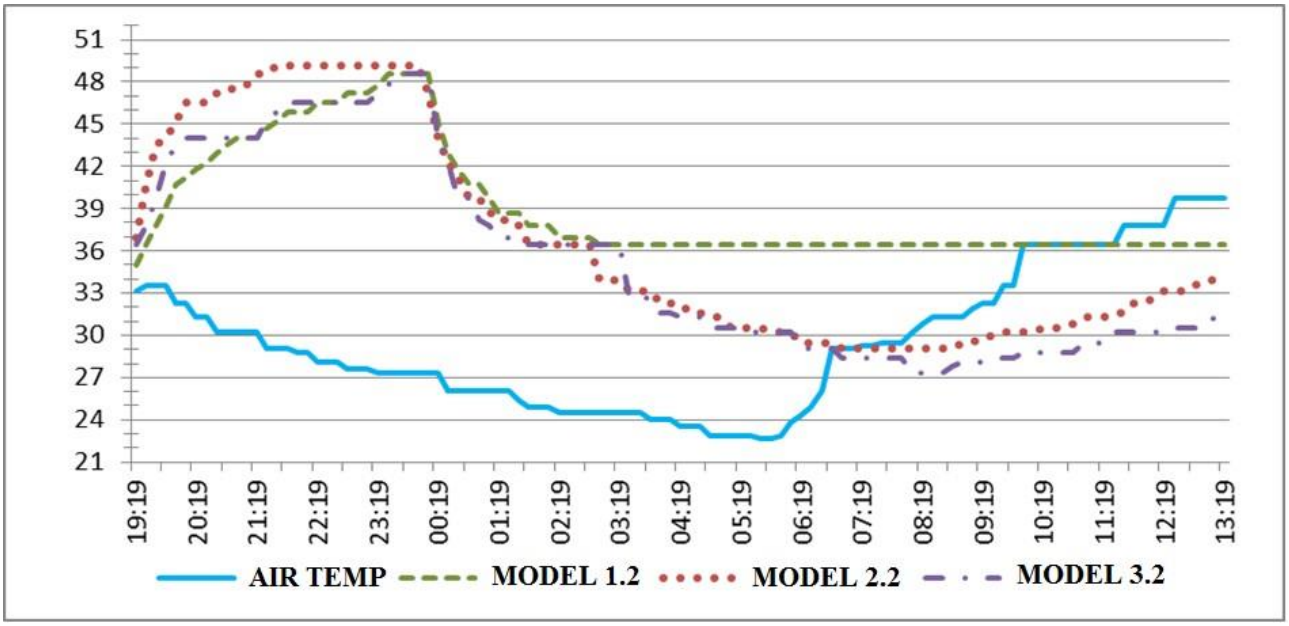

Figure 4 Air and models of temperature changes

RESULT

Within the scope of this study, Thermal insulation performance of XPS (Styrofoam), commonly used as thermal insulation material in our country and heat-insulated coating material containing ceramic, new entrants to the market and applied in the industry was compared in the light of experimental data on the model building. According to the experimental data XPS, 5cm thick has provided expected thermal performance without being influenced from the differences in temperature during the day. The model, applied 300microns thickness heat-insulating coating material has less thermal insulation by providing almost the same response to temperature changes with the reference model.

The most important factor in the insulation, the heat transmission coefficient of the material is low. The heat transmission coefficient is related to the air gaps in the cross-section of the material. Thanks to the material structure of the XPS 98% gap is still the most preferred insulation material. Heat insulation coating material is applied in 3-5mm thickness. The fact that heat transmission is low in a thin cross-section cannot be expected. As the sample thickness increases, the cost and implementation challenges will arise. It is understood from the test results that such materials and painting the exterior of the buildings with its currently shape in practice cannot be provided heat insulation.

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