RESEARCHES REGARDING THE THERMOGRAPHIC EVALUATION IN CATTLE BREEDING FARMS BY INTEGRATION OF ENVIRONMENT FACTORS

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Abstract

The goal of the paper presented is the application of some energetic evaluation methods for the buildings from animal breeding system using the new legislation norms for the detection of thermal irregularities of the envelopes elements of the buildings, using the thermo-graphic examination. Our studies carried out within the research project CEEX 6108 during three years between 2005- 2008, reveal the potential risk zones of the constructions envelope in cattle breeding farms from Transylvania, taking into consideration the materials thermal stability and technological process. The research contains analysis and measurements of micro- climate conditions in dairy cow farms and a holistic approach of the complex interaction between animal production system, construction, micro- climate conditions and environment protection mechanism. The diminish of specific energy consumption in all the sectors of activity, together with energy conservation into the buildings are key elements in sustainable development of animal breeding sector.

Key words: animal welfare, environmental conditions, thermo graphic examination

INTRODUCTION

Never during the last decades has been discussed more about energy and its costs, energy conservation for new buildings and thermal rehabilitation for the existent ones and so it became a generally accepted necessity for our country. It induces a supplementary preoccupation at national level for specialists and local authorities in the field.

Due to the scientific and technological development, the modernization of research methods together with the implementation of new biotechnological, nanotechnology and computerized discoveries, the rhythm of the changes- innovations became unpredictable (11, 12). The economical and social development of the contemporary society, the global changes and crisis together with ecological disasters demand increased efforts, energy and world wide programs that lead to global coordinated actions (4, 5, 10).

Energy depends on the expensive fossil fuels and their burning contributes to the global climate changes. E.U. legislation underlines the necessity of thermal diagnosis of the buildings as first step for increasing the constructions energetic efficiency (8, 13, 14).

Infrared thermography represents one of the methods used in many important applied scientific domains as civil engineering, energy, electronics, medicine, aeronautics, geology, environment protection, meteorology and even military techniques (1, 3, 6, 10, 12).

MATERIAL AND METHOD

Monitoring the behavior in time of the thermal rehabilitation systems of the buildings in Romania's climate conditions consists in complex investigations carried out by specialists, following main aspects such as (2, 7, 8):

- satisfying the exigencies for hydro-thermal comfort and energy economy during exploitation;
- total or partial correction of the thermal bridges;

- reducing the environment pollution by improving the buildings energy level;
- the appearance of the condensation and its spreading into the mass of the closing elements protected with thick insulating materials with reduced permeability to vapors;
- ventilation, together with the use of high tightness joinery.

The work principles of infrared thermographic apparatus contains the optical system that center the infrared ray from the image field into one of the two spectral band for transmission of the atmosphere and concentrates it on the detectors system that explores the environment (9). The radiation receptor transforms the electromagnetic signals into correspondent electrical signals that are reproduced as images shapes on the monitors that function with the frame frequency used in television. The thermo- vision system provides an image that permits rapid and precise identification of the spots that represent potential defects.

In constructions domain, the infrared thermography is used for nondestructive analysis of buildings envelopes, in measurements for investigation and localization of the hidden cracks inside the structures, water and moisture infiltrations or for the analysis of physical- chemical properties of the construction materials.

Like the civil buildings, the agricultural and industrial type buildings represent, from the source of radiation point of view, an amalgam of information regarding different materials, surfaces with different emissivity corresponding to certain materials, surfaces that represent planes with variable orientation against the sighting direction, radiation sources that correspond to the very temperature of the material and also reflected radiations (solar radiations or from other adjacent sources of radiation).

The temperature registered by the apparatus represents an instant value of the envelopes surface. There is always phase difference between the temperature of the interior sides of the exterior elements of the buildings envelopes and the exterior air's temperature. Because of the different thermal massivity of the envelope's components, the information may represent the temperature of a past situation (the duration of he phase difference depending on the properties of the material that builds up the envelope).

In thermo-technical calculations medium values of temperature are used (daily or monthly), these temperatures can't be linked to the momentarily temperatures offered by the surveillance apparatus. Using infrared thermography high variations in the thermal properties of the construction elements are identified (IR. 1, 2, 3).

Interior scans are more common in thermographic inspection because warm air escaping from a building does not always move through the walls in a straight line. Heat loss detected in one area of the outside wall might originate at some other location on the inside surface of the wall. Also, it is harder to detect temperature differences on the outside surface of the building during windy weather. Because of this difficulty, interior surveys are generally more accurate because they benefit from reduced air movement.

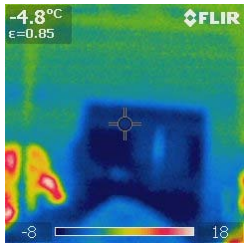
Thermographic scans are also commonly used with an open door test running. The method helps exaggerate air leaking through defects in the building envelope. Such air leaks appear as black streaks in the infrared camera's viewfinder (fig.1, 2, 3, IR. 1, 2, 3).

The thermographic images were taken inside the dairy cow shelter in January 2008 at Experimental Farm-"Sapca Verde" of University of Agricultural Sciences and Veterinary Medicine in Cluj-NapocaIn general, thermography uses specially designed infrared video or still cameras to make images (called thermograms) that show surface heat variations. This technology has a number of applications. The most accurate thermographic inspection device is a thermal imaging camera, which produces a 2-dimensional thermal picture of an area

showing heat leakage. By visually seeing heat with the use of an infrared imaging camera it is possible to avert problems before they become problems and make the necessary repairs or changes.

Photo 1. Dairy cow shelter- front

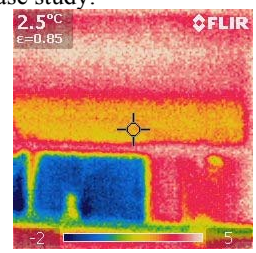
Photo 2. Dairy cow shelter- left side



IR. 1.

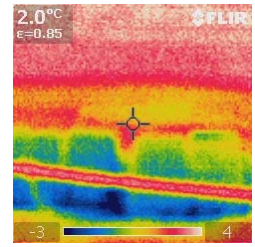
The situation of an old construction used several years, like dairy cow shelters, is far from the initial state or its designed characteristics. Moisture that can reach 98% (in the inside air) due to the metabolic activities and specific technologies during the cold season, affects the buildings materials and can destroy structural integrity, creating proper conditions for mold and insect infestations. Mold in particular is a growing concern for specialists, developers, and farmers because of the growing number of health-related claims.

The thermography was performed using a FLIR Systems Thermovision infrared imaging system. A visual record has been realized of each area surveyed during the case study.



IR. 2.

Photo 3. Dairy cow shelter- right side



IR. 3.

REZULTS AND CONCLUSIONS

The thermo-graphic activities goal is to provide information and to emphasize the real characteristics of the existent buildings. Thermal irregularities, air infiltration proof and the buildings structure produce different models of superficial temperature. Certain defects have characteristic shapes in a thermal image. For evaluation of the thermogrames it has to be taken into consideration the characteristics of the model such as:

- uniformity of the apparent radiant temperature in ratio with the sections of the similar surfaces of the structures with no thermal bridges;
- regularity of the cold or warm sections, for example the windows railings or at the corners;
- differences measured between the medium temperature of a surface belonging to the analyzed structure and the temperature of the selected sections, warmer or colder;

Irregularities in the aspect of a thermogramme often indicate an effect of the buildings envelope.

The infiltrations of cold air at joints and intersections produce irregular shapes with irregular margins and high variations of temperature.

The lack of insulation produces regular and well defined shapes unassociated with the general aspect of the building. The defect surface has a relatively uniform variation of temperature.

Moisture produces a diffuse model and the variations of temperature are not extreme. For each part of the buildings envelope where defects were detected must be realized a short analysis of the type and extension of each specific defect. The real distribution of the temperature is evaluated on the thermogramme.

The infrared measurements give a qualitative image of the thermal protection level of different sections of the building and emphasize the week zones hidden from usual vision.

The thermographic evaluation of the buildings envelopes combined with other materials analysis can offer an efficient protocol for energetic evaluation of all types of constructions from agriculture and animal breeding sector.

Energy conservation and decreasing of specific consumption of energy inside the buildings from all activity sectors are just two of the key elements for sustainable development of human society.

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