Environmental effects on farm buildings in Romania

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Воздействие окружающей среды на здания сельскохозяйственных ферм в Румынии

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A recent study made in the N.V. region of our country (within the Bilateral Research Program with University of Gent-Belgium, 2003-2005) referring to the existing constructive solutions into the dairy cows exploitations, emphasised a large diversity of buildings and interior arrangements, differentiated in function of the designed technological solutions used by the farmers, the level of the feeding and disposal mechanisation, solutions that in the majority of the cases do not respond to the interdependence of the functional factors. The quality conditions imposed to the envelope elements constitute the basis of a new approach of the building stock exploited in aggressive environment, at the same time with the resources conservation, economical development and pollution reduction and they represent the main instrument in assuring the users requirements. European environmental indicator-based reporting, allowing for policy-oriented monitoring has advanced considerably. A better integration of both agricultural buildings and quality of life in environmental policies is still an open issue. This requires consistent reporting and appropriate indicators to support evaluation and adjusting public-environmental security and health action plans for reducing and preventing these risks.

INTRODUCTION

The "aggressive environment" problem, treated many times as an accidental aspect, with special character, of short duration, became more and more a current problem of the old agricultural buildings, with an increased technical and economical importance.

For the animal houses this is a result of the technological processes and poor maintenance. The aggression is manifested not only upon the animal and vegetal world, but also on the building stock placed in the same area; by the appearance of some significant degrading phenomena of the built environment (Şerban şi col., 1981; Verdeş, 1994; Sîrbu, Tănăsescu, 2004).

From the analysis of the exigencies referring to comfort, animal welfare, security and sustainability, result their dynamic character, into a continuous evolving transformation.

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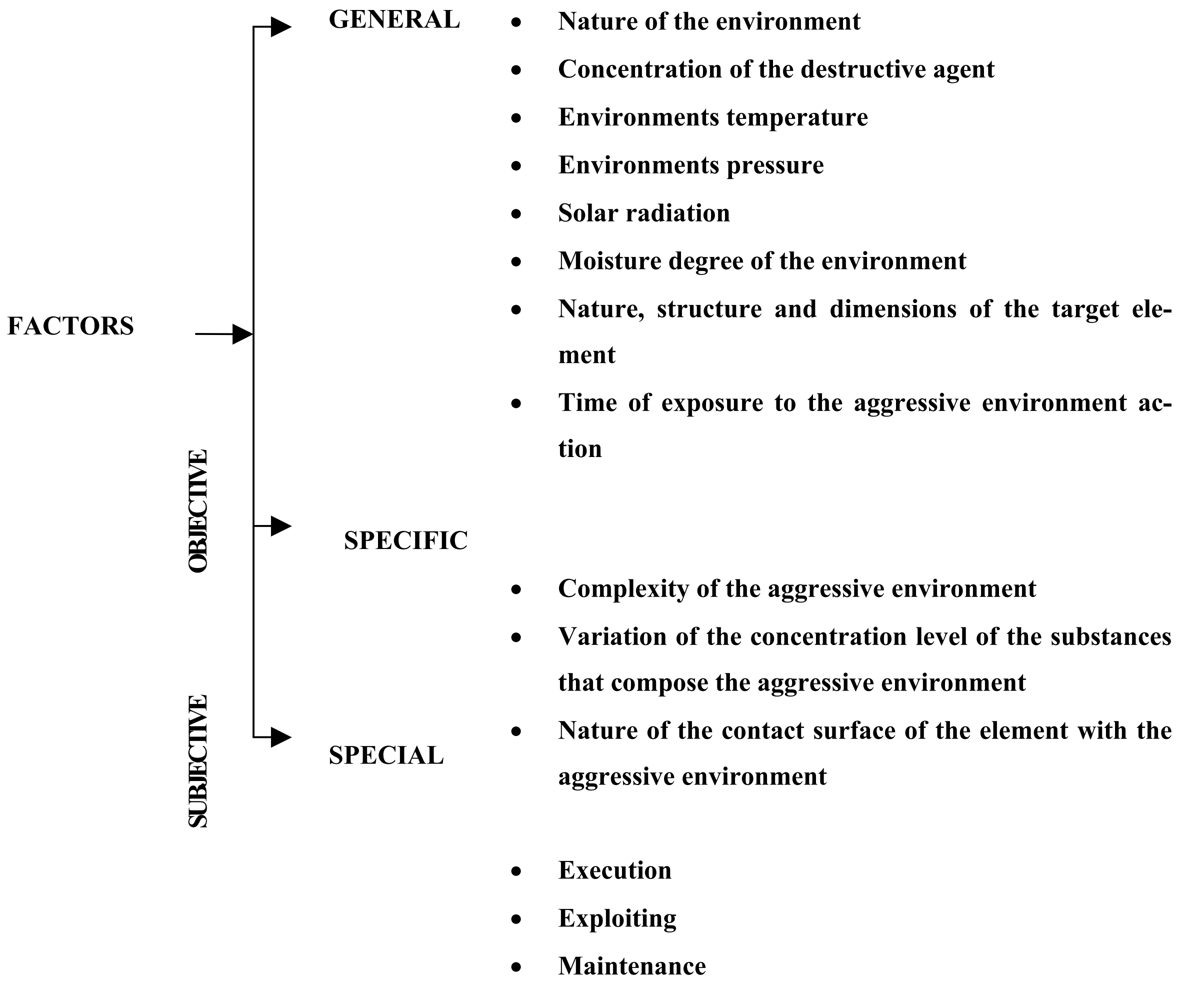


Fig. 1. Factors that influence environment's actions on the envelope elements.

MATERIAL AND METHOD

The „aggressive environment"existing inside the animal shelters as a result of the biological and technological processes submit in some cases the construction elements to strains with negative effect upon the animals health and implicit upon the production.

Within the building volume there are a number of moisture sources such as moisture from the animals and their physiological mechanisms, evaporating forage and manure moisture, open water tank, cleaning solutions and other technological processes. The building volume exchanges air to and from outside environment (Directive… 2000; EU Normes…, 1990; EN…, 1990; EN…, 1992).

There are now many numerical models to describe heat and moisture transfer within the building envelope. Generally these models are developed for civil buildings and are centered on the performances of the various layers of the envelope (Cunninghaam, 2003; Schijndel, 2003; Havno et al., 2001; Lecompte, 1986).

On the other hand, for dairy cow houses as for other species of farm animals, several other physical processes are involved, in direct relation with the metabolic process, animal age and weight, housing and ventilation (Commision…, 1999; Albright, 1990).

The surveying system used for climate control experiment consists of several transformers attached to measuring and transmitting stations and a central survey station. The signals transmission is made with radio channels and the system can reach automatically the information. It can assure the configuration of some alarm and signal barriers in case of exceeding the admissible limit values. The measuring and transmitting stations and transformers were placed: inside the building on the exterior wall al the animal level in lay down position (approx. 80 cm high), with sensors for moisture and inside air temperature measurement; and outside the building at the same level, with sensors for the determination of air temperature, humidity and wind velocity. The soil temperature and global radiation were not used in this experiment but were automatically registered by the station. Significant variations of temperature and humidity were registered both inside and outside the building.

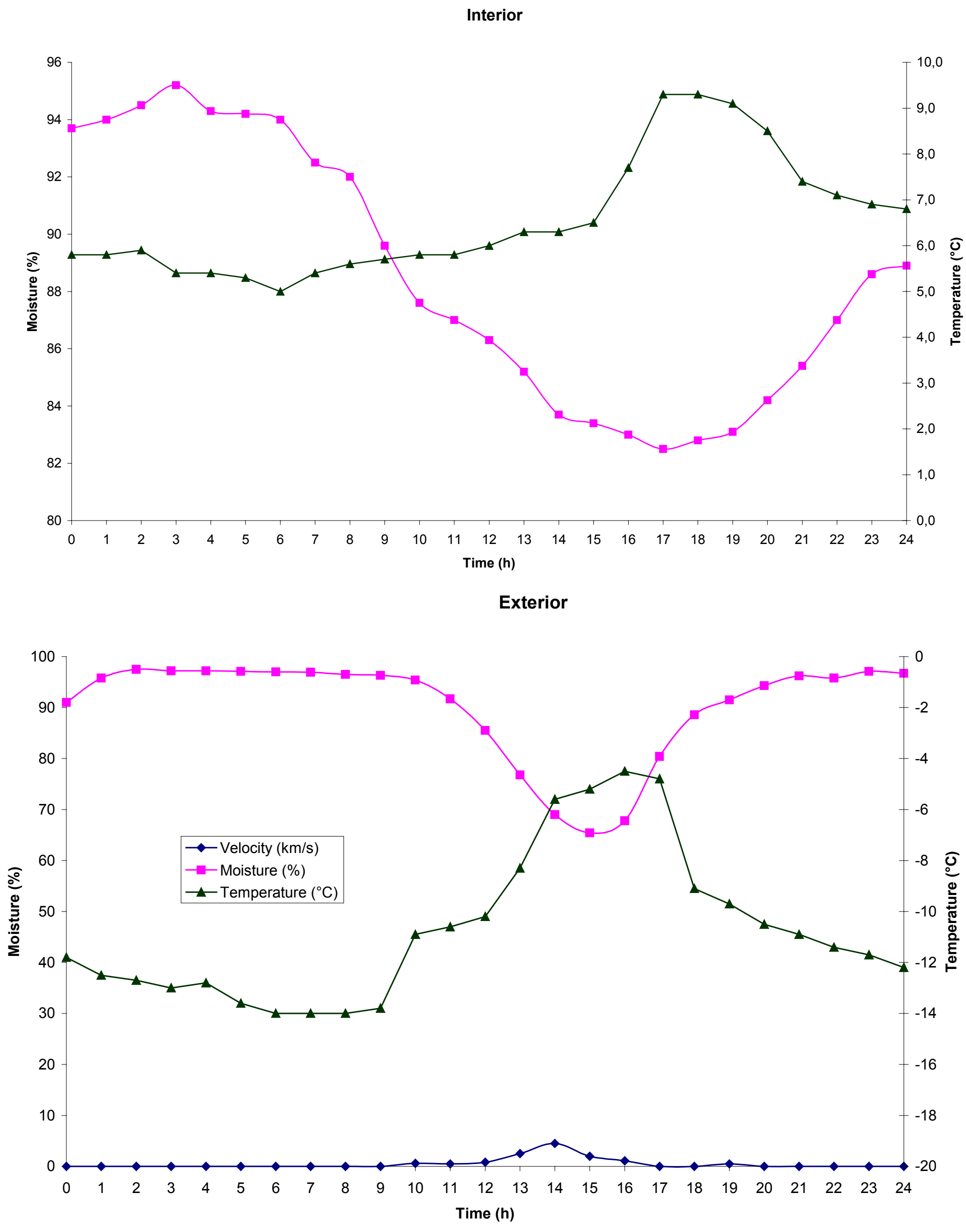


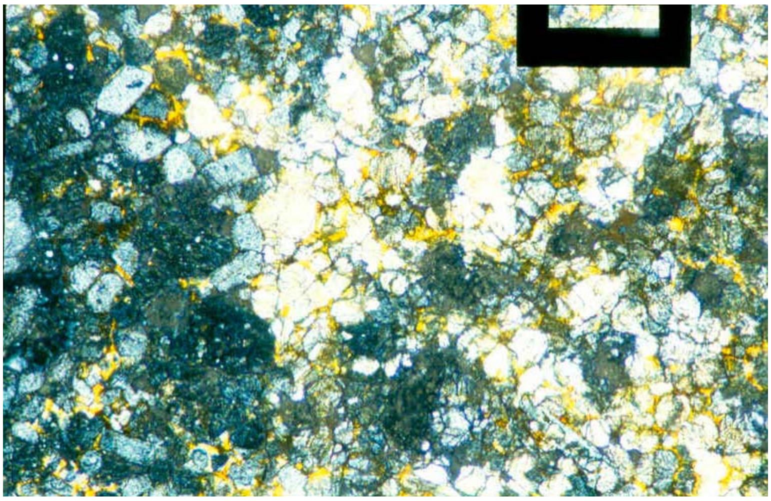
Fig. 2. Climate control during cold season

The ammonia, present inside the shelters, as a result of the decomposing manure, reacts with the walls, floors, roof and the rezistence structure.

The sulphatic ions appear due to the biological decomposion of the organic substances containing proteine, that is why the corosion with sulphatic ions is present on the part of the construction that comes in contact with the ground.

The chlorine ions and the chlorides appear into the waters that levigate the natural fertilizer and manure (the waters that sorraund the manure platforms contain 700 – 1000 mg/l chlorine). Because of the decomposition of the organic substances from the animal wastes, appears the sulphuretted hydrogen, that also has a limited corosive effect on concrete, while the reinforcements can be intense corroded forming iron sulphide (FeS) in the case when the concrete cover is too thin.

a.



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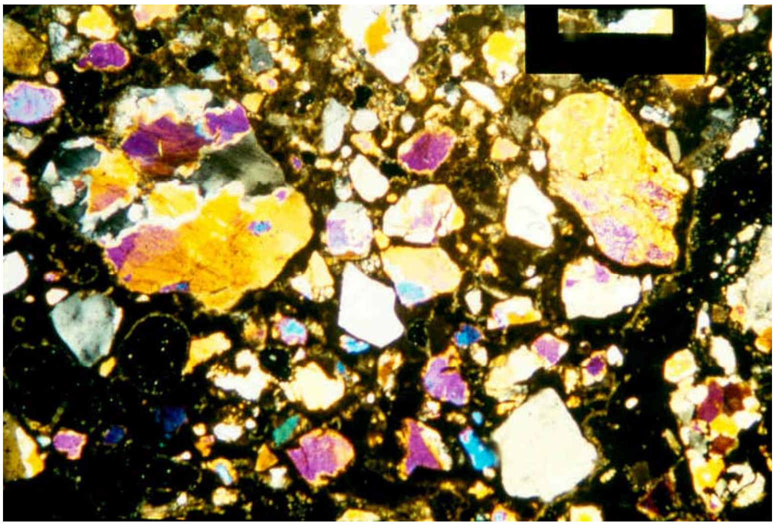


Fig.3. Microscopic image in polarized light.
a. Unused concrete material

b. Sample from the concrete floor

As a result of the applying of desinfecting and washing substances, appear the alkaline substances (pH > 7) with negative effects upon the construction materials. To all these it's added the high relative humidity (frequent values higher then 85%) that facilitate the appearance of the condensation phenomena.

Tests were sampled from inside the buildings for cattle breeding, from floors and walls, to study the degradation causes of concrete and plasters.

The concrete degradation was detected under diverse forms, as the aggresive agents from the exterior environment acted on the concrete rock:

- the aggresive ions reacted with the cement replacing the positive ions of calcium (Ca^{2+}), new reaction products with un-binder form appear. This type of corrosion is caused by acide solution, the salts and strong aljkali;
- on large concrete surfaces the corrosion by expansion due to the formation of some salts that chrystalize with a great amount of water, distroying the stiffened cement because of the volume increase. The concrete is distroied by the accumulation of expansive salts;
- the aggregates used to prepare the concrete were not affected by the aggresive agents.

The samples from the interior plaster of the exterior and the inside walls, show that the corrosive process is indicated on plaster but not on bricks. The plaster with 3,5 cm thickness made with fine aggregates, favored the water infiltration through capillarity .

Their detachment from the bricks surfaces is caused by the low temperatures during the cold season, when arround doors and windows frames were measured negative temparatures. The frost-defrost phenomena associated with the aggresive action of the environment lead to their degradation Inside the construction, the micro biocenosis, favoured by the environment are extremly complex and heterogenous.

From the samples taken from the material that built up the closing elements there were prepared cultures in the phitopathology laboratory and were identified 8 species of saprophyte fungus and one specie of nematodes .

Alternaria Tenuis and **Cladesporium Herbarum** –from **Demateaceae Family**, are characterized by a white-gray mycelium that form brown conidiophorus, simple or branched. Macroscopically, the mycelium formations and the fruit-forms appear under a velvet shape that proliferates and maintain a high rate of humidity into the affected zone.

Aspergillus Niger, Botrytis, Penicillium and **Stenphilium** –from **Mucedinaceae Family**, with a white-gray mycelium that develops characteristic spores, extremely numerous, that get birth to an colorless powder mycelium, or colored, with effects in time on respiratory system of animals and personnel.

Giberella–from **Tuberculariaceae Family** has a simple or branched and heterogeneous unicellular spores, or multicellular white-pink colored and different sizes.

Rhizopus Nigricans -from **Mycelia Sterilia Family** is characterized by abundant white-grey mycelium filaments that create a massive wool appearance on the infected surface.

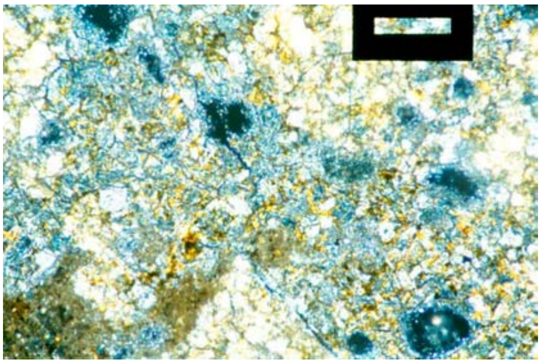
Ditylenchus -from **Tylenchidae Family** that register tiny cylinder worms with oblong bodies of 1,0 to 2,5 mm, thinned at the ends, transparent white-yellow colored, covered with a ringed cuticle under which there is a stratum of longitudinal muscular cells and at the surface, projections and thorns. Generally these nematodes arrive inside the specific microbiocenosis of the animal houses within the forage and straws (18).

By the humid environment existing into the tested areas and entertained by these microorganisms development the degradation process of the materials is favored.

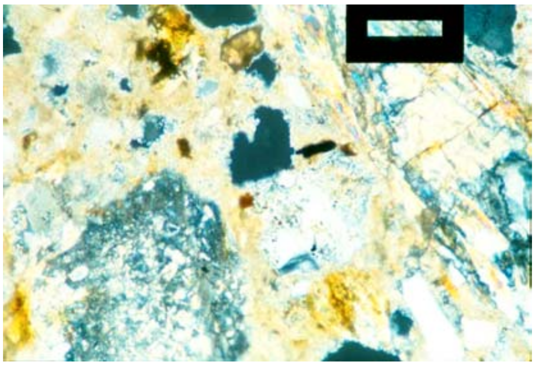
RECOMMENDATIONS AND CONCLUSIONS

For floors it's observed the necessity of using a high quality concrete, compact and dense, to stop the “aggressive agent's” penetration (the ratio water/cement between 0,5 ÷0,6; the cement’s dosage is 275 – 300 kg/m^3 with a low content of calcium and Calcium hydroxide, eventually the use of special cements).

The walls can be protected with coverings that can assure a superficial protection and special mortars.



a.



b.

Fig.4. Microscopic image in polarized light
Unused mortar material
Sample from the wall plaster

The design of the animal shelters that can assure the optimum necessary conditions is essential for developing a normal, physiological life inside the buildings. The internal climate conditions as: temperature, relative moisture and ventilation are determinant factors for obtaining high animal productions.

The correct sizing of the closing peripheral elements, from the building physics point of view, associated with proper ventilation maintain the environment between normal limits at all parameters.

The humidity regime of the construction elements is closely tied with their thermal regime. Due to the increasing of the humidity rate, the thermal conductivity increases, the thermal resistance decreases, reducing the animal welfare and raising the exploitation costs (Carmeliet, Roels, 1999-2002).

During the winter measurements and observations were carried out "in situ" together with specific calculations in building physics domain. It was taken into consideration the assembly of environmental conditions that define the animal welfare: temperature, relative humidity of the inside air, air movement velocity, it's purity and other specific factors as the temperature of the envelope elements, the quantity of air infiltrations through the closing peripheral elements, noise and light.

I. The peripheral structure has low thermal stability, being very sensitive to the temperature's daily variations. The existent insulation for the roof is not sufficient, so each variation of the air temperature changes the temperature of the inside surface of these construction elements.

The walls and the roof don't have the physical capacity to maintain the temperature variations of the inside surfaces and the air temperature between the limits that are required for animal welfare, without an energy supplement. This way, the sudden variations of the inside air temperature contribute in a negative way to animal health.

II. The humidity degree of the peripheral elements is in a tide relation with the environment temperature and has importance from several points of view:

The increase of the humidity degree inside the envelope's structure lead, as it was expected, to an increase of thermal conductivity, reducing animal comfort and increasing the exploitation costs;

High humidity level favors the conditions for mould, fungus and other biological products that affect the environment's quality. Condense phenomena appears on the inside surfaces of the envelope.

III. Infiltrations appear as a result of low proofing of the doors and windows and the air permeability of the cracked peripheral elements.

The differences between the air temperature near the floor and the roof's level is very high. At 2,50 m it's variation is between 4^0 and 10^0C.

In this situation increasing the thermal resistance of the peripheral elements is justified and it represents the solution to keep in function these farms as long as there are not enough funds to build new ones.

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