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Mould fungi in residential and agricultural buildings on farms

The formation of mould fungi in residential or agricultural buildings is a clear indication of construction-physical mistakes, penetrating moisture, or insufficient ventilation. This may not only result in higher energy costs, but also in massive damage to the substance of the building. The information given below shows how such damage can be avoided.

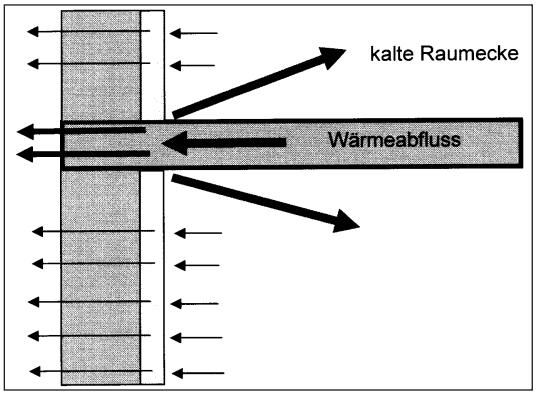

Fig. 1: Heat loss through the ceiling due to interior insulation

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Energy costs, i.e. also heating and cooling expenses, play a significant economic role in agricultural production. At the latest when the annual bill of the energy- or oil supplier comes, the insulation-technological weaknesses of buildings become apparent. This often leads to rash action, which is not only advantageous. Construction-physical mistakes can cause lasting damage. Therefore, insulation measures must not be considered in an isolated manner, but as part of a comprehensive system. Before a search for construction-physical reasons begins, however, it is necessary to exclude the penetration of water into parts of the building through untight walls, defective roofs or gutters. Even the smallest leakage which causes steady penetration of water can be the reason for mould formation.

Formation and spreading of mould fungi

Mould fungi occur everywhere in the ambient air. Only at high concentrations, however, do they pose a danger to health. Constant moisture in building parts not only leads to a reduction of insulation efficiency, but also to the spreading of mould fungi and spores, which result in rotting processes in organic materials. For this reason, not only direct water, but also high humidity in construction parts must be avoided. This can be prevented by additional heating, which keeps solid surfaces warm enough, or by means of strong ventilation, which dissipates humidity. However, both measures result in increased energy losses.

Relative humidity directly depends on the temperature. Cold air is virtually unable to store water (in a gaseous state). If warm, moist air cools down, the saturation point of water vapour is exceeded, and water vapour condenses on solid, cold surfaces. Especially in old buildings, where only parts of the building are insulated by installing windows which shut tight and thus lead to a lack of ventilation, for example, this problem occurs more and more often. Behind closets, covers, and insulation plates, fungi can develop undisturbed and spread their spores, which endanger the health of humans and animals, into the room air and, hence, into the food cycle without being noticed.

Interior insulation increases the danger of perspiration water formation. If old half-timbered- or clinker buildings are insulated, interior insulation is generally the only economical possibility of avoiding heat losses through construction parts. One of the disadvantages of interior insulation is that the massive shell remains in the cold. Therefore, the existing storage mass cannot be used. However, this has the advantage that the interior can be heated up relatively quickly – and cools down equally fast.

Warm air always tries to mix with cold air. This results in water vapour pressure from the warm to the cold. The problem with interior insulation is that heat is dissipated in the ceiling area even though the walls are insulated. Hence, the edges of the ceilings cool off more, which favours condensation. Together with organic wallpaper glue, this provides an optimal breeding ground for fungi.

The corner of the room becomes cold, which leads to the formation of perspiration water. This results in the development of mould and black spots in particular in the corners, where the exterior surfaces are disproportionately larger than the interior surfaces (*Fig. 1*).

Fig. 2: Mould fungi behind the base board in the living area

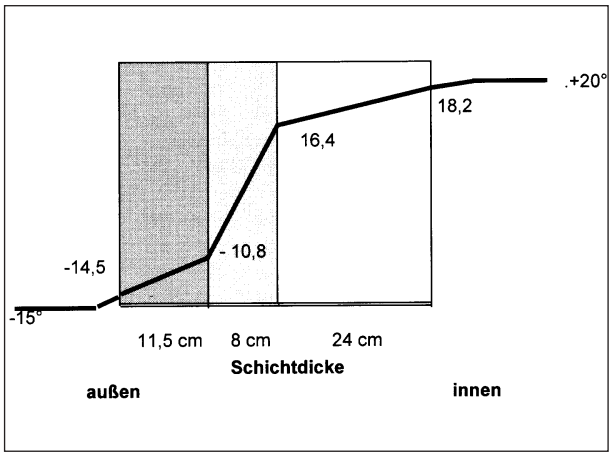

Fig. 3: Temperature cycle in a wall with 8 cm core insulation (between two stone layers)

Figure 3 shows how insulation influences temperature difference. While the temperature on the inner side of the outer wall (11.5 cm clinker) is –10.8°C, the inner walls (thickness: 24 cm) show a temperature range of 16.4° to 18.2° on the room surface. A warm interior surface contributes to a feeling of comfort and the avoidance of perspiration water on the surface. If possible, the interior surface temperature should not be more than 3 K lower than the room air temperature because otherwise heat radiation by the skin surface is so significant that it causes the impression of a draught.

Problems in agricultural buildings

Mould not only poses a danger to the health of people and animals, but also to the durability of buildings. Both stall facilities and storage buildings have different room climate requirements than residential buildings. In this case, climate must be understood as a combination of the influencing factors temperature and moisture in combination with technical measures for heating and ventilation.

- Stalls where high-yielding animals constantly release heat, water vapour, and gases
- Milking parlours which are additionally cleaned with lots of water and
- Storage halls where products which may not dry up and are thus kept at more than 90% relative humidity are kept cool

must be considered intensively moist rooms under construction-physical aspects.

Cleaning with high-pressure cleaners is an additional burden on the buildings.

For this reason, high humidity cannot be avoided in most agricultural buildings. Under these conditions, it is all the more important to optimize ventilation and to protect the construction parts against perspiration water by taking appropriate constructive measures and using proper building material.

Unheated buildings cool off through the roof and the wall during the night hours so that humidity can condense on construction parts, such as roof plates or in particular light plates. The water drops which form on the inner surfaces run down the roof area, become bigger and bigger, and fall either on animals and feed or penetrate into the purlins. Warm, humid air in combination with organic wood is an optimal breeding ground for mould fungi and putrefactive bacteria. Even if everything dries again when the stall is empty in the summer, the fungi live on and are reactivated during the next moist spell. The wood rots and loses its carrying capacity.

Measures for the avoidance and control of mould infestation

Before costly renovation measures are initiated, the reason for infestation must be analyzed, and deficiencies in construction, such as untight spots, must be corrected, if necessary.

In residential buildings

well-timed intermittent airing out in combination with heating is the most important prerequisite for the avoidance of mould. In addition, it is important to

- eliminate thermal bridges properly
- insulate floors above unheated cellar rooms from below and to avoid carpet out of organic materials
- remove interior insulation, such as thermowallpaper
- remove construction parts which are already infested with mould
- reduce additional sources of moisture (flowers, laundry dryers in the apartment…) as far as possible
- keep a distance of approximately 10 cm between externals walls and furniture standing near these walls.

If applied specifically for the treatment of infested spots, spraying the surfaces with alcohol at a concentration of 70 to 90% has proven an efficient measure depending on the dryness of the building. Household remedies, such as vinegar, are not suitable for the removal of mould. Such treatment may even be detrimental because acetic acid leaches lime out of the wall, which "fertilizes" the fungi and promotes their growth. The use of fungicides in rooms used for living is not recommended either because some chemical agents may cause allergic reactions in people.

In agricultural buildings

recurring problem spots should be given special attention, in particular with regard to building protection. In addition, massive mould infestation can also affect the animals and cause problems under labour aspects.

- Long roof plates, metal roofs, and light plates in the stall should be avoided because they lead to the formation of perspiration water and the penetration of moisture into the wood parts of the roof construction.
- Insulation measures in storage buildings by means of foaming should only be considered for anorganic construction parts on walls. The foaming of roof areas and wood constructions from the under side results in a significant danger of moisture penetration and thus provides points of attack for mould fungi.

Fig. 4: Mould in a potato store. When this point is reached, demolition is unavoidable.

- In constantly moist rooms, such as milking parlours, organic construction materials should be entirely dispensed with. This also applies to storage- and processing rooms for agricultural products, which are constantly exposed to humid air (such as slaughtering rooms, cheese factory…).