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Influence of natural insulating materials on interior climate

An important factor in the use of regenerative raw materials such as flax, wool and hemp as insulation is their performance in the presence of moisture and the associated possible influences on interior climate. Tests under practical conditions in a two-roomed climate chamber showed that insulating material from regenerative raw material could withstand substantially higher moisture contact without damage than had been thought. This result could mean an important improvement in market opportunities for the said insulating materials.

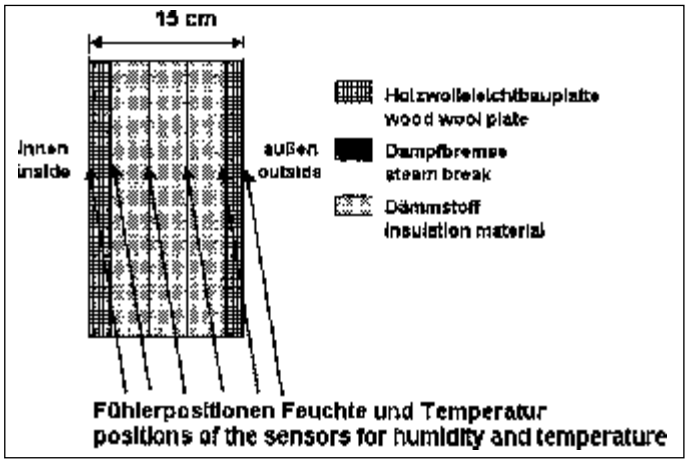

Fig. 1: Wall construction in the tow-room climate chamber

Insulating material from regenerative raw materials could greatly increase their current ~ 3% share of the insulation material market when:

- consumer advantages over conventional materials are more readily identifiable
- current price advantages of conventional insulation materials are reduced through developing a larger scale of production of insulating materials from regenerative raw materials
- environmental advantages of regenerative raw material insulation could be better expressed financially.

This investigation was made necessary because of the poor knowledge level regarding moisture effects with this insulation under practical conditions and the practice so far of largely protecting insulation from interior-sourced moisture penetration. To be investigated more closely, alongside the potential for interior climate influence in itself, was the danger of moisture damage to insulation as well as the constructional variants offering avoidance of this damage and simultaneous influences on interior climate.

Climate chamber trials

A selection of commercially available insulating materials from regenerative raw material was made for the investigations which were carried out in a two-room climate chamber. Insulating materials from flax, wood fibre and wool were tested in parallel with a conventional rockwool product. Firstly, all materials were subjected to moisture application and then investigated for microbial infestation.

The results indicated that insulation from the investigated fibres, where used properly (prevention of condensation, moisture over 90% and temperatures over 25 °C), is generally not susceptible to microorganism infestations. Clear microbial infestation took place only when condensation water formed within the material during the trials [2].

People's requirements regarding interior climate are associated with air temperature, relative moisture content, surface temperatures and air movement. The potential influence of regenerative raw material insulation on temperature and moisture susceptibility was investigated.

For own work, the isotherms of the investigated materials were measured over the relevant temperature ranges. The temperature dependency of results was not inconsiderable and was taken into consideration during the evaluation of the climate chamber recordings. The insulating materials were fitted in the same way (open to diffusion externally, varied interior vapour barriers, insulation thickness 12 cm, exterior and interior light wood-fibre panel cladding) onto a test wall within the two-room climate chamber and subjected to different test climates (*fig 1*).

Insulation reaction to moisture

Figure 2 shows how inert the insulation (wood-fibre) reacts, even in the surface-near layer – to the varied moisture values of the atmospheres applied in the trials. In the same trial climate and vapour barrier, rockwool showed substantially higher relative moisture values (and thus greater danger of microbial infestation) without absorbing any mentionable amount of absolute moisture. Basically, critical moisture contents in the

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Keywords

Insulation, regenerative raw materials, moisture behaviour, interior climate

Literature

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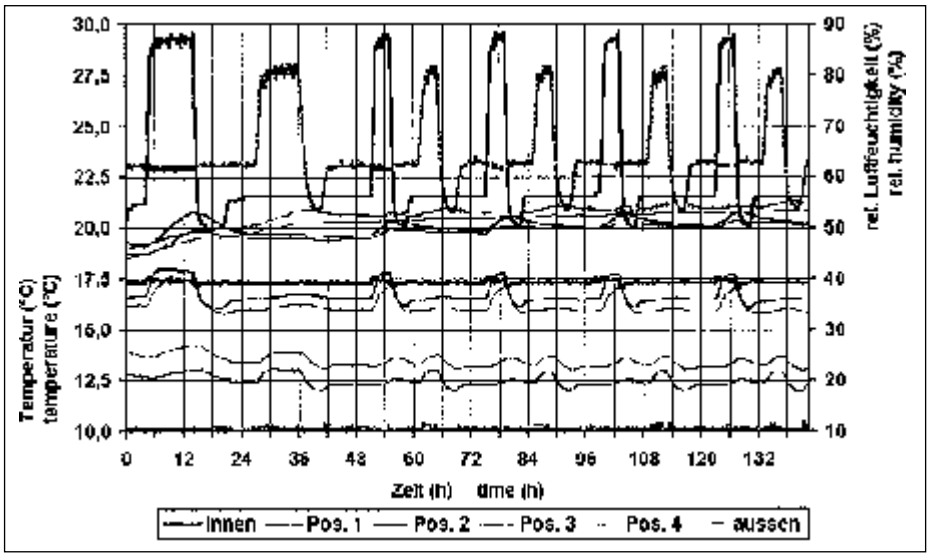

Fig. 2: Moisture and temperature gradients in a wall insulated with wood fiber (vapour barrier s_d = 0.1 m) [2]

insulation were not reached. Even with up to 10-hour phases of this climate (interior 85% relative moisture content/17 °C, exterior 55% r.m. /10 °C) with vapour barriers with s_d values of only 0.1 m led to limited relative moisture levels in the insulation of around 58% (wool), 55% (wood-fibre panels), under 60% (flax insulation) whilst the relative moisture in the rockwool variants reached up to 62%. The walls with vapour barriers showed a moisture reaction characterised by strong drying-out of the insulation towards the exterior. The material conducted the adsorbed moisture so well that this could be rapidly dispersed.

An important evaluation factor is the comparison of the walls with different materials investigated in the climate chamber regarding their absorption sped in the climates indicated. The absorption speed of wood-fibre was much higher than that of the other materials whereas the mineral fibre showed practically no absorption (*fig. 3*)

It can be seen that the insulation behind the light wood-fibre panels and a vapour barrier in the wall construction remained in moisture exchange with the interior atmosphere. Depending on the insulation material, where there were increases during the trials of about 55% relative interior moisture content to 85%, moisture exchange rates with 4 to 14 g/(m^2 • h) were achieved (rockwool: less than 0.15 g/(m^2 • h). Thus, for example, a dampness buffer effect is possible for the vapour emission of a person, typical value here is around 35 g/h, with a justifiable area. A short-term air moisture increase (cooking, showering) can also be balanced. The limiting of relative interior air moisture through ventilation with dry air in winter is able to be effectively compensated for with regard to exchange speed and absorption capacity.

Summary

An influence of insulating material from regenerative raw materials on interior atmosphere can be regarded as verifiable in principle on the basis of the results given here. As expected, this influence depends in the given extent of diffusion openness in the interior construction between insulation and interior atmosphere. For flax and wool the efficiency of the vapour barriers in the range between 0.1 and 0.5 m has only limited influence. In the microbiological investigation of the materials in the spectrum of temperatures and moisture values it was clearly shown that the insulation materials from regenerative raw materials could withstand without damage much higher moisture applications than previously thought. This result greatly increases the market chances for insulating materials from regenerative raw materials. According to the results of the trials and related to their scope, the manufacturers' claims often made regarding positive influences of insulation materials against moisture are justified even when, because of the complex relationships in the evaluation of interior climates through people themselves, the results cannot be presented directly in terms of figures. Further investigations are necessary in order to be able to better evaluate the influence of different production methods on the extent of moisture absorption as well as the absorption speed.

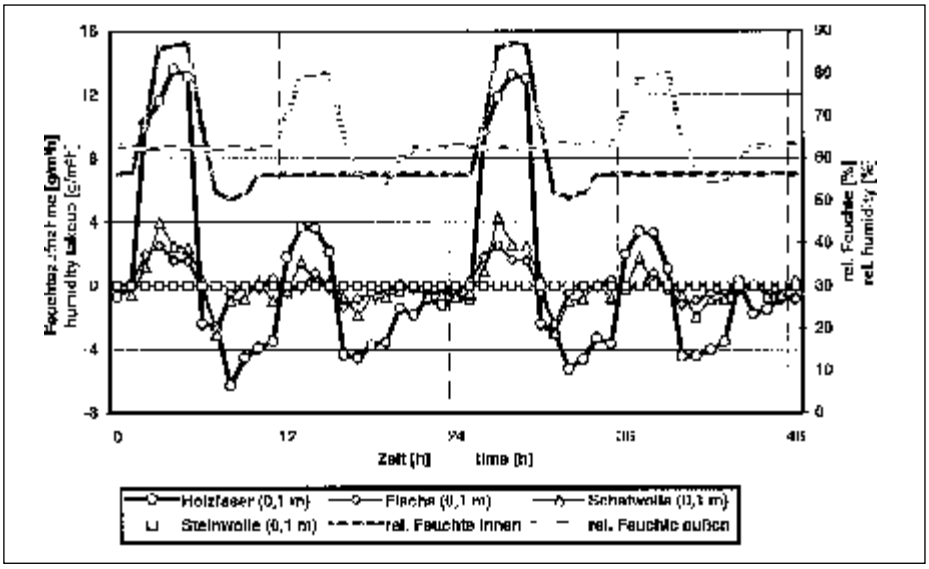

Fig. 3: Comparison of the humidity adsorption rate of different insulating materials in the wall construction (sd value of the vapour barrier), insulating material thickness 12 cm, rel. humudity (temperatures constant, interior 17.5 °C, external 10 °C) [2]