INNOVATIVE RETROFITS FOR FIGHTING MOULD IN RESIDENTIAL BUILDINGS

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INTRODUCTION

As a consequence of measures necessary for reducing the heating energy consumption in residential buildings, there have been more and more complaints in the last few years concerning the contamination of dwellings by mould, in particular in retrofitted old buildings. Mould growth is frequently the result of a marked reduction in the natural air change in old buildings caused by the installation of airtight windows and by unchanged user habits. In dwellings, an average quantity of humidity of 8 - 15 l/day is produced which is usually released through window joints. However, airthight windows and insufficient ventilation cause indoor air humidity to rise, something which may lead to surface humidity on cold external walls, e.g. at thermal bridges, thus providing ideal conditions for mould growth. The process can only be mitigated by increasing the surface temperature of the exposed areas, i.e. by improving the level of thermal insulation at the same time. Some examples of how to prevent or limit mould growth in housing will be presented below.

MEASURES FOR PREVENTING MOULD GROWTH

Paints

To prevent conditions favourable for growth, it is necessary to develop and utilise paints with alkaline pH values. Such paints are already on the market. However, their efficiency is limited. Since mould merely needs a layer of dust to germinate and grow, it is doubtful whether alkaline paint covered with dust will prevent their growth. Besides, it is not clear, whether the alkalinity, i.e. the inhibiting effect, does not vanish with time. In addition, the chemicals which alkalise the paint must not present any health hazards. These problems are particularly serious for fungicidal additives, which may lead to an increased level of chemical substances indoors. Chemicals represent a restricted possibility of fighting mould in residential buildings.

Electrical Strip Heating for Problem Areas

Due to missing or insufficient thermal insulation, low surface temperatures may result in critical relative humidities ranging above 80 %. Through heating these areas by way of electrical strip heating, surface temperatures may be increased such that the equilibrium relative humidity at the wall surface does not exceed critical values. However, heating also requires electric energy. To offset defects in the building structure by additional heating can only provide a temporary solution.

Ventilation

Missing or insufficient thermal and humidity insulation as well as insufficiently-insulated thermal bridges are related to the building construction. In comparison, the production and release of humidity are user-related. Surveys conducted in the Ruhr (FRG) [2], where modernized rental flats were examined, have shown that about one third of the damage is a result not of flaws in the building fabric, but of insufficient ventilation. If a building is constructed in accordance with the rules and regulations (thorough thermal and humidity insulation!), it is the difference between the quantity of humidity generated indoors and released that becomes the major cause for mould damage. As humidity is in general released through ventilation, a few ventilation methods for regulating the level of indoor air humidity will be discussed in the following.

The most common method is free ventilation by way of opening windows and through window joints. While the basic air change formerly took place through window joints, the installation of new, airtight windows now often results in mould contamination. To increase the air change by window ventilation is often insufficient as in many cases the windows are neither opened frequently nor long enough. Continuous ventilation results in increased heat losses during the heating period, and in cooled down window reveals (often with mould contamination of the reveal). To satisfy energetic and hygric requirements, a short period of intensive ventilation seems to be the best solution here. As the ventilation is actively influenced by the user - he assesses the air quality - this may nevertheless result in air change rates either being too high (energy losses!) or too low (risk of mould!). Several systems have been developed in order to adapt ventilation to requirements.

Free Ventilation Adapted to Actual Parameters

Based on the principle of free ventilation, a humidity-controlled ventilation unit has been developed at the Fraunhofer Institute of Building Physics (see Fig. 1).

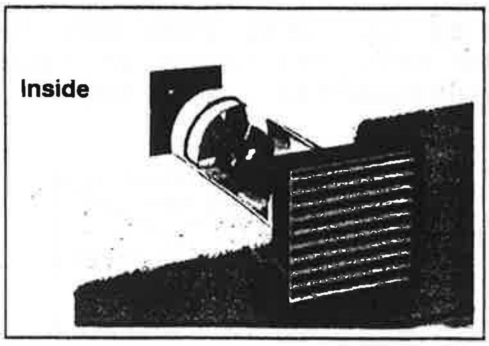

FIGURE 1. Automatic, humidity-controlled ventilation unit developed at the Fraunhofer Institute of Building Physics. It functions based on the principle of a hair hygrometer and reacts without electric energy. The air change is the result of pressure differences between indoor and outdoor air.

The unit is installed in the external wall of the building, thus providing a connection between indoor and outdoor air. Its sensor-regulated opening functions according to actual parameters (see Fig. 2).

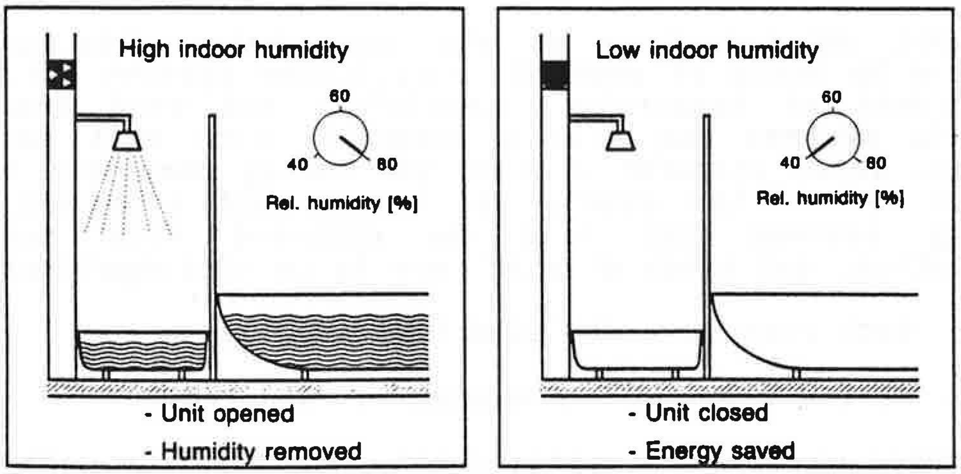

FIGURE 2. Principle of the ventilation unit: the unit automatically opens at high indoor air humidities and closes at low values.

At high indoor air humidities, the valve opens and an air infiltration starts, dependent on the difference of pressure between indoor and outdoor air (see Fig. 3). Several such units, which function dependent on wind pressure, are required to provide openings for supply and exhaust air. The unit is opened and closed by way of sensors working without auxiliary energy. The longitudinal dilatibility of adequate natural or chemical filaments due to the relative humidity of the surrounding air is used directly for adjusting the valve. For this reason, no auxiliary energy is necessary, and the unit works self-sufficiently for years. The air change is reduced by the unit when the indoor air humidity decreases below the critical value of relative humidity; at the same time, substantial ventilation heat losses are avoided, too.

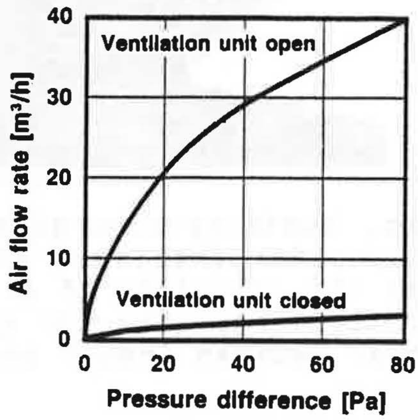

FIGURE 3. Air flow through the ventilation unit (above: open, below: closed), dependent on the pressure difference between the air of the room considered and the outdoor air.

Mechanic Ventilation Adapted to Actual Parameters

An exact determination of the air change rate can be achieved by means of mechanic ventilation systems which are independent of temperature conditions and wind pressure. Mechanic systems can also be combined with heat recovery systems, which transfer part of the energy contained in the exhaust air to the supply air via a heat exchanger. Air heating systems can also be combined with mechanic ventilation, two kinds of which are to be distinguished:

- Each room is ventilated individually

- Central ventilation system for all rooms

A switched-on mechanic ventilation results in a continuous air flow which, if it is sufficient, keeps the values of indoor air humidity in an uncritical range . If mechanic ventilation is not adapted to actual parameters, there will be unnecessary heat losses. By way of example, two such systems will be presented below.

Single room ventilators Single room ventilators are mostly installed in bathrooms and toilets. They are switched on together with e.g. the lighting system each time the room is being used. The ventilators frequently go on working for a certain time after the light has been switched off, in order to release a specified quantity of exhaust air and desorpt humidity. Hereby, it is not taken into account whether this is actually required for reasons of humidity production or hygiene. The device is provided with a ventilator powered by electricity.

Central mechanic ventilation adapted to actual parameters
Values of indoor air humidity are also kept in an uncritical range by way of humidity-controlled supply air and central mechanic exhaust air systems. In this context, a supply air valve is mounted between indoor and outdoor air, which automatically regulates the opening. A mechanic exhaust air system is mounted in the centre of the dwelling, permanently removing exhaust air with a suction pump. As the flow of supply air is controlled by the level of indoor air humidity, the supply air is in particular released from rooms where high values of humidity prevail. If all supply air valves are closed, the exhaust air suction pump is running against the joints of the windows and doors of the dwelling, thus leading to increased heat losses. It has to be mentioned that mechanic systems permanently consume electricity because of the suction pump.

CONCLUSION

In order to successfully fight moulds in housing, the interior of dwellings has to be such that the conditions for mould growth are eliminated. The first step at the occurrence of mould consists in investigating the building fabric to detect flaws in thermal and humidity insulation. If there are no such defects, it is often due to interior conditions that mould occurs. The most effective measure for improving the indoor climate consists in one of various ventilation systems based on free or mechanic ventilation. Mould prevention through paints is advisable only under certain conditions.

LITERATURE

[1] Schrodt, J.: Schimmelpilzbefall in Wohnungen. BDB -Bausachverständigen Handbuch 1988/89

[2] Erhorn, H.: Schäden durch Schimmelpilzbildung im modernisierten Mietwohnungsbau. Bauphysik, 10 (1988), H. 5, S. 129 - 134.