IVD-Instruction Sheet No. 14
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Sealants and Mould infestation
Causes – Precaution - Restoration

Content

0 Policy Statements on Standardization and Quality

Legal Framework

The following statements refer to the standard EN 15651 anticipated to come into force in 2012.
The following requirements resulting from the standard (e.g. use of CE-marking) are also expected to come into force in 2012 together with the standard.

Sealants as a construction product succumb to the European Construction Products Directive, CPD (in Germany transposed into national law by the Construction Products Act). Building products are by definition intended to remain permanently in the building. The Construction Products Directive forms the legal basis for defining the requirements for a general fitness of the products and the elimination of technical barriers to trade within the EU.
The directive itself only states targets, but not how to achieve them. These targets are summarized in the six essential requirements:

- Mechanical resistance and stability
- Fire Protection
- Hygiene, health and environmental protection
- Safety in use
- Sound insulation
- Energy saving and thermal protection

These essential requirements provide the basis for the creation of so-called "harmonized" standards. Such standards are prepared on the basis of a mandate from the European Commission, by CEN. The necessary compliance of a construction product with the harmonized standard is documented by the CE-mark. Without CE-mark a product must not be placed onto the market!
In developing the harmonized standards, the different circumstances of member states have to be taken into account via the introduction of classes, so that local products can still be placed on the market, i.e. the CE-mark only indicates suitability for distribution in the EU, which does not necessarily imply a high quality standard.

The harmonized standards are created as EN standards and then adopted as DIN EN standards in Germany. Possibly conflicting national standards shall be withdrawn from that date. However, some further parts of the national standards continue to exist as a so-

called "residual rules". Thus, if essential national building code regulations are affected, a product not compliant with these rules may not be used in this country, despite the CE-mark.

1 Preamble

Not only in connection with sealants, but also in many other areas of everyday life the infesting of substances by microorganisms such as mould can be observed. This is known from foods such as bread and fruit, but also for walls, ceilings, wood and plastic surfaces in homes, where microorganisms undesirably colonize.

2 Scope

In this leaflet causes, corrective actions and preventive measures for mould growth on cured sealants are described. The instruction sheet contains information about:

- General information in chapters 2 and 3
- For planners in chapters 4, 5 and 7
- For fabricators in chapters 4, 6 and 7
- For builders in chapters 4, 6, 7 and 8

3 Mould

Mould can be summarized in a large group of fungi, of which about 60,000 species are known to date. It is estimated that there are over 250,000 species. In nature fungi together with bacteria take over the important task to degrade organic material such as leaves or compost to recyclable materials, which are made available to the plants in the form of nutrients.

Man has taken advantage of the special metabolic properties of many fungi for a long time. Certain types of mould are used in the processing and conditioning of some foods. Familiar examples are Penicillium camemberti for the production of Camembert and Brie. The technical use of many fungi is equally unimaginable. So many antibiotics such as penicillin are derived from mould.

”Mould” is no systematic biological concept, but a collective term for mushrooms growing on the surface in the form of filaments. The extension of this thread braid (mycelium) is often invisible to the naked eye. Mouldy bread, but even so an infected sealant usually is much more permeated by fungal mycelium, as this is obvious. Mould often only gets visible when the mostly colored reproductive organs, the so-called spores (conidia) have formed in large numbers.

Mould has the following characteristics:
Adaptability to different food sources
High growth rate under favorable environmental conditions
Formation of large amounts of spores.

The best known mould genera are:
Aspergillus species (watering can mould), such as Aspergillus niger
Penicillium species (brush or green mould), such as Penicillium spinulosum
Paecilomyces species, such as Paecilomyces varioti
Fusarium species, eg Fusarium verticillioides
Alternaria species, such as Alternaria alternata
Cladosporium species, such as Cladosporium herbarum

3.1 Occurrence, Development and Growth of Mould

Mould and especially mould spores are ubiquitous in the environment. They are, for example, in the form of spores in the air and in dust and soil (also in potting soil). Spores are generally round cells with an average diameter of 0.01 mm. These cells can stay alive in dry air for a long time and are diffused by the wind like dust particles. Fungal spores are heavier than air and sink with no wind. If spores meet surfaces that provide them with suitable conditions, they start to settle.
Under favorable conditions for fungal spores, ie, in a warm and humid climate, the spores can germinate. They form a germ tube and subsequently, with a sufficient supply of nutrients, by further growth form an extensive fungal mycelium, before new spores ripen.

3.2 Ambient Conditions

Mould mycelium can grow very quickly in favorable conditions. Optimal conditions for most moulds are:

- Humidity relative humidity >80 %
- Warmth especially 20° bis 35°C
- Suitable medium
- pH value especially pH 4.5 to 6.5 – that is slightly acidic conditions
- low air movement promotes the deposition of fungal spores and the formation of a high humidity.

4 Fungicides and their Mode of Action

Microbicides are substances that kill the microorganisms. A distinction is made between:

- Fungicides — are effective against mildew
- Bactericides — are effective against bacteria
- Algaecides — are effective against algae

Mould can also be affected by physical environmental factors, such as heat and UV rays. Microbicides one the one hand can be found in nature and on the other hand are produced artificially. In addition nature uses a series of chemical microbicides to protect animals and plants from being attacked by mould. For the continuation of life of animals and plants, these microbicides are essential.

Many building materials must also be protected against mould growth. The same is true for sealants used in many applications.

Fungicides are active ingredients against mould. They are added to the sealants in small quantities. There is a distinction between a film preservation of the applied product and conservation of the pot, such as microbicides to improve the durability of acrylic emulsion sealants during storage of the product. In the following just film preservatives are treated.

To protect the cured sealants against attack by mould, fungicides are only slightly soluble in water. Thus they can develop their full effectiveness in the border area of the sealant surface. If the joint is excessively stressed by water, eg in a permanently used public shower or underwater, the effect of fungicides may quickly subside. The duration of the efficacy of fungicides is partly determined by the water stress on the sealant and the intensity of the mould infestation.

Several fungicides have a different spectrum of efficacy, ie they are effective against a certain range of mould species.

There is no danger for humans from the added fungicides in sealants since they usually have a very low water solubility and extremely low vapor pressure and are thus transferred neither into the air nor into the water in significant concentrations.

5 Causes for Mould on Sealants

Apart from structural-physical defects in the construction mould growth on sealants is favoured especially by the following factors:

First:
Lots of moisture
unfavourable joint formation on the surface of the joint

Second:
Nutrients for mould
inadequate cleaning / hygiene

Third:
High indoor humidity
inadequate ventilation

5.1 Unfavourable Joint formation

Joint designs that allow for water to accumulate on the sealant surface, for example by a distinct chamfer formation, promote mould growth. The joint design thus is of vital importance. See also section 7.1.

5.2 Inadequate Cleaning and Hygiene

Sealants can absorb dust and dirt from the environment on the surface. In combination with high air humidity that organic-based pollution represents an ideal food supply for mould.

5.3 Inadequate Ventilation

Areas with higher susceptibility to mould in residential buildings these are areas with high humidity onset:

•Bath / Shower / Toilet	•Sanitary area
•Cooking zones	•Kitchen
•Small rooms with a lengthy presence of their inhabitants	•Children's rooms •Bedrooms

•Damp walls	•Thermal bridges •Poor insulation on exterior walls in old buildings •Rising damp in basements
•High water evaporation	•New buildings •Rooms with lots of plants •Swimming Pools •Sauna •Winter Gardens
•Rooms without windows	•Sanitary areas / toilets with inadequate air exchange •With ineffective ventilation facilities
•Areas with cold condensation	•Windows •Thermal bridges

In public buildings, sports facilities and commercial enterprises:

•Rooms with a high water consumption	•Public showers in swimming baths •Sports facilities and sauna areas
•Rooms requiring a high level of cleaning	•Food- and Beverage Processing

In areas underwater and in rooms with accumulating humidity:

•Swimming- and Bathing pools •Drinking water reservoirs	

Large rooms with low usage and low moisture accrual are in general not infested by mould.
Joints of all kinds, perimetre joints, floor joints and glazing joints can be subject to mould infestation, but also porous surfaces such as concrete, mortar or plaster surfaces, and even tile and wood surfaces, wallpapers etc. This is especially true for areas without direct ventilation.

6 Fungicidal activity and Requirements for Sealants

The efficacy of fungicides in sealants can be determined in accordance with ISO 846, Method B, with the help of the five test fungi mentioned there. There is a growing strength of ≤ 1 required. This ensures a high level of safety.

6.1 In Sanitary areas

Sealants for use in sanitary areas must be abrasion resistant and must fulfil the requirements of the IVD-Instruction Sheet No. 3, Section 6:

- fungicidal treatment
- resistance to flow
- small volume change
- good adhesion with adherence to the technical notes regarding primers by the sealant manufacturer
- expansion behaviour and elastic recovery

6.2 In Drinking water areas (storage and pipes)

Sealants that get in contact with water may not cause a deterioration of the microbiological quality of drinking water due to the release of organic, microbial utilizable ingredients.

Therefore, sealants for expansion joints must be tested according to the KTW-Richtlinie (KTW directive). They may only contain certain suitable ingredients, among them are no fungicides. They may not release virtually any ingredients into the water, which may change the water quality regarding taste and odour and may not significantly influence the effect of disinfection by chlorination.
In addition, the technical rules of the DVGW Worksheet W270 apply.

6.3 In Pool areas

The Federal Institute for Consumer Health Protection and Veterinary BgVV in its "Recommendation concerning the aptitude test for plastic materials in the pool and bathing area (CPC)" only allows for plastics, including sealants, which meet the requirements of KTW and DVGW W270. These are applied regarding joints in the area of pool water and for the overflow channel and in all water-carrying parts. The use of microbicidal additives is rejected for reasons of hygiene.

Joints which are exposed to permanent underwater contact are maintenance joints according to DIN 52460. They require constant care, especially in swimming pools (see also IVD-Instruction Sheet No. 15 - The Maintenance of movement accommodating Sealants and affixed elastic Joint Tapes).

DIN 19643 - part 1 to 3 - sets for the operation of swimming and bathing pools in public baths cleaning intervals and methods, which are to be observed. For private baths too adequate measures for the hygienic operation are required.

The temporary non-compliance with the operating poorer water qualities, especially in dead zones, where the water exchange only works inadequately, may cause discoloration of the sealant surface. Particular emphasis should be placed on the proper operation of the recirculation and filtration systems.

6.4 In the living area (glazing rebate sealing)

Requirements for sealants for glazing are regulated in DIN 18545, Part 2. Additional antifungal equipment according to DIN 18545 and IVD-Instruction Sheets No. 10 and No. 13 is not required.

The increasingly dense building technique with higher requirements for thermal insulation (air tightness of the building shell) increases the tendency for condensation on the inside of the window. The condensate water runs down the glass, collects at the bottom seal and does not dry quickly enough. These humid conditions may foster mould growth. Therefore, a fungicidal treatment for glazing sealants is recommended.

7 How to detect Mould on Sealants?

Typically point-shaped, coloured stains develop on the sealant surface during the first infestation with mould. Over time, these spots enlarge. It is also typical that only sections of the surface are affected. The stains are often black, but they can also have a yellowish, reddish or brown colour. The stains can be removed either mechanically or by normal household cleaner from the surface of the sealant.

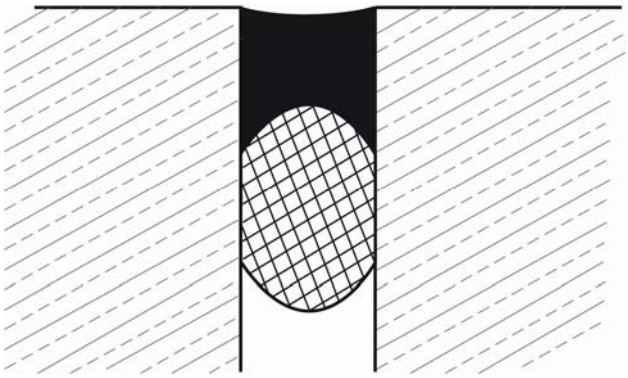
Other causes of discoloration may be that the sealant is in contact with building materials incompatible with the sealant. This usually not only leads to superficial discoloration, but also the discoloration within the sealant.

Moulds can be determined nonambiguously by experts through a microscopic examination and microbiological analysis.

8 Precaution against Mould

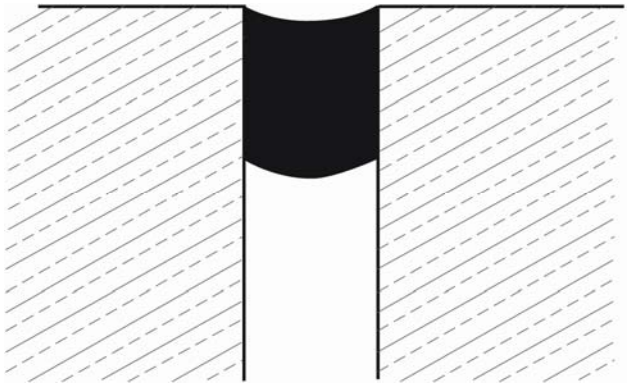
8.1 Proper Jointing to avoid Mould infestation

During the jointing the surface of the sealant has to be executed so that moisture can not gather or accumulate. This must be watched especially for floor joints, floor-wall connection joints and for windows at the bottom glass sealing joint. Here sealants with low loss rates prove more effective.



Correct joint formation:

- With little chamfer
- Sealant with little loss of volume
- with closed-cell sealing cord



Wrong joint formation:

- With strong chamfer due to high loss of volume
- Through non suitable burnishing tool
- Without backer-up

The recommendations of the sealant manufacturer regarding primers must be observed. Sealants have to be inserted into the joint, so that the joint edges are completely covered

and there is no edge detachment. The sealant surface shall be racked smooth with a suitable tool before the skin develops.

Tooling agents should be used sparingly so that little residue remains on the sealant. The use of special tooling agents in the concentration specified by the sealant manufacturer is advisable. Less suitable are many common household cleaners. They do have a good smoothing effect, however, form nutrient-rich residues for bio fouling. The tooling agents shall not affect the adhesion of the joint edges and not cause discoloration on the sealant and the adjacent components.

8.2 Joint cleaning

Regular cleaning of the joints:
with surface-active cleaning agents, with agents containing vinegar for descaling, with a well wetted cloth or sponge, Wipe dry.

- Sanitary areas: Rinse sealant after the bath / shower with clear water in order not to provide a breeding ground for mould on soap and shampoo residues and other organic particles, which are located at the sealant surface.
- Sufficient ventilation (cross ventilation, draft)
  In order to dissipate high humidity levels. (Avoidance of condensation on cold surfaces in basements).

8.3 Proper Ventilation of living areas

The most common cause of mould infestation in residential buildings, apart from imbued parts due to structural-physical defects (planning), is inadequate ventilation of the premises.

While shortcomings in planning and construction certainly cannot be attributed to the residents, it is within their responsibility to ensure a good indoor climate and thus the ventilation.

Naturally, the air is loaded with carbon dioxide, water vapor and odors of the humans. For hygienic and structural-physical reasons thus there is the need for ventilation.

Water vapor exposure dependant on room use
Different room uses constitute a different concentration of the loading substances, whereas with respect to the mould growth there is a focus on indoor air humidity and thus on the water vapor concentration in the room air.

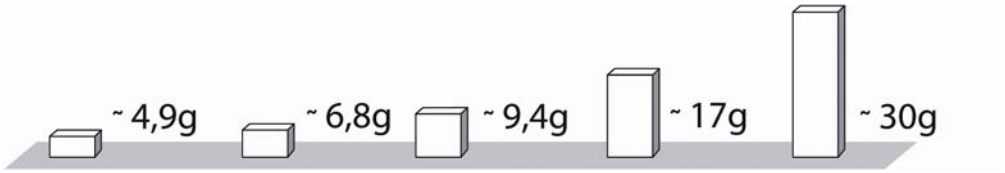
Development of indoor air humidity by:	Amount of Moisture:
Bathing / Showering	1-1,5 litres per person and day
Drying laundry	1,0 – 3,0 litres
Cooking	0,4 – 0,8 litres per cooking time
Dish washer	0,2 litres per flush
Washing machine	0,2-0,3 litres per wash
Aquarium, Indoor fountain	0,9-1,2 litres per m2 water surface and day
Potted plants	0,5-1,0 litres per day
Respiration of humans during the sleep phase	~ 1 liter per person

Values taken from: „Energieeinsparung durch richtiges Heizen und Lüften“(Energy saving by proper heating and ventilation)

In the corresponding rooms thus there is also a higher risk for the formation of mould (see also table in section 5.3).

Structural-physical relationships - ventilation
Air is able to absorb limited amounts of water in the form of water vapor until it is saturated. The amount of water is very strongly dependent on temperature.

Absorbed amount of water in 1 m3 of air:



At: 0°C +5°C +10°C +20°C +30°C

Cooler air is drier air!

With increasing temperature, the amount of absorbable water vapour to the air also increases. Thus the aim of the ventilation of the living room must be to exchange used, moisture-laden air of a higher temperature for significantly cooler air. The cooler air is heated after the ventilation process and thus can absorb bigger amounts of humidity.

Proper ventilation of dwellings:
In cases of high humidity it is recommended to ventilate at least three to four times daily. During the ventilation process the air in the room should be completely replaced within the shortest possible time. This means that windows and doors of opposite rooms must be opened wide (cross ventilation). The ventilation time depends on the ambient temperatures:

- At least 5 to 15 minutes

Winter temperatures ideally dry the living room rather quickly, i.e. short ventilation suffices. In the transitional seasons, although the temperature differences are not that great, the ventilation time accordingly is longer.

A continuous ventilation of the rooms is a waste of energy!
In the summer time at warm temperatures the windows often are opened in order to get a certain air movement with a pleasant climate. Due to this very quickly a balance between the climatic conditions inside and outside develops, which generally results in no excessive moisture load.

- Exception: In ever-cool areas such as basements
  Extended ventilation in summer may bear the
  Danger of condensation on cold surfaces

Bathrooms, but kitchens as well are depending on the floor plan sometimes executed without a window. In these rooms an indirect ventilation should ensure the exchange of indoor air, eg by a fan installed in a ventilation shaft. The usually automatically controlled ventilation systems are often coupled with the light switches. After switching off the light the fan should go off only after a sufficient time delay so that the moisture can be removed from the room air. The length of stay in the bathroom alone certainly is not sufficient for a complete air exchange. Recently, ventilation systems are offered, which are coupled to a moisture meter. They provide a safer discharge of moisture.

In public buildings effective ventilation concepts are to be ensured.

9 How to remove Mildew Stains?

Mould growth on sealants is at least a visual impairment. Infestation of larger areas can also lead to health impairment. Basically a cleaning or restoration of infested areas in inhabited rooms is advisable.

In the early stages of infestation (primary infection) mildew may be removed successfully from the surface of the sealant. For this a number of products are available, of which those containing chlorine are the most effective. If the infection progressed very far, which means the inside of the sealant is discoloured (secondary infection); a permanent solution can only be achieved by removal of the infected sealant and re-grouting.

The instructions for storage and the application of mould-fighting agents have to be strictly adhered to. The products should be rinsed off with clean water after their application time. For subsequent disinfecting the surface can be treated with a 70-80% alcohol solution (denatured alcohol in water). During the treatment, and subsequent drying the areas should be ventilated adequately. It is important that after a successful removal of mildew stains the conditions for future growth should be removed through appropriate ventilation and cleaning methods. If this is not obeyed, a new infestation can be expected.

If the sealant has no more adhesion to the joint edges, moisture can penetrate the joint at this point. This can lead to structural damage and also to the formation of mould in the joint areas. In this case, the sealant must be removed and the joint and in particular the adhesion area has to be cleaned. Then re-grouting is carried out, taking into account the recommendations of the sealant manufacturer.

Joints with a strong chemical, biological, physical or mechanical stress are maintenance joints according to DIN 52460. Among them are joints with severe water stress, excessive dirt and frequent cleaning cycles. These include joints in heavily frequented wet areas, under water, in hospitals and commercial enterprises. Here the joints as well as the other surfaces must be monitored at regular intervals. In accordance with the above instructions infestation must be cleaned and, if necessary, the sealant may be renewed in order to avoid subsequent damage.

Swimming and bathing pools should be emptied on a yearly basis, during which the joints should also be checked.

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Contributors:

Thomas Keuntje

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Price on application.

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In addition, all information about the joint-sealing in the areas of soil, facade, windows, sanitary and water construction.

As well as the IVD term search, the entire sealant online lexicon and continuously updated news about the topic.

www.abdichten.de – Your internet platform for joint sealing.

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