

General information for the use of CONICA primers and blocking (barrier) primers on substrates with increased residual moisture or backward exposure to moisture

1. Product description

CONIFLOOR EP 110, EP 112 N, EP 115, EP 116LE and the CONIPROOF EP 190/1 and EP 191/1 used in the car park deck coating systems are solvent-free (total solid), unpigmented, partially prefilled (CONIFLOOR EP 112 N) epoxy resins, which are characterized by a very high degree of cross-linking and in the hardened state characterized by a "lack" of water-soluble substances.

All above named primers are primers that are used in CONIFLOOR and CONIPROOF reactive resin coating systems. These can also be used, if there is a risk that the residual moisture content in the concrete is above 4% (CM) but less than 6% (CM) and also rising water can also have an effect below the coating system. The risk of damage that often occurs in such cases (e.g. blisters due to osmotic processes) can be avoided or reduced by using CONIFLOOR EP 110, EP 112 N, EP 115, EP 116LE as well as CONIPROOF EP 190/1 and EP 191/1 [if a film-forming and double application is carried out](#).

CONIFLOOR EP 110, EP 112 N, EP 115, EP 116LE as well as CONIPROOF EP 190/1 and EP 191/1 offer the greatest security of all primers in the CONICA delivery program against damage due to backward-acting moisture and should therefore be preferred to other CONICA primers on new cementitious substrates especially in direct contact to the subsoil.

All these CONIFLOOR primers can be over coated with all solvent-free (total solid) on epoxy resins or polyurethane resin-based coatings from the CONICA product range (see system data sheets).

2. Application fields

CONIFLOOR EP 110, EP 112 N, EP 115, EP 116LE as well as CONIPROOF EP 190/1 and EP 191/1 are used as a primer below CONICA reactive resin coatings in areas with expected rising moisture, even under coatings that do not have sufficient water vapour diffusibility.

They can also be used for priming floor plates in contact with the ground, e.g. Underground garages, industrial floors, etc., which have no sealing against rising damp ("white tub"). With this type of construction, the use of water-impermeable (WU) concrete prevents the ingress of water, but not the diffusion of water vapour. Furthermore, it can be used as a primer for concrete containers (e.g. in drip pans, rainwater retention basins), especially when there is no adequate external waterproofing is available.

Another area of application is the coating of concretes, which are dry on the surface, but which still contain an excess of mixing water in the core. This is often the case even after the frequently quoted "28 days" drying and curing time has expired, if

- the concrete was processed with a too high water/cement ratio,
(We recommend a W/C ratio of < 0.48 or lower, otherwise there is a risk of capillary pores forming)
- the concrete cannot dry out quickly because it touches the ground or is laid on insulation,
- the concrete can only give off a little water due to high air humidity (often in poorly ventilated, cool underground garages and basements even after months after installation); here the dew point during processing must be observed in any case.

CONIFLOOR EP 110, EP 112 N, EP 115, EP 116LE and CONIPROOF EP 190/1 and EP 191/1 are not generally used to coat concrete surfaces that still have a very high level of residual moisture at the time of processing. In individual cases, these cases must be clarified with the technical department from CONICA and approved by them.

CONICA – General notes – Blocking primer below coatings

The primers are approved in the technical data sheets up to a residual moisture of $\leq 4\%$ (CM). In the case of an increased residual moisture of up to $\leq 6\%$ (CM), an application must be carried out in 2 work steps, whereby the first work step is not allowed to be sprinkled with quartz sand and a second work step must be carried out within the specified reworking times. The further system structure decides whether this must then be sprinkled with quartz sand or not. It is important that the application is "film-forming", which is usually at least 500 - 600 g/m² (even higher if there is a high absorbency, for example with cement screeds) without sand sprinkling and the second step is at least 300 - 500 g/m². These guidelines may be verified on sample areas on site.

3. How CONIFLOOR / CONIPROOF epoxy resin primers work

In the following, possible damage mechanisms, the probability of their occurrence and the mode of action of CONIFLOOR primers are described.

3.1 Possible damages when exposed to water pressure and / or high residual moisture with coatings

3.1.1 Vapour pressure

In the past, damaging influences on coatings, which are installed on concrete and cement screed substrates, were attributed to an increase in the temperature of the steam pressure.

According to a concomitant opinion and in various specialist literature, the formation of bubbles due to vapour pressure is rather unlikely when the coating has already reacted fully.

In the regulations and recommendations of the coating manufacturers, at least 1.5 N / mm² adhesive tensile strength is required for the subsequent coatings on cementitious substrates. With an OS 8 coating (accord. to EN 1504-2) and with high chemical resistant water protection coatings (accord. to WHG § 62) with traffic and a layer thickness of min. 2.0 mm, which are used in structures in contact with the ground, a minimum tensile strength of 2.0 N/mm² is required. The fracture must take place in the concrete or cement screed. As a rule, this is easily achieved with a suitable substrate with reactive resin coatings.

In order to exceed these adhesive forces, at least a higher pressure of a gas (e.g. water vapour) above these forces must be created. 1.5 N/mm² would correspond to a gas pressure of 15 bar, which would be 5 times the pressure in a normal car tire. It is very unlikely that you can build such high pressure in the concrete.

According to Fiebrich (1), an overpressure of approx. 0.04 N / mm² can arise, if the temperature of water vapour-saturated air increases by 60 K. This overpressure, which can theoretically form in a pore under the coating (prerequisite would be an absolute tightness of the pore walls) is not able to exceed the adhesive strength of the coating by > 1.5 N/mm² and lead to a detachment or is able cause blistering.

This does not consider the formation of bubbles that occur during the application of coatings if the coating is applied at increasing temperatures. Due to the temperature increase, the air in the pores, bubbles can form blisters during the hardening process (gel time). For this reason, the general principle applies only when the temperatures are constant or falling.

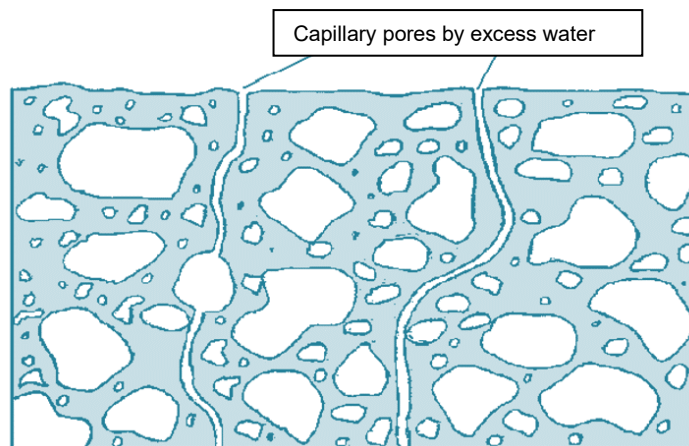
3.1.2 Hydrostatic pressure

Even a water pressure caused by rising water can only rarely be held responsible for the occurrence of detachments. To pull off a coating with an adhesive strength of 1.5 N / mm² theoretical a water column of 15 m is required. Even with underground garage floors, which is very deep in the ground, however, hardly any pressures above 15 m water column can be expected.

An exception to this is water-bearing cracks that can also occur later. Here, the use of dynamic crack-bridging coatings must be considered separately since major damage cannot be excluded here.

3.1.3 Capillary pressure

Capillary pores in the concrete result from evaporating water, which is not involved in the hydration (chemical process of hardening the cement stone) (= excess water / mixing water). The formation of capillary pores is consequently influenced by the water cement ratio w/c or cement quality. The water not chemically bound (the hydration needs only a w/c of 0.4) evaporates and leaves finely branched capillary pores in the concrete.



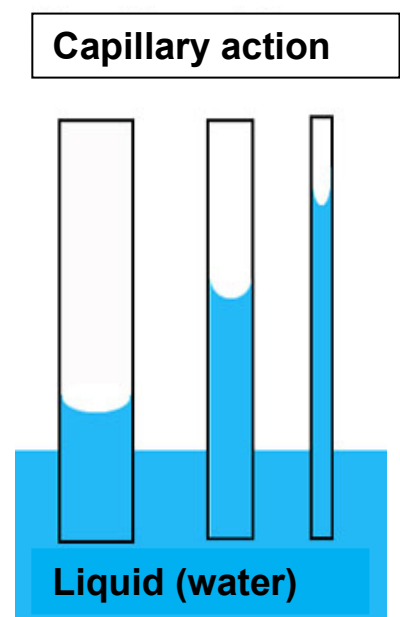
The proportion of capillary pores is therefore lower, the lower the water cement value is. A water cement value W/C <0.48 is recommended. To improve the processing ability of the concrete, the use of concrete plasticizers or liquefiers is recommend keeping the W/C low.

The number and diameter of the capillary pores are decisive for the water permeability of concrete. Under certain circumstances, the pressure building up in capillary pores is able to produce detachments on coatings. According to a rule of thumb, the rise height (for water) in a capillary can be calculated as follows:

$$h_{\text{cap}} = 30 / d \text{ (d = Capillary diameter)}$$

As a result, the height of rise (and thus the water or air pressure acting in the capillary) increases with decreasing capillary pore diameter. The finer the capillary pores, the higher the capillary pore pressure can rise. For this reason, higher capillary pressures can be expected in high-quality concretes (e.g., C50/60 or C55/67) than in low-strength concretes, which are usually, have capillary pores with a larger diameter.

The capillary pores found in the cement stone can have very small diameters with correspondingly high pressures. In purely arithmetic terms, an internal pressure of approx. 49 bar (corresponds to a tension of approx. 4.9 N/mm²) can exist in a capillary pore with a pore radius of 30 nm under ideal conditions. In practice, however, pressures of this magnitude have never been demonstrated.



CONICA – General notes – Blocking primer below coatings

If the danger of high capillary pressures is seen, a primer must be used which, due to its good wetting, achieves very good adhesion to the substrate and is able to close off capillary pores. CONIFLOOR 110, 115 and CONIPROOF EP 190/1 and EP 191/1 are suitable for this.

If these are not sufficient, the subsurface may have to be prepared in advance with a very low-viscosity or slow-curing epoxy resin impregnation, here CONIFLOOR 100 should be applied in a test area.

Primers with a high solvent content are much low viscous due to the solvent content (up to 70%) but should never be used on substrates where rising water or higher residual moisture content is available because this can build up the risk of osmotic processes. The addition of solvents also worsens the guaranteed technical properties and is not recommended.

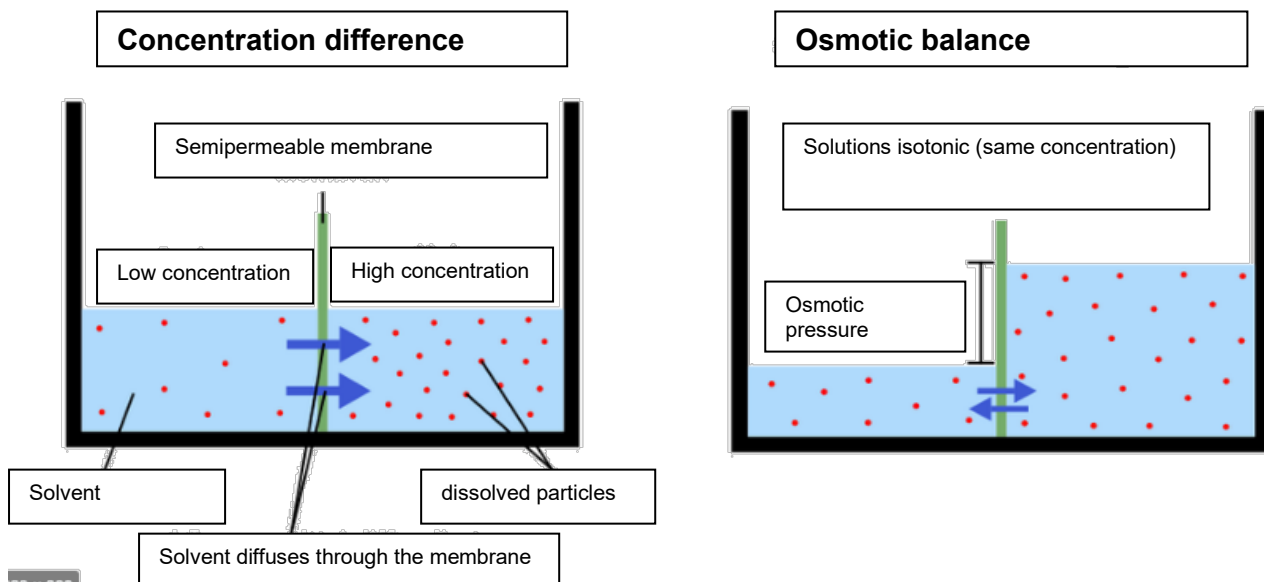
3.1.4 Osmotic pressure

An osmotic pressure is a hydrostatic pressure that can arise below a coating if two liquids (solutions) of different concentrations are in contact with each other but are separated from each other by a "semipermeable membrane".

General explanation of osmosis:

If two differently concentrated solutions (e.g., saline water, solvent-containing liquid) come into contact with each other, they have the desire to exchange information until the same concentration of the solution (e.g., salt water) has set in both liquids. If a semipermeable membrane from each other separates the two liquids, the pure water can pass through "diffusion", but not the substances dissolved in the water e.g. the salt dissolved in the water.

First, the salt tries to distribute itself evenly in both liquids in order to create a concentration balance. However, the semipermeable membrane is not passable for the salt, but since the liquids still strive to equalize the concentration, a "different way" is now used: Instead of the salt, the water now passing through the semipermeable membrane to produce the concentration equalization. Now the water level in the liquid with the low concentration will drop, while the water level in the highly concentrated solution will rise. If the rise in the water level is impeded (containers with constant volume), a pressure rise will be observed there. The osmotic pressure in a saturated saline solution can for example rising up to 380 bar (corresponds to 38 N/mm²).



CONICA – General notes – Blocking primer below coatings

Now the transfer to the problem of "osmosis formation" in concrete and floor coatings:

Liquids can also be found in and below concrete or in cement screeds if moisture penetrates from the outside, due to a lack of a damp proof membrane (D.P.M) or remains as excess mixing water (increased residual moisture) in the concrete or cement screed.

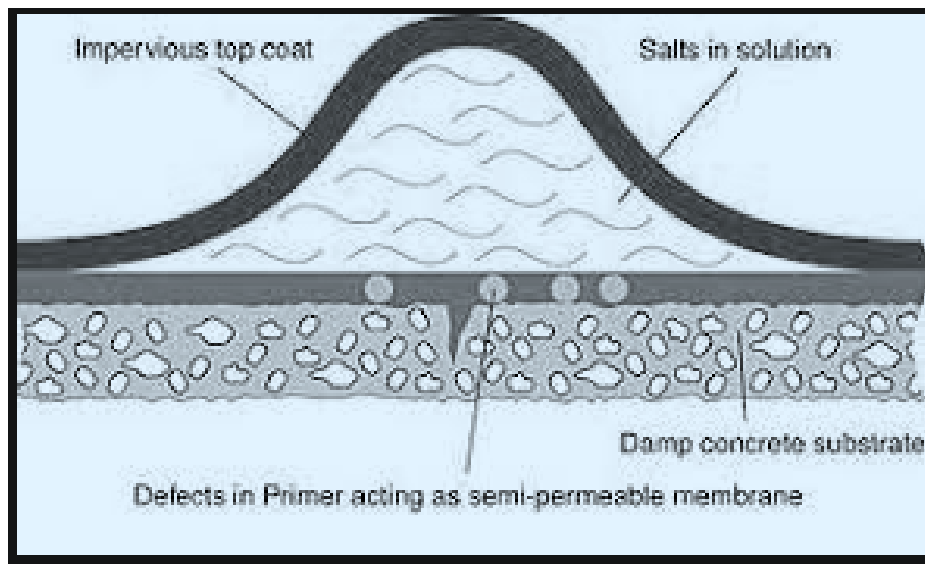
This water can now form a solution with a certain concentration with water-soluble substances found in the interface with the concrete or cement screed.

Water-soluble substance could be e.g.:

- Impurities on the surface of the concrete or cement screed that have not been completely removed
- Salts (de-icing salt)
- Minerals
- Solvents (alcohol, e.g., dilutions that are water-soluble)
- Saponification products
- Volatile, uncross linked components of the coating (plasticizer, reactive thinner)
- Excess of A or B component

Since this liquid is in contact with pure water, an effort to balance the concentration can also be observed here. If a semipermeable membrane now separates both liquids, the compensation can in turn only be achieved by adding clean water to the highly concentrated liquid. As a result, water collects in osmotic bubbles under the coating.

Since the one layer applied or even with silica, sand scattered primer (rarely liquid tight, rather porous, i.e., "semi-permeable" primer) very often takes over the function of the semi-permeable membrane, the water consequently collects in the interface between the primer and the top coating. If the osmotic pressure that builds up exceeds the adhesive strength of the coating on the primer, the known osmotic bubbles occur.



Osmotic blister in a coating (sectional view)

In rare cases, however, bubbles also form under the primer: It is therefore assumed that a concrete surface impregnated with epoxy resin primer can also take on the function of a semi-permeable membrane.

CONICA – General notes – Blocking primer below coatings

In the chemical analysis of filled bladder contents (4), water was found as the main component. Solvents, organic salts (acetates, phthalates, etc.), as saponification products of plasticizers and thinners, inorganic salts (sulphates, chlorides) and alkalis (KOH, NaOH), which were dissolved from cement, were detected as further constituents. In addition, non-cross linked hardener constituents and reactive thinners as well as added solvents in the bubble fluids were detected.

In almost all cases in the examined bubbles, only organic substances (solvents, non-cross-linked components) were found that came from the coating itself. The risk of osmotic bubbles is therefore not only influenced by the substrate, but also by the selected coating system and the care taken in the processing.

According to (4), the following circumstances must be present at the same time to create osmotic processes under coatings:

- Presence of moisture / water
- Semipermeable membrane
- Water-soluble and osmosis-promoting components
- Pressure and waterproof coating / top layer

3.1.5 Conclusion damage mechanisms

Of the possible considered damage mechanisms

- Vapour pressure
- Hydrostatic pressure
- Capillary pressure
- Osmotic pressure

Essentially, only osmotic pressure is identified as a common cause of damage.

All other mechanisms have not contributed significantly to damage to coatings in the past and have often been classified as not so dangerous.

Conclusion:

Coatings on component surfaces with expected exposure to moisture by rising water or higher residual moisture content can mostly be carried out without damage if they are designed in such a way that osmotic processes are not promoted.

3.2 How CONIFLOOR epoxy resin primers work

CONIFLOOR EP 110, EP 112 N, EP 115, EP 116LE as CONIPROOF EP 190/1 and EP 191/1 do not promote the formation of osmotic bubbles because these primers are

- **solvent free (total solid),**
- **have no content of water-soluble ingredients,**
- **are absolutely resistant to saponification,**
- if a **defect-free, film-forming layer is applied**, the formation of a semi-permeable membrane is prevented (therefore the recommendation to apply the primer twice, film-forming in the case of increased residual moisture and rising water)
- have a very **good wetting of the substrate** and therefore have good adhesion to the substrate and subsequent coatings.

4. Sources, further literature

- (1) M. Fiebrich: For adhesion between polymeric binders and concrete with special consideration of water effects, dissertation, RWTH Aachen
- (2) M. Fiebrich: Synthetic resin coatings on constantly moist concrete, DAfStb issue 410, Beuth Verlag
- (3) Encyclopedia of natural sciences and technology, Zweiburgen Verlag, Weinheim, 1981
- (4) R. Stenner / J. Magner: Influence of moisture from the substrate, Lecture 3rd International Colloquium "Industrial Floors '95", January 10th to 12th 1995, Technical Academy Esslingen
- (5) G. Lohmeyer: White tub concrete - simple and safe, Beton Verlag

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