TKB-Technical Briefing Note 9

Technical Specification and Installation of Floor Levelling Compounds

Version: April 2008

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1. Area of application

This information sheet describes floor levelling compounds used for preparing sub floors/substrates for subsequent installation of floor coverings, parquet, ceramic tiles, natural stone and coatings in interior spaces, ensuring suitability of the substrate for the intended type of installation.

Special levelling compounds are also suited for use in outdoor areas or can be applied directly as a wearing surface.

2. Terminology

2.1 Definition

DIN EN 13318, paragraph 8.4, distinguishes between levelling compounds and screeds. According to this provision, levelling compounds are always installed bonded to a weight-bearing floor such as screed or concrete.

Although levelling compounds are no screeds, like screeds they serve as a substrate on which floor coverings can be installed and can therefore be classified according to DIN EN 13813.

Principally, we distinguish between self-levelling (self-smoothing) and non-slump (not self-levelling) levelling compounds. However, there are intermediate stages in the property profile of levelling compounds.

2.2 Layer Thickness

According to the “Erläuterungen zur DIN 18365 Bodenbelagsarbeiten” (Auflage 2006) (notes to DIN 18365 Floor installation (Version 2006)) "levelling compound" is a generic term for products which, depending on layer thickness and function, are also known as

- Fine levelling compounds
- Smoothing compounds
- Patching compounds
- Fillers

The following layer thickness ranges clearly describe levelling and smoothing compounds:

- Fine levelling compounds, applied in one pass up to a layer thickness of approx. 3 mm,
- Smoothing compounds, applied in one pass, also in thicker layers (approx. 3 to 10 mm),
- Fillers and levelling compounds applied in one pass with layer thickness ranging from 5 mm to more than 10 mm,

- Repair compounds, used for (quick) filling of holes and compensating substantial unevenness and height differences, e.g. stair steps.

Non-slump levelling compounds are usually suited for a layer thickness of up to 40 mm.

The actual admissible layer thickness of each levelling compound can be found in manufacturer's specifications for a specific compound.

2.3 Classification by Binding Agent

Depending on binding agent, levelling compounds are classified as:

- Mineral levelling compounds
- Cement-based levelling compounds
- Calcium sulfate-based levelling compounds
- Dispersion levelling compounds
- Reaction resin levelling compounds

2.4 Consumption

Consumption of levelling compounds is indicated in kg per m² and layer thickness in mm. For mineral levelling compounds this quantity refers to the powder (without water), for dispersion and reaction resin levelling compounds to the overall volume.

2.5 Suitability for Underfloor Heating Systems

Principally, all levelling compounds are suitable for application on warmwater underfloor heating systems according to DIN EN 1264 with a maximum inlet water temperature of 55 °C. However, installer shall always ask manufacturer to expressly confirm suitability, in particular for electric heating systems and special constructions. Regarding specifications and installation of underfloor heating screeds, please refer to DIN 18560, Part 2.

2.6 Shelf-Life/Storage

Shelf-life of levelling compounds mainly depends on storing conditions and composition of the compound. Paste-like levelling compounds shall be stored in a frost-free location, levelling compounds in powder form must be stored in a dry place. Consequently, manufacturer's instructions regarding shelf-life and storage may deviate.

During storage life, the main product specifications must remain unaffected.

In general, shelf-lifes are as follows:

- Mineral levelling compounds with normal setting time: 6-12 months
- Fast setting mineral levelling compounds: 3 - 6 months
- Reaction resin and dispersion levelling compounds: 12 months.

3. Purpose of Levelling Compounds

Self-levelling compounds are typically used to level and smooth large areas of rough floor (new and renovation substrates).

Non-slump levelling compounds are used for smoothing, creation of downward slopes, levelling of height differences, compensation of large uneven areas as well as for filling and repairing of holes, cracks and defects.

Using levelling compounds for layer construction of a floor, the following properties of raw sub floors can be optimized:

- Uniformity
- Evenness
- Absorbency
- Strength
- Adhesiveness

For floor, parquet and tile installers, a levelling compound is an important bridge to the rough substrates they find on site.

Warning! Levelling compounds are not suited for force-fit closing of screeds cracks.

4. Mineral Levelling Compounds

4.1 Classification of Mineral Levelling Compounds

A distinction is made between cement-based and calcium sulfate-based levelling compounds. Cement-based levelling compounds are classified into those suited for indoor as well as outdoor use and compounds solely suited for indoor applications. When applying levelling compounds in damp and wet rooms, special sealing measures might be required (please always observe manufacturer's instructions). Calcium sulfate-based levelling compounds shall only be applied indoors with the exception of wet rooms.

4.2 Requirements for Sub Floor

The following sub floor requirements must be met before levelling compounds are applied:

- Sufficient load-bearing capacity in view of future stress on floor,

- Sub floor shall be clean and all materials adversely affecting bond must be removed,
- Strength of upper peripheral area of sub floor in view of overall bond structure,
- Sub floor shall be dry according to standard requirements of the respective contract work section
- All old adhesive residues shall be removed.

Certain sub floors, such as

- Very dense substrates
- Very smooth substrates
- Very absorbent substrates
- Calcium sulfate and magnesia screeds
- Wooden bases

generally require special pre-treatment (e.g. sanding, vacuuming, priming depending on manufacturer's instructions).

Levelling compounds containing a higher amount of organic polymers and fibre-reinforced levelling compounds are recommended for preparation of wooden sub floors, prefabricated screeds according to DIN 18340 and renovation sub floors, since these compounds have a reduced tendency of crack formation caused by deformation.

4.3 Priming of Sub Floors

Sub floors must always be primed[1].

Primers

- Reduce absorbency
- Bind residual dust
- Protect sub floor from moisture contained in levelling compounds
- Improve wettability
- Serve as adhesion promoter, especially on dense and/or smooth substrates
- Improve bond structure strength
- Act as a water vapour barrier on sub floors with increased humidity content

For different types of sub floors, manufacturers sometimes recommend different primers. For mineral levelling compounds, typically water-based dispersion primers are used.

Note: levelling compounds not requiring prior application of a primer, must be identified accordingly by manufacturer.

[1] Priming of sub floors is a separate procedure according to DIN 18 365 Floor covering work, paragraph 4.

4.4 Processing

4.4.1 Mixing

Mineral levelling compounds are mixed with clean, cold water according to mixing ratio specified by manufacturer. Water can be replaced in part or totally by aqueous dispersions according to manufacturer's instructions and may then be used as mixing liquid.

The amount of water or mixing liquid specified by the manufacturer is poured into a clean mixing container. Using an appropriate electrical stirrer (preferably 300 – 600 rpm, spiral or blade mixer) the proper amount of levelling compound powder is added and mixed until you have a homogenous, lump-free compound. Stir again after ripening time specified by manufacturer. For some levelling compounds, additional fillers (sand) may be added after the compounds have been mixed. Please always observe manufacturer's instructions.

Note: Increased amounts of water result in lower strength and longer drying times, in case of self-levelling compounds also settling of components with higher density (sedimentation) and the floating of light-weight fines content may occur. Consequently, this results in weakened peripheral zones on the surface and reduced structural strength.

Levelling compounds which have already started to set shall never be re-diluted with water since this will disturb formation of a strong structure and causes a loss of material-specific properties.

The processing time indicated by the manufacturer usually refers to ambient temperatures of approx. 20 °C. Lower temperatures require longer, higher temperatures shorter processing times.

4.4.2 Levelling

Room temperature and relative room air humidity have to checked using suitable devices.

For floor covering and parquet work, ambient temperatures shall not fall below 18 °C. The relative humidity shall preferably be in the range of 40 - 65 %, but must not exceed 75 %.

Low temperatures and high relative air humidity decrease the setting speed of installation materials. This may even lead to the complete loss of functional capability. Therefore the above mentioned conditions have to be complied with even after installation.

In case of improper temperature or humidity conditions heaters or dehumidifiers have to be installed early enough. In winter unheated rooms have to be heated at least three days before installation work starts.

The surface temperature of subfloors with heating systems shall be between 18 °C und 22 °C.

For other levelling work, e.g. for subsequent installation of tiles, lowest admissible temperature is 5 °C.

The mixed compound is applied to the sub floor in the required quantity and then smoothed using a tool, e.g. a smoothing trowel, a pointed finishing trowel or a rakel. If needed, area can later be reworked using a toothed roller.

While setting the levelling compound layers shall be protected from direct sunlight and drafts. Otherwise humidity contained in levelling compound evaporates too quickly which may result in irregular structure and strength of the surface. With calcium sulfate-based levelling compounds the drying can be accelerated by direct ventilation (if applicable open window over night).[2]

In case a surface needs to be re-levelled, this second levelling step must be performed immediately after the floor is accessible, i.e. before the lower layer has completely dried. Dried layers of levelling compound must be re-primed before another layer is applied.

4.4.3 Minimum Layer Thickness

Levelling compound layers applied over an entire area must have the following minimum thickness in all areas, depending on sub floor and requirements:

- Suited for rolling wheels according to DIN EN 12529: 1.0 mm
- For dense sub floors (e.g. flow asphalt): 1.5 mm
- For dispersion adhesives between dense covering and dense sub floor: 2.0 mm

While complying with the minimum layer thickness requirements, evenness tolerances according to DIN 18202 must be taken into account.

If layer thickness falls short of minimum requirements, the levelling compound layer may be destroyed by regular loads.

Water absorption capacity of a levelling compound layer is directly contingent on layer thickness. If layer is too thin, e.g. on dense substrate or under dense covering, setting and drying of water-based dispersion adhesives is adversely slowed or even prevented entirely.

When using dispersion adhesives for elastic floor coverings in sheets, please observe the following:

Levelling compounds with a very high content of synthetic resins and consequently a slightly reduced water absorbency speed, can be temporarily softened to a certain extent on the surface by the applied adhesive. Especially when folding back the floor covering sheet, this may result in reduced strength in the folded back area and pulling away of a skin of levelling compound. This effect, often also called "skin formation" can be avoided when levelling compound layer is sufficiently thick, absolutely dry and the covering is only folded back shortly after adhesive was applied, preferably within ten minutes after application.

4.4.4 Pumping of Levelling Compound

When processing self-levelling compounds on large areas, mixing and application can also be performed using machines like appropriate piston or spiral pumps. In order to be processed using pumps, a levelling compound must have the following properties: must mix rather quickly and lump-free, spread easily and have a sufficient processing time. Pumpability of a levelling compound must be indicated separately by the manufacturer.

If not indicated differently, the required amount of water for preparation of levelling compound for pumping is normally calculated based on the spread value.

When pumping process is paused for more than five minutes and directly after end of pumping process, the pump as well as all product carrying parts must be cleaned immediately.

4.5 Material Characteristics

4.5.1 Standardized Material Characteristics

Some levelling compound material characteristics are established in laboratories using special standardized procedures at 23 °C and a relative humidity of 50 %. Consequently, the values determined in the lab can not directly be transferred to material characteristics found on site, since there, additional parameters such as the mixing method and ambient conditions play a role.

Material characteristics are determined based on the following standards:

- Mixing
  DIN EN 1937, DIN EN 13892-1
- Bulk density
  DIN EN 1097-3
- Spread value
  DIN EN 12706
- Fresh mortar gross density
  DIN 18555-2

[2] Opening of windows must be avoided in case of water vapour condensation may occur.

- Setting time (hardening characteristics) DIN EN 13409
- Compressive strength/flexural strength DIN EN 13892-2
- Wear resistance according to Böhme DIN EN 13892-3
- Wear resistance – BCA DIN EN 13892-4
- Wear resistance to rolling wheel DIN EN 13892-5
- Shrinkage and swelling properties DIN EN 13872
- Bond strength DIN EN 13408

4.5.2 Processing Properties

Processing properties of levelling compounds are defined by their material characteristics, however to a large extent they also depend on conditions on site (material temperatures etc.).

4.5.2.1 Processing Time

Processing time is the period after mixing or maturing respectively, where levelling compound has the required consistency for processing at approx. 20 °C. Lower temperatures prolong, higher temperatures shorten processing time. Processing time can only be determined by visual inspection. It is always shorter than the onset of hardening determined in the lab.

Depending on type of levelling compound, processing time ranges between 5 and 60 minutes. Normal self-levelling compounds for large area levelling have processing times between 15 and 45 minutes.

4.5.2.2 Consistency of Levelling Compounds

According to 2.1, a distinction is made between self-levelling and non-slump levelling compounds. Pourable levelling compounds represent an intermediate form. Levelling compounds are characterized as pourable when they have a liquid consistency and are therefore pourable, however show no tendency for self-levelling.

The flow characteristics of self-levelling compounds are determined by the spread value. Self-levelling compounds are primarily used for full or large area applications. Already in thin layers they have very good spread characteristics and are therefore not suited to maintain or create slopes. In order to achieve a specific uniform layer thickness and to facilitate processing for larger areas, it is recommended to apply self-levelling compounds with suitable notched trowels or rakels.

Pourable and non-slump levelling compounds can be used to level substrates with existing slopes or to create slopes. Non-slump levelling compounds are mainly used for levelling of partial areas with large layer thickness differences at small distances, e.g. to fill holes, for height adjustments, for repairs etc. For these types of applications with large layer thickness differences, it is essential to observe the respective hardening and drying times. Non-slump levelling compounds with extremely fast hydration speeds, increased water binding and high initial strength allow for fast work progress.

4.5.2.3 Accessibility

Accessibility designates the time span after which the applied levelling compound has hardened enough to be walked on without causing damage. Depending on levelling compound and site conditions, accessibility ranges between approx. 30 minutes and several hours.

4.5.2.4 Drying Properties/Readiness for Installation of Coverings

The drying properties of mineral levelling compounds and consequently the readiness of the layers built with the compounds for installation of coverings, mainly depend on their type and composition. For example, Portland cement based compounds normally dry slower than aluminate cement based levelling compounds. Calcium sulfate based levelling compounds dry somewhat slower than cement-based levelling compounds.

Drying and readiness for the installation of floor coverings on a levelling compound layer are directly influenced by layer thickness, existing ambient conditions and floor temperature. High humidity and/or low temperature prolong, low humidity and/or high temperature reduce drying times and readiness for installation of coverings. Apart from ambient conditions, it must always be ensured that floor temperatures are not too low since a fresh layer of levelling compound quickly takes on the temperature of the substrate.

Under conditions conforming to standards, levelling compound layers with thickness of up to 3 mm are normally ready for installation of covering after 24 hours. Thicker layers require longer drying times. Since drying time is not only affected by layer thickness and room climate but even more complexly by composition of the levelling compound, manufacturer’s information regarding readiness for installation might vary. Determination of readiness for installation, e.g. by measuring residual moisture as with screeds, is generally not performed for levelling compounds on account of the low layer thickness, the type dependent equilibrium moisture content and the different degrees of crystalline bonding of water.

4.5.2.5 Sandability

The term sandability designates the characteristic of an already hardened layer of levelling compound to be improved regarding levelness and evenness by subsequent manual or mechanical

sanding. In order to avoid polishing or compacting of the surface, rather coarse sanding disks shall be used (e.g. grain size 16). Sandability of levelling compounds may differ depending on composition, strength and processing method. Levelling compounds with high internal strength normally offer reduced sandability properties. In case such surfaces must be sanded, sanding shall be performed as soon as possible, i.e. when by sanding only the surface of the levelling compound layer is roughened. This point is normally reached several hours after accessibility.

Note: Even after sanding, the required minimum layer thickness according to 4.4.3 must be kept.

4.5.3 Usage Properties

The usage properties of levelling compounds are determined by their material characteristics. In addition, they substantially depend on conditions on site as well as on proper and expert processing.

4.5.3.1 Adhesion to Substrate

A hardened and dry levelling compound layer must have a sufficiently high adhesive strength to the substrate for the intended use. Careful preparation of the sub floor (see 4) is just as important as the adhesion characteristics of the levelling compound itself. Adhesion properties of a levelling compound on a standardized concrete substrate can be tested in the lab as a material characteristic according to DIN EN 13408. These tests however only have restricted validity for practical use. The adhesive strengths achieved on site mainly depends on ambient conditions on site and processing method. On site the adhesive strength can only be measured by trained experts following the provisions of DIN EN 13408.

4.5.3.2 Stress Characteristics – Swelling and Shrinkage

Mineral levelling compounds can develop structural stress during hardening on account of the respective swelling and shrinkage properties. With higher layer thickness, such stress increases and depending on the type of levelling compound can result in a more or less pronounced tendency for crack formation. Consequently, manufacturer's instructions regarding maximum layer thickness shall always be observed.

4.5.3.3 Surface Strength

Surface strength of levelling compounds is tested with surface scratch tests (grid scratch test), using a spike, if needed with pressure spring (e.g. Ri-Ri device). During scratch tests, deep scars or large area flaking must be avoided, not even at the crosspoints of the scratch lines.

The levelling compound surface shall not chalk or sand during testing, e.g. when using wire brush.

4.5.3.4 Absorbency

For rapid film formation and setting, water-based dispersion adhesives must be able to release the contained water to the environment. In particular with installation of impervious floor coverings, this water must temporarily be absorbed by the levelled substrate. Consequently, levelling compound layers must not only have sufficient absorbency but layers must also have adequate thickness.

In most cases, a simple water drop test is inadequate to determine absorbency, especially for levelling compounds containing higher amounts of organic polymers and with slow wettability. Preferably, absorbency of a levelling compound layer is determined by pre-testing the setting and drying properties of the dispersion adhesive to be used.

4.5.4 Industrial and Environmental Safety

Mineral levelling compounds can produce considerable amounts of dust when mixed. Therefore, it is recommended to run agitator only at reduced speed when mixing in the powder and to turn mixer to higher speed only once powder is fully wetted. Always wear protective mask and goggles when mixing levelling compound.

Cement-based levelling compounds normally contain Portland cement. This type of cement normally produces a strong alkaline reaction when in contact with moisture (classification: Xi, irritant). For this reason, always avoid contact of powder and mortar with eyes and skin. Therefore, protective gloves must be worn when working with cement-based levelling compounds. Cement-based levelling compounds low in chromates are classified as Giscode ZP 1 "low in chromates according to EU directive 2003/53/EG“. Cement-based levelling compounds very low in emission can also be classified as EMICODE EC1 R.

Calcium sulfate-based levelling compounds show neutral or weakly alkaline reactions and are therefore less aggressive than cement-based products. Calcium sulfate-based levelling compounds are classified as Giscode CP 1. Very low emission calcium sulfate levelling compounds can be classified as EMICODE EC1.

Always observe hazards identification (R-warnings) and safety instructions (S-instructions) printed on containers and product information given by manufacturer.

5. Dispersion Levelling Compounds

Dispersion levelling compounds are composed of water-based synthetic resin dispersions containing a high level of consistency-producing mineral filler materials in addition to other components. They

are ready to use and offered as pasty, non-slump compounds. For one-component dispersion levelling compounds, mixing with water is not required, however after prolonged storage times they might need to be restirred. The compound hardens simply by evaporation of the water contained in the mix. Consequently, drying to a large extent depends on ambient conditions on site, especially on the relative humidity. Dispersion levelling compounds shall not be processed when air and floor temperatures fall below 15 °C and relative humidity exceeds 75%, preferably not over 65% and drought is to be avoided.

Since the water contained in the compound evaporates, drying always results in a certain shrinkage which may lead to formation of cracks on the surface when thicker layers are applied. Always observe maximum layer thickness specified by manufacturer. In many cases, the maximum layer thickness is therefore limited to a few millimetres per pass. In case a second application is required, it shall only be installed after the first layer has thoroughly dried.

Dispersion levelling compounds have a very good adhesive strength on a wide variety of substrates. Priming is therefore normally not required for clean substrates. The levelling compounds are applied using smoothing trowels or pointed finishing trowels.

Since dispersion levelling compounds are not self-levelling, their surface must first be sanded before applying adhesives. Compared to mineral levelling compounds, absorbency of the levelling layer is considerably lower. This fact must be taken into account for selection of the adhesive to be used and for airing time.

Many dispersion levelling compounds develop an easy deformable, flexible layer after drying. As a result, they are ideally suited for non-shape retaining coverings which are however solidly bonded to the sub floor, e.g. wood, PVC and rubber and are suited as migration barriers on rubber granulate sheets. On account of their low water resistance, dispersion levelling compounds are only suited for areas which later will not be exposed to water. The mechanical strength of these compounds has its limits as well. Consequently, dispersion levelling compounds are best suited for indoor dry construction.

Handling of dispersion levelling compounds normally does not require special protective measures.

6. Reaction Resin Levelling Compounds

6.1 Types of Reaction Resin Levelling Compounds

Reaction resin levelling compounds are mainly based on polyurethane (PUR) or epoxy resins (EP). Other reaction resins such as unsaturated polyester resins (UP) or methacrylate resins (MA) can also be found in special repair levelling compounds, patching or grouting mortars. Reaction resin levelling compounds for floor applications are normally offered as 2-component systems, to be mixed immediately before use. Besides reaction resin binders, these levelling compounds contain mineral filler materials, either pre-mixed with the resin component or offered separately as a third component to be added.

The characteristics of the reaction resin decisively influence the property profile of the levelling compounds based on this resin. For example: reaction resin levelling compounds are considerably more water and chemical resistant than comparable cement, calcium sulfate or dispersion based products. Surface and structure of reaction resin levelling compound are mostly impermeable and non-absorbent. To achieve sufficient adhesion for subsequent application of adhesive layers, especially when using dispersion or solvent-based adhesives, the smooth surfaces of reaction resin levelling compounds require thorough sanding over the full area.

6.1.1 Polyurethane Levelling Compounds

PUR levelling compounds are almost exclusively offered as 2-component systems – with a resin and a hardener component. The resin component may contain premixed mineral filler materials. Normally, the formulation of PUR levelling compounds results in a honey-like consistency with good flow characteristics and self-levelling properties after mixing. Normally, they are water and solvent-free and therefore produce no adverse effects on delicate substrates. They harden without shrinkage and free-of-cracks in any applied layer thickness. Hardening and curing is mostly unaffected by humidity. On almost all standard construction substrates, PUR levelling compounds have a high adhesive strength even without priming. PUR levelling compounds have a very high compressive and flexural strength and are deformable from high-impact resistant to flexible.

Their special characteristics make PUR levelling compounds especially suited for deformable substrates such as flow asphalt, chipboards, dry screeds, insulating and installation boards, for point or area elastic sports floors etc.

PUR-levelling compound layers produce a very smooth, dense surface. For approx. one or two

days after application, the surfaces are still sufficiently adhesive and reactive to continue work with either PUR or EP based reaction resin products without requiring other preparation measures. PUR levelling compound layers which have been left untreated for longer periods must be fully sanded before applying other installation materials. When using dispersion adhesives, PUR levelling compound layers must always be thoroughly sanded. When using dispersion adhesives on sanded PUR levelling compound layers, e.g. for PVC coverings, pressure-sensitive adhesives are the best choice.
For all other elastic coverings, either reactive dispersion adhesives with a water-binding component, PUR, EP or other reaction resin adhesives are recommended.

PUR levelling compounds are generally suited for indoor use only.

6.1.2 Epoxy Resin Levelling Compounds

EP levelling compounds are exclusively offered as 2-component systems consisting of a resin and a hardener component. In most cases, filler materials are not pre-mixed, but are added to the binder as a third component during mixing. Depending on grain-size and amount of filler material, the consistency of the levelling compound can thus be varied from thin to plastic and non-slump.

EP levelling compounds are normally water and solvent free. On almost all standard construction substrates, they have a high adhesive strength without prior priming. In contrast to PUR systems, the normally very hard to brittle EP levelling compounds produce a certain stress. On account of this stress and the expected future loads on these compounds, application in thicker layers is only recommended with restrictions for flow asphalt, chipboards etc. They are preferably used on stable, mineral substrates when high-strength layers with very good chemical and mechanical load capacities are required.

EP levelling compound layers produce a very smooth, dense surface. For approx. one or two days after application, the surfaces are still sufficiently adhesive and reactive to continue work with either PUR or EP based reaction resin products, with certain restrictions also with water-based dispersion products, without requiring other preparation measures. EP levelling compound layers which have been left untreated for longer periods must be fully sanded before applying other installation materials.

On account of their high water and chemical resistance, EP levelling compounds can be used for indoors and outdoors applications.

6.1.3 Other Reaction Resin Levelling Compounds

Other reaction resins besides PUR and EP are rarely used as binding agents in levelling compounds and then only for special applications. On account of their general characteristics and handling they can best be compared with EP levelling compounds. In this context, unsaturated polyester and methacrylate resins are noteworthy, since their hardener component consists of an initiator which is not added in a certain mix proportion but can rather be added in variable doses. The quantity thus added controls the hardening speed of such resins from several minutes up to several hours.

6.2 Industrial and environmental Safety

Reaction resins are always hazardous substances. PUR systems contain the allergenic isocyanate hardener, EP systems the allergenic EP resins and irritant amine curing agents. When working with reaction resin levelling compounds, contact of eyes and skin with the material and inhalation of vapours must always be avoided. Protective gloves and protective goggles must be worn for mixing. Clothing contaminated with reaction resins must be changed immediately. When following these basic rules, reaction resin levelling compounds can safely be processed.
However, it is preferable to rather select less hazardous products such as dispersion, cement or calcium sulfate-based levelling compounds as an alternative for reaction resin products when functional properties are sufficient.

Reaction resin levelling compounds can be classified as EMICODE EC 1 R, i.e. very low emission according to GEV. After complete hardening, reaction resin levelling compounds result in a duroplastic layer safe for the environment and room climate.

7. Levelling Compounds as Wearing Layers

Some levelling compounds can also be applied to serve as wearing layers. For this type of application, mainly cement and reaction resin based systems are recommended.

7.1 Cement-based Levelling Compounds as Wearing Layers

7.1.1 Fields of Applications and Properties

Cement-based levelling compounds are used as wearing layers to build joint-free sub floors in industry, business and residential construction, indoors as well as outdoors. Even without additional covering, they can directly be used, e.g.

in garages and basements, workshops, factory halls and storage rooms.

Cement-based levelling compounds used as wearing layers do not fulfill any esthetical demands on the surfaces. In case of decorative requirements, e.g. regarding colour or design, some manufacturers offer levelling compound systems which can be colorized. Surfaces can also be treated with special coatings to achieve the desired effects.

Levelling compounds for use as wearing layers must have adequate compressive, flexural and surface strengths as well as abrasion resistance.

In order to find information on stress classes for wearing layers and the respective requirements, please refer to DIN EN 13813, DIN 18560, parts 3 and 7 and the related test standards as well as AGI worksheet A 12.

7.1.2 Requirements for Sub Floors

The requirements for sub floors listed in section 4.2. also apply for levelling compounds used as wearing layers.

Cement screeds are particularly suited for this purpose on account of their high strength and absorbency (minimum requirements C 25 – F 4) as well as concretes with the same strength values. Sub floors must be at least 28 days old. When sub floors are created using rapid screeds, manufacturer's instructions apply.

When sub floors are old wearing used surfaces such as ceramic tiles or slabs, they must first be sanded and primed.

The adhesive bond strength of the substrate shall not fall below 1.5 N/mm² (average value) and never below 1.0 N/mm² according to BEB information sheet 'Oberflächenzug- und Haftzugfestigkeit von Fußböden' (Surface tensile and adhesive bond strength of floors), version 2004.

7.1.3 Priming of Sub Floors

Substrates shall be primed according to manufacturer's instructions. Please observe that for levelling work in outside or wet areas, only water-resistant primers are used.

7.1.4 Processing

Levelling compounds used as wearing layers shall never be processed at temperatures under 5 °C. For outside applications, these levelling compounds shall not be processed when strong winds or rain prevail or when surface is exposed to direct sunlight.

Since levelling compounds used as wearing layers are exposed to higher loads than levelling compounds under floor coverings, a higher minimum layer thickness is required. Generally, layers shall have a minimum thickness of 3 mm.

The targeted layer thickness shall preferably be achieved in one pass. For multiple layers, please proceed as described in chapter 4.4.2.

7.1.5 Usability

Levelling layers are only ready for use once the final strength has been reached. Depending on type of levelling compound, layer thickness and site conditions this is the case after 3 to 7 days at the earliest.

7.2 Reaction Resin Levelling Compounds used as Wearing Layers

On account of their high strength, abrasion and water resistance, reaction resin levelling compounds on polyurethane and epoxy resin basis can generally also be used as wearing layers. They are largely comparable to reaction resin coatings. Polyurethanes are characterized by abrasion resistance and flexibility, epoxy resins by their strength, hardness and resistance to chemicals. If required, skid resistance can be improved by sprinkling the freshly applied levelling compound with sand. When indicated the required skid resistance class can be achieved by spreading of quartz sand on the first layer.

8. Bibliography

Floor levelling compounds can be classified as screeds, but this is not necessarily the case. On account of this rather ambiguous classification, a number of standards may apply in part or in their entirety – some standards from the levelling compound sector, others from the screed sector. When floor levelling compounds are classified as screeds, the mandated DIN EN 13813 applies with the related test standards as well as the respective screed classification and CE designation.

8.1 Standards for Testing and Specification of Floor Levelling Compounds

DIN EN 1097-3 1998-06	Schüttdichte (Test for mechanical and physical properties of aggregates – Determination of loose bulk density and voids)
DIN EN 1264	Warmwasser-Fußbodenheizung (warm water subfloor heating systems)

DIN EN 1323 2007-11	Mörtel und Klebstoffe für Fliesen und Platten - Betonplatten - (Adhesives for tiles – concrete slabs for test)
DIN EN 1937 1999-10	Prüfverfahren für hydraulisch erhärtende Boden-Spachtelmassen - Standardmischverfahren - (Test method for hydraulic setting floor smoothing and/or levelling compounds – Standard mixing procedures)
DIN EN 12529 1999-05	Eignung für Stuhlrollen (Castors and wheels – castors for furniture – Castors for swivel chairs - Requirements
DIN EN 12706 1999-12	Prüfverfahren für hydraulisch erhärtende Boden-Spachtelmassen - Bestimmung des Fließverhaltens - (Test method for hydraulic setting smoothing and/or levelling compounds – Determination of flow characteristics)
DIN EN 13318 2000-12	Estrichmörtel, Estrichmassen und Estriche - Definitionen - (Screed materials and floor screeds – Definitions)
DIN EN 13408 2002-06	Prüfverfahren für hydraulisch erhärtende Boden-Spachtelmassen - Bestimmung der Haftzugfestigkeit - (Methods of test for hydraulic setting smoothing and/or levelling compounds – Determination of bond strength)
DIN EN 13409 2002-06	Prüfverfahren für hydraulisch erhärtende Boden-Spachtelmassen - Bestimmung der Abbindezeit - (Methods of test for hydraulic setting smoothing and/or levelling compounds – Determination of setting time)
DIN EN 13454-2 2007-11	Calciumsulfat-Binder, Calciumsulfat-Compositbinder und Calciumsulfat-Werkmörtel für Estriche – Prüfverfahren (Binders, composite binders and factory made mixtures or floor screeds based on calcium sulfate – Test methods)
DIN EN 13501-1 2007-05	Klassifizierung von Bauprodukten und Bauarten zu ihrem Brandverhalten – Klassifizierung mit den Ergebnissen aus den Prüfungen zum Brandverhalten von Bauprodukten (Fire classification of construction products and building elements – Classification using data from reaction to fire test)
DIN EN 13813 2003-01	Estrichmörtel, Estrichmassen und Estriche - Eigenschaften und Anforderungen - (Screed material and floor screeds – Screed material – Properties and requirements)
DIN EN 13872 2004-04	Prüfverfahren für hydraulisch erhärtende Boden-Spachtelmassen - Bestimmung der Maßänderung - (Method of test for smoothing and/or levelling compounds – Determination of shrinkage)
DIN EN 13892-1 2003-02	Prüfverfahren für Estrichmörtel und Estrichmassen - Probenahme, Herstellung und Lagerung der Prüfkörper - (Methods of test for screed materials – Part 1: Sampling, making and curing of specimen for test)
DIN EN 13892-2 2003-02	Prüfverfahren für Estrichmörtel und Estrichmassen - Bestimmung der Biegezug- und der Druckfestigkeit - (Methods of test for screed materials – Part 2: Determination of flexural and compressive strength)
DIN EN 13892-3 2004-07	Prüfverfahren für Estrichmörtel und Estrichmassen - Bestimmung des Verschleißwiderstands nach Böhme - (Methods of test for screed materials – Part 3: Determination of wear resistance – Boehme)
DIN EN 13892-4 2003-02	Prüfverfahren für Estrichmörtel und Estrichmassen - Bestimmung des Schleifverschleißes nach BCA - (Methods of test for screed materials – Part 4: Determination of wear resistance – BCA)

DIN EN 13892-5 2003-09	Prüfverfahren für Estrichmörtel - Bestimmung des Widerstandes gegen Rollbeanspruchung von Estrichen für Nutzschichten - (Methods of test for screed materials – Determination of wear resistance to rolling wheel of screed materials for wearing layer)
DIN EN 13892-6 2003-02	Prüfverfahren für Estrichmörtel und Estrichmassen - Bestimmung der Oberflächenhärte –1 (Methods of test for screed materials – Determination of surface hardness)
DIN EN 13892-7 2003-09	Prüfverfahren für Estrichmörtel - Bestimmung des Widerstandes gegen Rollbeanspruchung von Estrichen mit Bodenbelägen - (Methods of test for screed materials – Determination of wear resistance to rolling wheel of screed materials with floor coverings)
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DIN 18365 2006-10	Bodenbelagarbeiten Kap. 2.9 / 3.3 (German construction contract procedure – Part C: General technical specifications for building works – Flooring works) Erläuterungen zur DIN 18365 (2002), Holzmann Buchverlag Kommentar zur DIN 18365 (2006) SN Verlag
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DIN 18560-2 2004-04	Estriche im Bauwesen – Teil 2: Estriche und Heizestriche auf Dämmschichten (schwimmende Estriche) (Floor screeds in building constructions – Part 2: Floor scredds and heating floor screeds on insulation layers)
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BEB-Merkblatt	Beurteilen und Vorbereiten von Untergründen (Stand Februar 2002), Kap. 3.2 / 6.8
TKB-Merkblatt 8	Beurteilen und Vorbereiten von Untergründen für Bodenbelag- und Parkettarbeiten (Stand Juni 2004), Kap. 5.2.4
Merkblatt	von H.-D. Altmann u. G.F. Hausmann Vorbereitung von Estrichen für Bodenbelagarbeiten (Stand Februar 1998), Kap. 3.3