TECHNICAL BULLETIN – TB131

COMMON PRACTICES WHEN INSTALLING FLOOR SMOOTHING CEMENT THAT RESULT IN PROBLEMS

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INTRODUCTION & SCOPE

There is an old saying, 'that a poor workman blames his tools' when something goes wrong on a job. In the same way, problems in a flooring installation seem to be sheeted home to the products in the first instance, rather than looking at the installation practices.

In the 30+ year long history of ARDEX flooring products in Australia, experience and investigation of customer complaints has shown that the most common cause of problems results from poor installation procedures. This occurs either through unfamiliarity with the application and product properties, or via ingrained procedures which go against the recommendations of ARDEX, flooring manufacturers or the Australian Standard.

Installers always need to keep in mind that the cost of a rectification is roughly three times the initial job cost, and that the profit from the next 30 or so jobs may be consumed in making good this one job. In this bulletin we will look at some of the practices which are most likely to produce complaints.

WHAT ARE THESE PRACTICES?

Basically there are four installation areas where issues can arise due to problems with poor working practices, or omission of preparative steps -

- Moisture in the subfloor
- Preparation of the subfloor including priming
- Mixing and application of the product
- Using the wrong product

MOISTURE IN THE SUBFLOOR

This is an area where there is a temptation to say 'she'll be right' and go ahead with the job, even though no measurements or checks have been done. The subfloor moisture can come from either young uncured and damp concrete, or damp slab syndrome resulting from ground water or rising damp. Moisture can be trapped under sheet vinyl and cause blistering, or odours and smells in carpets.

The results of ignoring damp can be truly financially catastrophic for the installers. For example, having a vinyl installation bubble, blister or de-bond in a large supermarket, or health care facility will result in lengthy disruption and large demurrage charges for lost income.

The corrective actions are straightforward –

- ✓ Is the slab young age, remembering that concrete dries around 25mm a month? If so, damp is likely to be a problem. Let the slab dry naturally where possible.
- ✓ Has an exposed slab been rained on the last few days.
- ✓ Ask is the slab below grade and look for signs of dampness during the inspection.
- ✓ Measure the subfloor moisture contents. The Australian Standard AS1884-2012 specifies 75% relative humidity at 40% depth.

- ✓ Install an appropriate moisture barrier and protective topping where moisture is a problem.
- ✓ Do not skimp on the membrane thickness, two coats of ARDEX WPM300 or ARDEX WPM368 MOISTURE BARRIER to a thickness of 0.3mm are required.
- ✗ Do not lay flooring directly onto the membrane.
- ✓ Refer to ARDEX Technical Bulletins TB006 or TB040 for specific information.

SUBFLOOR PREPARATION

Remember, when the installer starts the job they have accepted the condition of the subfloor and are responsible for whatever happens from there on with flooring installation. This is written into the Australian Standard.

The major sources of problems with flooring installations derive from poor subfloor preparation. ARDEX always recommends that the subfloor is correctly prepared prior to any product (flooring, tiling or waterproofing) being installed. The contaminants include old adhesives, paints, oil-grease, dust and dirt, cement laitance, rain damaged surfaces, weak screeds, curing compounds and sealers. Advice that products can safely go over contaminants should be considered dubious at best and the old maxim 'when in doubt don't' is good sense. Steel trowelled, highly dense non-porous and polished concrete also provide adhesion problems.

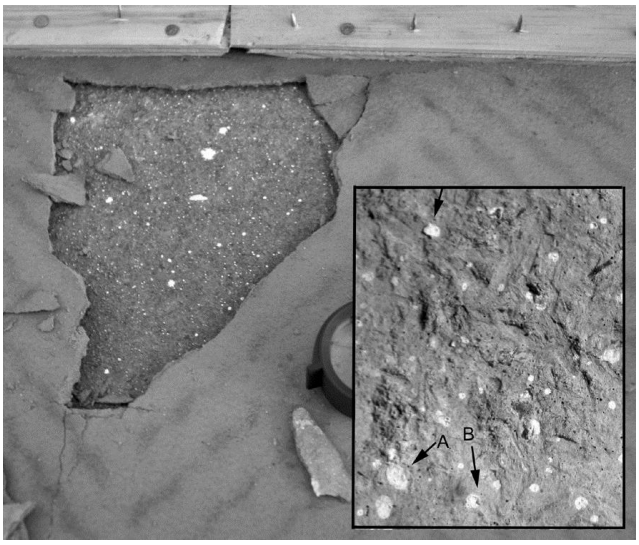
Failure to do this elementary first step in a flooring job is inviting a problem, though we in Technical Services are regularly told that preparation is too dirty and will make mess, there is no time to do the preparation, or it is too expensive and the customer won't pay for it. Another common request is, "can we prime over the subfloor contaminants?" This is another poor practice that cannot be recommended, since the bond for the primer/topping then relies on the contaminants sticking to the subfloor.

An all-too-frequent end result of failing to perform adequate preparation is de-bonding of the topping and covering from the subfloor. It is easy for ARDEX when conducting a forensic analysis of the problem, to identify this malpractice since the contaminants are usually stuck to the back of the topping.

The corrective actions are based on sound techniques –

- ✓ Prepare concrete or timber by mechanical means to a sound surface with adequate surface profile, removing all contaminants, old adhesives and weak layers.
- ✓ Always vacuum the surface clean after mechanical preparation processes.
- ✓ ARDEX Technical Services has produced Technical Bulletins which give instructions on the types of preparation that are required and what happens when it is not done. Refer to TB037, TB039 and TB041.

The following case histories give examples of poor practices that have resulted in field failures. In all these examples a customer complaint was received and ARDEX Technical Services conducted an investigation in conjunction with the sales representative. In each example shown, examination of the site and samples traced the source of the problem back to an aspect of the subfloor preparation.



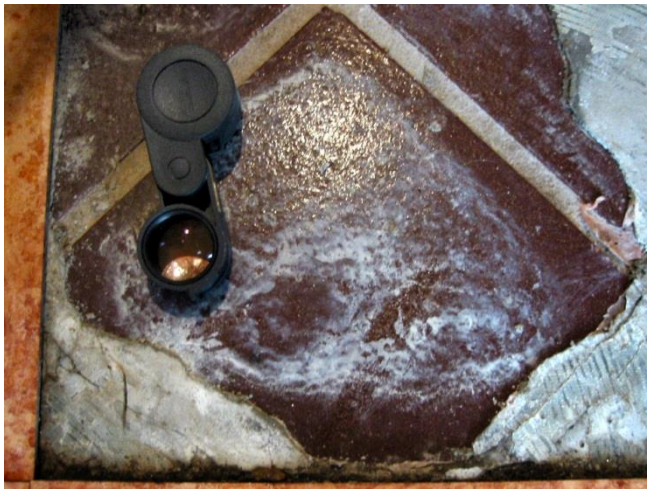
The floor shown on the left was particle board timber which was not sanded to remove the waterproof coating and building contaminants including plaster residues. This floor had also been rain affected and had a weak surface layer.

The topping was ARDITEX which de-bonded the weak top layer.

An example of contaminants on the back face of de-bonded ARDEX 45.

A – Weak concrete subfloor material such as laitance.

B – Clay dirt from foot traffic.



Ceramic tiles which were covered with ARDEX K15. The glaze and other residues were not fully removed prior to the application of the levelling cement was partially responsible for the Neoprene primer to de-bonding. Also this location had rising damp (white efflorescence on the tile) which further degraded the K15 and loosened the primer bond. Vinyl tiles de-bonded off the floor.

A concrete floor coated with a curing compound. The floor has been partially ground, but not sufficiently to promote good adhesion.

Vinyl tiles which de-bonded with the skim coat of levelling cement. In this case the swirl patterns shown are from the original concrete surface which was both rain effected, and had not been ground back. The combination of a overly thin layer of K15, high floor loads and weak surface layer resulted in de-bonding.

PRIMING – FAILING TO DO IT

The ARDEX flooring cements are part of a system, and each component has a role to play in that system. There seems to be a range of erroneous perceptions that priming is optional, will cure a multitude of poor preparation sins and any old primer will do the job. Nothing could be further from the truth.

In the ARDEX systems primers perform two major tasks;

- They penetrate in the substrate and promote chemical bonding key to surface
- They assist in the correct curing of the cement base of the product by preventing premature water loss through absorption into the substrate.

The primers also close up the pores of the surface (concrete) and prevent trapped air bubbles from migrating through the drying cement and producing ant holing.

Primers are not intended to help bond the topping to contaminants. Yes, the primer normally bonds to the contaminants such as old adhesives, weak layers and dust, but then the whole lot comes off the floor when the contaminant de-bonds. Plastic films of ARDEX P51 primer have to been observed to lift cleanly off a floor in a sheet because the primer has stuck to the cement dust and rubbish not vacuumed off the floor in the first place, and not adhered to the concrete itself. Paint for example does exactly the same thing over dusty dirty surfaces.

Another fairly common question is, “can we use XYZ bonding agent from the hardware”, and the answer is simple – No. ARDEX primers are designed to work with ARDEX levellers, other manufacturers’ products are not, and the results can be unpredictable and no warranty will apply.

Where priming is not done on porous surfaces ant holing will occur. This is not satisfactory for vinyl flooring.

Remember: Use the correct ARDEX primer for the application that is being attempted and don't be tempted to cheat and go without, or use substitutes.

When using the primers always –

- ✓ Mix the two parts of ARDEX P82 completely and do not apply too thickly over the surface.
- ✓ Use ARDEX P82 over ARDEX WPM300 Hydrepoxy or properly prepared non porous surfaces such as tiles, timber or metal deck.
- ✓ Use the appropriate dilution ratio for ARDEX P51 for the substrate;

  Diluted 1:2 with water for porous surface

  Diluted 1:3 for highly porous surfaces and

  Diluted 1:1 for less porous surfaces or as a second coat over 1:3 dilutions.
- ✓ Apply thin coats and spread out evenly. Allow to dry for the recommended times. Typically the floor is ready when primer is tack free.
- ✗ Do not lay leveller over pools of P51 or P82 on the subfloor. This can produce areas that are locally over-watered at the subfloor interface or can result in cracking of the topping.
- ✗ Do not allow more than 24hrs to elapse before placing smoothing cement over P82 primer.
- ✗ Do not apply levellers over wet primer. Again, this can lead to problems with localised over-watering or primer rising through the topping and forming a skin, or even formation of ant holes where the primer rises through the topping and the water in evaporates.
- ✗ Do not use primers from non-ARDEX sources as unpredictable performance may occur.

- ✕ The floor at left has been primed with ARDEX P51 Primer. There are puddles which need to be dispersed, and the floor allowed to dry before the topping is poured.
- ✕ Below is a puddle of P82 about to be over coated. This could cause cracking in the leveller.

APPLICATION OF THE LEVELLING CEMENT

When it comes to laying the levelling cement, there are two basic times that procedures can go wrong and these are;

⇒ The mixing stage

⇒ The laying operation

MIXING STAGE

Gauge Water

ARDEX levelling cements are designed to work with specific amounts of added water or water/ARDEX E25 mixes. These water ratios are printed clearly on the relevant product datasheets, packaging and Technical Bulletins for special applications.

In general under-watering has no real negative effects on product performance other than reducing flow properties. However, by contrast over-watering the product by as little as 10-15% produces a raft of problems which can lead to having to re-do the floor.

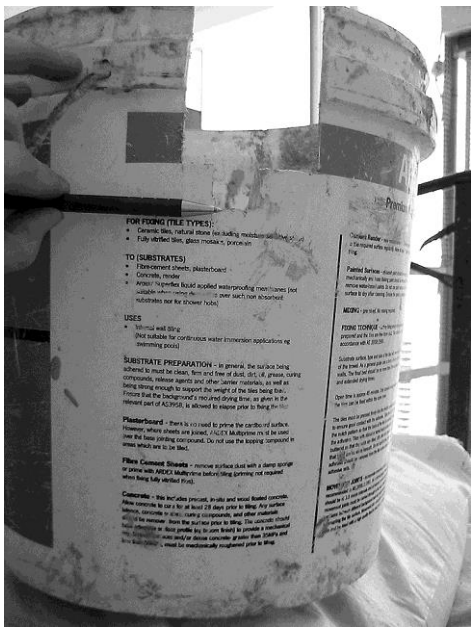
The problems which can be caused are;

- ✕ Segregation of the particles in the leveller.
- ✕ Slow drying.
- ✕ Excessive shrinkage with resultant cracking and de-bonding.
- ✕ Weak surface layers and reduction in overall underlayment strength.

The physical signs of over-watering are very obvious. The surfaces are light in colour, often whitish, and very variable. Water accumulates in low spots and produces distinctive tide marks as it evaporates away. The excess water disrupts the viscosity properties of the leveller so that the coarse grains settle to the bottom and the fines go to the top. This stratification results in changes to the surface hardness and drying properties of the leveller. The fines at the surface are weak and soft, leading to indentations and possible de-bonding of the adhered floor covering. The different layers have varying degrees of shrinkage on drying which can lead to cracking, concave cupping and de-bonding of the topping.

Excessive water application leads to overall shrinkage problems, but also greatly retards drying of the levelling cement, which effectively negates the advantages of the ARDURAPID technology used in ARDEX levelling products.

The following examples are case histories where over-watering has been responsible for the creation of problems on site. In each case the complaint was investigated by ARDEX Technical Services and the major contributing factor to the problem identified. As noted above, the signs or over-watering are easy to recognise and can be seen in the illustrations.



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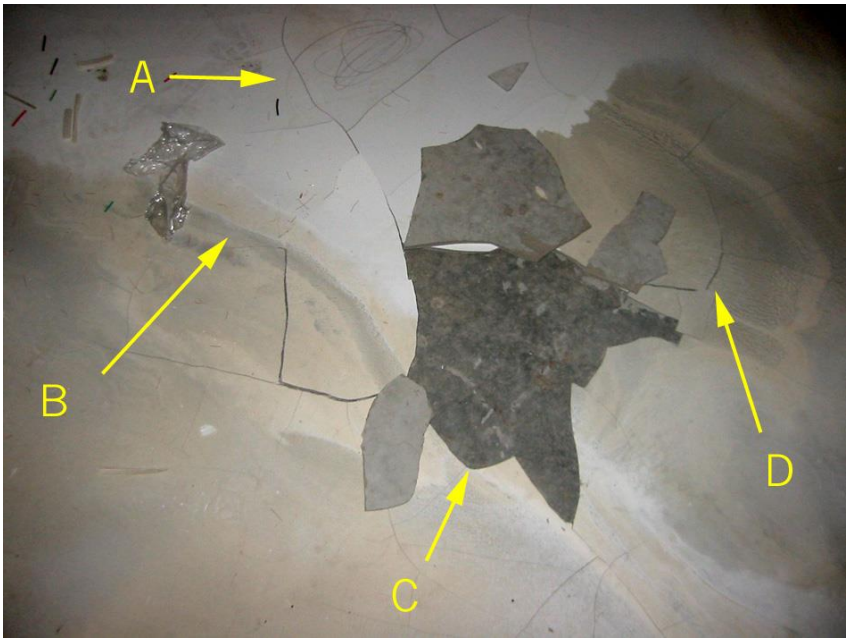
An example of a home made gauging bucket, which can result in variable or inaccurate water dosages unless carefully cut and used.

✓ Above is the standard ARDEX gauging bucket.



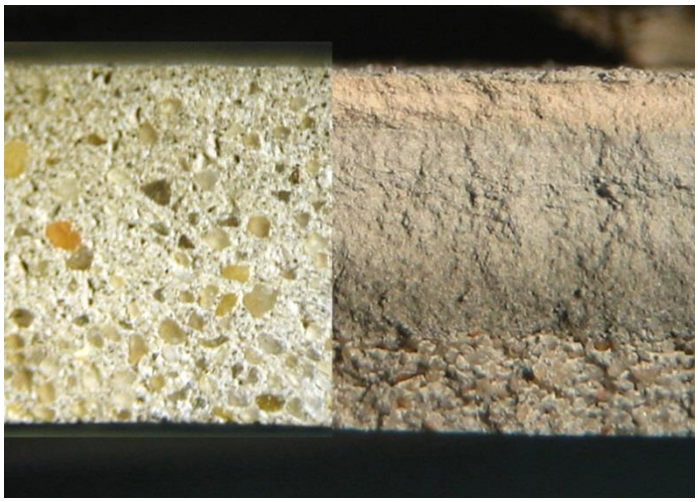
Classical signs of over-watering product.

A- Light discolouration which is made up from fines on the surface.

B- Water marking

C- Sheet de-bonding off floors

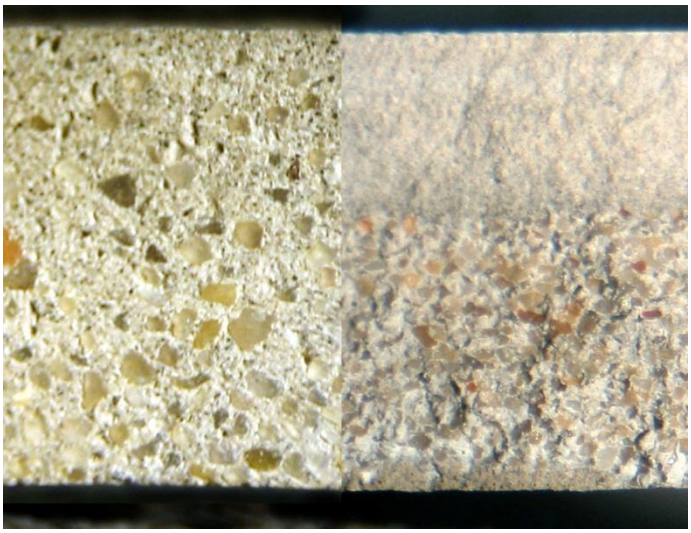
D- Polygonal shrinkage cracking



Samples of product returned from job sites.

The sample on the left is normally water ARDEX levelling cement

The sample on the right has been over-watered by approximately 100%



The right hand sample was over-watered by approximately 50%.

The obvious feature of both of these returned samples is the degree of particle segregation. The pale colour at the top is weak and soft.

Why do floor layers over-water?

- ✕ Wrong water gauging buckets used (not calibrated).
- ✕ Don't know the correct water amount (haven't read the bag instructions).
- ✕ To try and 'improve' the product flow.
- ✕ To try and re-invigorate mixed leveller that has started to cure.
- ✕ Assumption that levellers are like concrete and can have some extra water added for workability.
- ✕ Bad mixing techniques or mixers.
- ✕ Too much haste in adding the mix water.

When mixing always use clean water and do not use water that has mud or dirt in it, or has been used for clean up. In rural areas avoid the use of bore water which contains mineral salts, and may be alkaline, acid or heated.

Mixing technique and equipment

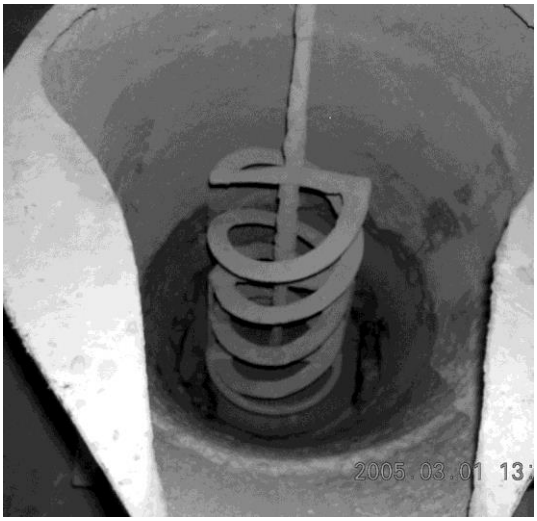
The ARDEX recommended mixer is a paddle type which breaks up lumps and makes a good vortex into the mix. Many layers use a spiral type of the mixer which is really designed for surface coatings. In ARDEX's experience, this type of mixer does not adequately break

up lumps, or create a sufficient vortex to turn over the viscous cements. When using bulk fills, the spiral mixers do a poor job and tend to overwork the mixer's electric motor.

Where the mixer is fixed to the side of the mixing container, cement builds up on the sides in unmixed and hard lumps which can then drop into the mixed material and end up on the floor. A hand held heavy duty drill/mixer will allow the user to scour the sides of the bucket and the base to ensure thorough mixing.

Poor mixing, and not mixing for the recommended 2 minutes minimum has several side effects;

- ✗ It can lead to localised over-watering.
- ✗ The formation of un-mixed lumps and segregation.
- ✗ Does not allow special additives in the leveller to disperse and react properly, altering flow and viscosity.
- ✗ *Do not use concrete mixers with levelling cements.*
- ✗ *Do not over mix.*



✗ The above picture is a spiral type mixer which is not preferred by ARDEX for its products.

✓ The ARDEX mixing paddle, and mixing of material with the paddle and a heavy duty drill.

LAYING STAGE

Weather Conditions

The first thing to consider is the weather conditions. If it is below 10^0C there will be delayed curing, and at 5^0C and less the reactions stop. Above 30-35^0C, the levellers react very quickly which limits working time significantly and can result in premature hardening on the floor and poor workability.

The poor practices that occur in this situation tend to be at the high temperature end where extra water is added to help workability – leading to over-watering. At the low end heaters may be used which leads to over-rapid drying with possible surface cracking.

Refer to ARDEX Technical Bulletin TB097 for advice.

Laid Thickness of material

The levelling products are designed to be laid at certain thicknesses, and it must be borne in mind that these are toppings, and not slabs. The products ARDEX K15 and K80 are not thickness restricted, whilst ARDEX K005 is limited to 120mm maximum. The other levelling cements generally are designed to be laid less than 35mm, and a number less than about 8-10mm. Addition of aggregate varies the thicknesses allowed for certain products and these are listed in the product datasheets, and ARDEX Technical Bulletin TB102.

When products are laid in excess of their recommended thickness there can be problems with;

- ✗ Slow drying
- ✗ Shrinkage cracks leading to de-bonding
- ✗ In some cases high temperatures generated during curing can affect adhesion.

These problems can be avoided by -

- ✓ Selection of the correct product for the job, and not just whatever happened to be cheap or available at the time.
- ✓ Use a bulk fill product for high thicknesses to reduce cost, as well as technical reasons.
- ✓ Use the higher performance products for deeper fills such as ARDEX K15, K80 or K005.
- ✓ Follow recommended maximums for ARDEX K250, ARDEX K12, ARDITEX, A45 and LQ92.
- ✗ Do not lay excessive thicknesses of ARDEX K120, K220, ARDITEX, or FEATHER FINISH.

An example of material used above recommended thickness. In this case the product is ARDEX A45 used above the recommended maximum thickness of 20mm without a filler aggregate.

During curing the cement can become quite hot and produce tensile strains which can result in some cracking or possible de-bonding from lower strength substrates.

Conversely, where laying a leveller over an impervious surface too thin an application can cause some problems as well. The final surface is then not porous enough for certain types of water based adhesives.

Over-working the leveller on the floor

In terms of the finished floor, over-working has effects which can be visually indistinguishable from over-watering with many of the same problems.

Flowable grade floor levellers are basically designed to be poured out, raked once or twice with the thickness rake to adjust depth, and then given one or two passes with the spreading trowel to smooth out edges and ripples.

However, layers may decide the material needs to be 'worked' and will drag the trowel back and forth, and do multiple passes over the leveller. At the same time they might walk back several metres into the laid area and 'adjust' a small irregularity. The first practice results in the fines being brought to the surface, segregation and a weak top layer. The second can end up producing marks in levellers that is on the way to initial set, which then have to be 'worked' again.

- ✗ Don't over-work the material.
- ✓ One or two passes of the trowel only (or spiked roller for ARDITEX).
- ✗ Don't walk into laid leveller more than 5 minutes old.
- ✓ Do wear studded footballs boots.

Laying Toppings over Joints

Movement and construction joints are just that, they are designed to allow for building elements to move around independently. Some clients request that joints are covered by the floor covering, be it vinyl, carpet or tiles.

This practice must be condemned as any movement in the subfloor will crack through the leveller, and result in cracking or de-bonding of tiles, lumps in carpets, and depressions or tears in the vinyl.

Movement joints must be correctly detailed with the leveller diamond cut through and flexible sealants or proprietary joint strips or systems used for the carpet/vinyl.

Premature laying of coverings

The last thing that is done is to lay the floor covering. If the leveller has not fully cured, this can lead to moisture problems, mainly with vinyl flooring, though carpet glues are affected as well. The rapid set technology levellers, are alright to lay vinyl on after periods of time that vary between 30 minutes and 24 hours, depending on the product. Hydration products require between 2 and 3 days to cure and will remain damp in this time period.

USING THE WRONG PRODUCTS FOR AN APPLICATION

There is a temptation to use what is available in the back of the truck, or what is the cheapest product, which can lead to problems. Some products are more flexible in their applications than others, for example ARDEX ARDITEX can be used in many environments, but some levellers are more specialised and should be used in the their correct usages.

Another temptation is to be creative with products and use them in ways other than intended, which may or may not work.

Each of the products in the ARDEX flooring range has particular attributes, though there is a degree of overlap between them in applications. The product bags and the datasheets describe the use for each leveller, but the following rules apply.

Remember, the majority of ARDEX's products are for internal applications only.

- The only products rated for external usage as underlayments in ***protected*** conditions are ARDEX LQ92, ARDITEX and ARDEX K005.
- The only externally rated products exposed to weather are ARDEX 301 or ARDEX A46.
- The only products which can be considered a dry area wear surfaces is ARDEX K80.

- ✕ ARDEX neither warrants nor recommends the use of ARDEX K15 as a wear surface ‘feature floor’.
- ➢ ARDEX LQ92 and K005 can be used in wet areas to level and create falls.
- ➢ ARDEX K15, K12 and ARDEX A45 can be used in internal wet areas under suitable membranes with sheet vinyl floor coverings.
- ➢ ARDEX K15 mixed with ARDEX E25 is recommended for heavy duty vinyl installations in supermarkets, commercial premises or institutions.
- ➢ ARDEX K15 mixed with ARDEX E25 or ARDITEX are rated for flexible surfaces such as Compressed Fibre-Cement or timber.
- ➢ The only products which can be laid over suitable ARDEX flexible membranes are ARDEX ARDITEX or ARDEX FEATHER FINISH.

An example of a poor choice of product. ARDEX K10 was laid on a floor that was subject to continuous disinfectant washing under water resistant carpet.

The K10 had no form of membrane or protective coating and the K10 degraded over time. Eventually the topping de-bonded in patches from the subfloor.

CONCLUSIONS

When used within ARDEX recommendations and correct industry practices, ARDEX flooring products perform at the top end of the market and provide a strong and durable surface for flooring, which have been proven in service since 1949.

When poor practices are used, some of these products will tolerate a degree of abuse, but others will not and bite the installer hard. The financial cost of being bitten is high as we have already mentioned, and the best way to avoid this is to follow good practice, read the product literature, and insist that specifications are followed when doing an installation.

It is in the installer’s best interests to encourage builders and specifiers who may have contracted them onto a job, to allow for the full set of correct procedures to be followed.

IMPORTANT
This Technical Bulletin provides guideline information only and is not intended to be interpreted as a general specification for the application/installation of the products described. Since each project potentially differs in exposure/condition specific recommendations may vary from the information contained herein. For recommendations for specific applications/installations contact your nearest ARDEX Australia Ofiice.

DISCLAIMER
The information presented in this Technical Bulletin is to the best of our knowledge true and accurate. No warranty is implied or given as to its completeness or accuracy in describing the performance or suitability of a product for a particular application. Users are asked to check that the literature in their possession is the latest issue.

REASON FOR REVISION
AS1884 moisture levels altered to only the ASTM F2170 test. Deletion of K009, addition of K120, K220.

REVIEW PERIOD
36 months from issue.

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