Understanding Paint, what can go wrong?

Introduction

Resene was asked to inspect a pair of semi detached houses that were due for repainting. The invitation to us was extended by a painter who had repainted the houses previously and was concerned that there were problems in the recoating that he couldn't handle.
The initial inspection of the structure tended to provoke the comment ‘another paint failure’.

Paint peeling on the tops and bottoms of the weatherboards, from edges of wooden joinery and from ends of weatherboards. Ends of weatherboards were also cracked about 2" back from any cut. One could think that this was a typical case where surface coatings were simply not proving adequate and were letting down the rest of the building. Two factors tended to refute this however. Firstly, the areas where the paint was not broken down were in excellent condition, maintaining good gloss and film integrity and secondly the tradesman involved was known to us to be one of the finest exponents of his craft, the fact that he called us in to discuss the latest repainting indicating his responsible attitude to his craft.

We then started to look for the reasons for the failure and several things became apparent that not only precluded the painter from doing a satisfactory job but precluded this dwelling ever having a satisfactory painting system applied to it.

The first point which showed itself was that this weatherboard construction had no soffit and the protection that the soffit provides against rain and U.V. light was totally lacking.

The next contributing factor to failure was that the wooden joinery used, had no facing timbers protecting the joint of the weatherboard to the joinery; the joint was open to the weather. The weatherboard used on the dwelling was of a shiplap profile with absolutely sharp edges top and bottom of the board. The timber joinery equally had razor sharp profiles.

It is worth dwelling a little further on this aspect because it is a phenomenon of all liquids that, due to surface tension effects, they will pull away from sharp edges resulting in a decrease in thickness at those edges.

In paint systems this can result in sharp edges being only half as thick as the rest of the paint system. As sharp edges also tend to become drip points for water, they can easily be

identified as weak spots in the system. The radiusing of sharp edges, even by as little as a 5 millimetre radius, can increase paint durability by a more significant amount than all the formulating principles known to the paint industry at present.

The final problem besetting this structure was that the builder had done no end priming of cuts made in the preprimed weatherboard. Moisture uptake via end grain is an order of magnitude greater than uptake through the faces and consequently priming of end grain is absolutely vital to maintain timber stability. In fact two coats of primer on the end grain would be preferable.

The consequence of the above meant that before the painter even came on to the job, his efforts were doomed to premature failure and the rectification of the problems were outside his scope. The problem in fact lay with the designer, the timber miller, the joiner and the builder. It is interesting to note that at this stage in the life of the building (about 10 years) it is only the painter who remains involved with the building. It has become the easy thing to do, to blame failures on paint and painters, whereas the truth of the matter is that for a successful paint job, all of the above mentioned disciplines have a vital part to play.

Classifying problems

If we classify a problem the way a customer sees it then there would only be one category. That would be that the paint is faulty. This could be broken down further into whether it is faulty because of poor production techniques, poor R&D design, poor labeling and marketing, or poor testing of the paint. The writer has been handling complaints for over 10 years and can report that in fact only about 10-15% of complaints are due to faulty paint. Complaints can also follow different trends each year.

Resene completed an analysis of complaints and found they fitted into the following categories:

User error	50%	In can problems	10%
Product fault	15%	Exterior stains	9%
General enquiry	10%	Not our product	2%
Not enough information	4%		

The user error complaints were broken down further and we found that:

Poor preparation	29%	Old paint failing	16%
Application fault	31%	Faulty substrate	12%
Wrong product or system	12%		

Classification

1. In can problems

- Skinning of solventborne paints
- Skinning of waterborne paints

- Gassing
- Lumps or bits
- Settling problems
- Gelling paint

2. Colour problems
- Wrong to colour card
- Tinter lumps
- Poor tinter acceptance
- Can to can colour variation

3. Application
- Sagging
- Wet edge problems
- Craters (cissing)
- Foaming or bubbling
- Holidays or misses in coating
- Flow problems
- Picture framing
- Hiding power
- Roller fly off

4. Drying problems
- Wrinkling
- Slow dry solventbornes
- Slow dry two packs
- Slow dry waterbornes
- Pot life problems
- Splitting

5. Long term performance
- Factory primers
- Weathered primers
- Sharp edges
- Alligatoring
- Flaking paint
- End grains
- Chalking
- Erosion
- Yellowing
- Blistereing

- Osmotic blistering
- Fading
- Loss of Gloss
- Peeling
- Burnishing

6. Appearance problems
- Gloss or colour of touch up paint
- Discolouring
- Patchy, ropey appearance
- Salt staining

7. Weather problems
- Micro-cracking
- Micro-blistering
- Surfactant leaching

8. Substrate problems
- Corrosion in sheltered areas
- Levels of finish for paperfaced plasterboard
- Timber gum bleeding
- Wallpaper
- Sealants
- New concrete plaster
- Old concrete
- Weathered timber
- LOSP timber problems
- Efflorescence (concrete)
- Knotty timber
- Rusty nails
- Rusty steel
- Solventborne flaking off Galv.
- Saponification (concrete)

1. In can problems

- **Skinning of solventborne paints:** All solventborne paints will skin in the can unless a special anti-skin additive is added during manufacture. This additive is quite volatile and can be lost if opened cans of solventborne are stirred excessively. Skin is especially problematical if painters don't realize it is there and shake or stir the paint up vigorously, thereby dispersing a sheet of skin into hundreds of small lumps. Skinning can also occur if a can is left without a lid (or incorrectly fitted with a lid) for an extended

time. Part cans of solventborne paints are best decanted into smaller cans (properly labeled) to minimise the risk of skinning. Alternatively, a good trick is to place a sheet of plastic over the wet paint.

- **Skinning of waterborne paints:** We have had a lot of problems with 10 litre pails skinning because of basically poor storage conditions. When there are large temperature changes during storage, conditions develop inside pails that allow skinning to occur. We have a patent out for a new lid design to overcome this problem. With any paint it pays to take the lid off and check for skins before shaking. Skins not shaken into the wet paint can usually be easily removed.

- **Lumps or bits in the wet paint:** Assuming these are not skins this sort of problem is uncommon. Possible reasons are that stability problems exist with the paint or somehow it never got strained during manufacture. It is also possible the customer has contaminated the paint or mixed non-compatible material with it. If lumps are strongly coloured then the tinters may not have been mixed in soon enough. Tinters need to be mixed into paint immediately after dispensing and failure to do so may see them turn into hard lumps of pigment that cannot be mixed in even in our Lab. The use of inappropriate tinters may also result in this type of problem.

- **Gelling paint:** This is pretty obvious but some paints do structure up to get what is termed a 'false body'. Vigorous stirring can reclaim paints with false body. Check this out before getting too excited. Real gelling may be caused by moisture contamination of moisture cured urethane paints, zinc rich or aluminium paints. Gelling may in odd occasions be the result of a poor unstable formulation. Obviously 2 pack paints which have been mixed up will gel after their potlife has been exceeded. Most paints will thicken up considerably if lids are not fitted tightly. Watch out for the snags in this area.

- **Settling problems:** This occurs when the pigments in the paint settle out to the bottom of the can. Some degree of settling is normal as long as the settled material can be easily reincorporated with reasonable hand stirring. Adding thinners to paints can make them more prone to settling problems. Some of our industrial paints such as our zinc rich primers have extremely heavy pigments and need constant attention during application to ensure they don't settle out.

- **Gassing in the can:** This is usually associated with paints containing large amounts of zinc metal and aluminium flake pigments. The first sign of gassing is a bulging lid and immediate action is needed. If a can of paint has a bulging lid it should be covered with a denim type rag (these rags are useful for something). A 3-inch nail (75mm) should then be punched through the rag to make a hole in the lid and release the pressure. Tape the hole with masking tape and return to the place of purchase. Gassing of solvent borne paints is the result of water contamination (maybe in the factory, maybe from the customer) chemically reacting with the zinc or aluminium pigment to create hydrogen

gas. Waterbased aluminium containing paints may also gas for the same reasons if the wrong grade of pigment is used or if the stabilising agents on the pigment are somehow neutralised.

2. Colour problems

Back In 1981, the major paint companies offered collectively 32 different colour charts showing more than 1200 different shades of the seven primary colours, plus black and white. Just imagine how many there are now!

Since colour preference is essentially a question of fashion, charts are updated and reissued with alarming regularity. Manufacturers vie to produce bigger and better colour ranges, and so charts proliferate - and with them the problems of colour selection. The colour chips on many of the Resene colour cards are made using Resene SpaceCote Low Sheen (See Data Sheet D311) to alleviate this problem.

Choosing a precise paint colour from postage-stamp sized printed samples has always been risky and often expensive. Colour charts necessarily carry a disclaimer, while every care is taken, printers ink can never exactly match actual paint colours. Then of course, there is the fact that the paint colour itself will vary according to the base colour or material being painted over, and again, colour charts cannot take this into account.

Subtle differences that may seem unimportant on colour charts are glaringly obvious at wall-magnification. For example, at chart size three blacks may seem interchangeable. Black it would seem, is black. Not so. Black can have as a base tint green, or blue, or yellow. The difference in situ would be noticeable to a client - perhaps disappointingly so - even though he or she may not be able to see why.

Subtle differences in shades are usually described as more or less warm.

The actual colour on the wall would also be affected by the amount of light in the room and its source, other colours present, the size of the room itself and the area being painted. In other words variations are caused by colour absorption, reflection and saturation; by varying characteristics of the paint itself; by variations in surfaces to be painted - and, not least, by the tendency of different individuals to see or interpret colour differently. In other words there's only one sure way to select colour - especially for someone else - and that is by test.

Actually paint some on the wall, and test reactions on the spot. To facilitate this Resene has put their entire colour range in the sample-sized cans called appropriately, testpots.

Each Testpot covers nearly 1 sq. metre. The usual colour charts are still supplied, and the recommended system is to use the charts as a guide for initial selection taking a Testpot as a form of colour insurance for the final decision.

- **Wrong to Colour Card:** Tinting colours requires full attention from the operator at all times. There are many possible ways for mistakes in tinting to occur. For example:

  - The wrong colour formulation is used.
  - Tinting a 4 litre can instead of a 2 litre.
  - The tinter ran out halfway down a stroke.
  - The tinter is sprayed sideways (dirty nozzle) and partially miss the can.
  - The operated forget which tinter was added last.
  - Juxtapose tinter quantities.
  - The right tinters were used in the wrong base.
  - The tinter was stuck up under the rim of the can.
  - The tinters were not shaken into the paint quickly enough.

  In addition the tinters themselves may be faulty, not stirred up properly before adding to the machine, or even grossly aerated from being shaken up. Resene staff tinting paint should ideally do so in a quiet area free of distractions. They should use the ruler slide to help identify and read the correct formulation. Never under estimate how easy it is to make a mistake tinting colours.

- **Tinter Lumps: I**s the result of not mixing tinters in soon enough. It is also possible that tinter may settle out in the can and be accidentally added to the tint machine pot without stirring. This is more likely to block up the tinter dispensing unit.

- **Small tinter additions:** As tinter quantities become smaller the reproducibility of colours becomes more difficult.

- **Can to can colour variation:** Always advise customers to box paint to ensure there is enough for large wall areas.

- **Poor tinter acceptance:** This happens from time to time and basically is caused by the tinter not wishing to mix it with the paint. The result can be patchy, streaky brushouts with the colour being deeper in areas that have been brushed more. This sort of problem should be immediately noticeable to the customer. Let the paint dry then check for colour difference. This may be caused by faulty tinter, faulty paint, leaving the tinter too long before shaking in or possibly the use of ineffective shakers.

- **Reproducing colours which contain tiny quantities of tinters:** When colour formulations contain tiny volumes of tinters it will be difficult to exactly reproduce the colour each time a can is tinted.

  - Different batches of tinter may vary in strength by 5-6%.
  - Tinters may not have been mixed up properly before adding to tint machine.
  - There may be gunge on nozzle of the tint machine.

- Sometimes base paints vary in tinter acceptance.
- On the Resene Lab machines we measured 11% and 13% differences in the weight of L tinter dispensed as a quarter unit.
- On the Resene Lab machines we measured 2.5% and 5% differences in the weight of G tinter dispensed as a half unit.
- Different batches of white base may vary in strength by 5-10%.
- Tinter may get caught on the rim of the can. A quarter unit of L weighs only 0.32 grams.
- Tinter not mixed into paint in the first 5 minutes after dispensing can throw out and never be able to be mixed in by conventional methods.
- The time on the painter shaker can affect tint acceptance (if too short).
- Any differences in tinter quantities will be much more noticeable if tinters are complementary. Complementary tinters tend to cancel each other out.

One can of paint to another can be as different as batches of knitting wool. Before painting a wall (or other monolithic area) ensure there is enough paint in a can to coat the entire wall. Otherwise cans should be boxed together.

3. Application problems

- **Sagging:** This occurs when paint that has been applied to a vertical surface starts to run a few minutes later. When designing paints for interior use (especially where a really smooth finish is desired) the paint needs to have excellent flow. Otherwise you will see brush-marks or a heavy roller pattern. Unfortunately there is a fine line between paints with good flow and paints that sag. If such a paint is applied too heavily or is thinned this can tip the balance. Slower drying paints such as solventbornes are quite sensitive in this area especially if spray applied. When painting weatherboards there can be gaps between boards that excessive paint gets pushed into that later runs down. Sagging can be avoided by taking care with application and observing what is happening to paint just applied. Avoid thinning paint.

- **Wet edge problems:** When we apply paint by brush (as an example) we apply the first brush-load and spread it out to get an even uniform layer of paint. We then reload our brush and apply another brush-load. What we are trying to do with the second brush-load of paint is to create an invisible join with the first brush-load. This requires us to brush into the first brush-load area with the new brush-load and merge them both together as evenly as possible. To do this properly we need both the new and older paint to be of similar viscosity and have similar brushing properties. Unfortunately there are a number of factors that prevent this from happening. The most obvious is if the first brush-load has dried for too long before the second is applied. Reasons for this may be that it was overworked with the brush, the painter may have stopped for a phone call, temperatures may be very hot or there may have been a strong wind blowing. Waterborne paints are more prone to this sort of problem because of their colloidal (particles suspended in water rather than solid material dissolved in water) nature.

- **Foaming:** This is associated with roller application and refers to the bubbles formed as paint is rolled on. Solventborne paints are especially prone to foaming and in most cases the foam can be minimised by carefully laying off with an almost dry roller sleeve or even by brush. Be careful when you do this because you are also removing paint in the process and film builds may be halved and a lower gloss finish may result. The choice of roller sleeve can make a big difference to foam and as a general rule 8-10 mm Dacron type sleeves are ideal for waterborne paints and a 5mm nap mohair for solventborne paints. Resene Uracryl 403 (See Data Sheet RA56) and solventborne paints can also be applied rather well using a Strong Solvent sleeve (from PAL).

- **Flow problems:** If flow is too good we get sagging which has already been covered. Poor flow results in brush marks, lapping marks, cutting in brush marks and a dimply finish if rolling or spraying. This may be a natural property of the paint or from bad weather conditions during application. Poor wet edge properties of a paint will result in poor flow. Paints such as our Resene Thixalon 5 (See Data Sheet D63) are deliberately made with almost zero flow so that they can be textured. This type of paint can not generally be used to get a smooth even finish as would be expected from Resene Sonyx 101 (See Data Sheet D30) say. Solventborne paints such as Resene Super Gloss (See Data Sheet D32) have excellent flow along with good wet edge properties. Because of this adding Thinners may result in too much flow and sagging problems. Solventborne paints can be very difficult to spray apply for this reason.

- **Holidays in the coating:** This is where you miss a bit of substrate. This can be particularly noticeable if sealing Particle Board with our Resene Particle Board Sealer (See Data Sheet D43) and you miss a bit. Application of Resene Polythane (See Data Sheet D53) to bare particleboard results in a very deep, rich colour compared to the colour when applying over the sealer. The result is darker patches over the holiday areas. This can only be rectified by sanding the surface off the particleboard.

- **Roller fly off:** This is the paint that flicks off a roller sleeve as you roll it across a wall. Generally it is the result of the flow properties of the paint and the roller sleeve chosen. Obviously it will also result from over vigorous rolling of any paint or if too much paint is loaded onto the roller. Roller fly off is always probable with solventborne paints but should be minimal with quality waterborne paints as long as a quality 8-12 mm nap Dacron type roller sleeve is used.

- **Hiding power:** This is a measure of how well a paint blocks out the colour of the surface it is applied over to give an even colour.

- **Cratering:** Also known as **cissing**. This occurs when freshly applied paint takes on an appearance that resembles the surface of the moon. Common causes are painting over oil or grease or contamination left by silicone sealants. Over-thinning some waterborne

clears can also cause cratering. The recently introduced zinc stearate treated sand-papers (Drilube types) leave a lubricating contaminant on the surface which may cause some paints to crater. It should be cleaned off with Turps before painting.

- **Picture framing:** This picturesque term is used to describe the pattern sometimes left when you cut in around the edge of a wall before coating it with a roller. Some pigments in paint such as yellow ochre (C tinter) are needle shaped and tend to line up along brush strokes. Areas applied by roller can look slightly different in colour as a result. With other paints different colours may result because the higher sheer of the brush (compared to a roller) is bringing out the tinters more (possibly the tinters not stirred in properly on tinting). The brushed area may be very thin (or thick) compared to the adjoining rolled area resulting in possible transparency and thus colour differences. Picture framing problems can be minimised by keeping a wet edge and by taking the roller as close to the adjacent wall or ceiling as possible.

I've applied 5 coats of Resene Half Pearl Lusta and I still can't get any coverage! Your B-- paints NBG!

Anyone who has tried to apply 5 coats of any Resene off white colours over a black and white card will know that this claim is quite ludicrous. Unfortunately Resene get many such problems each year in regards to this.

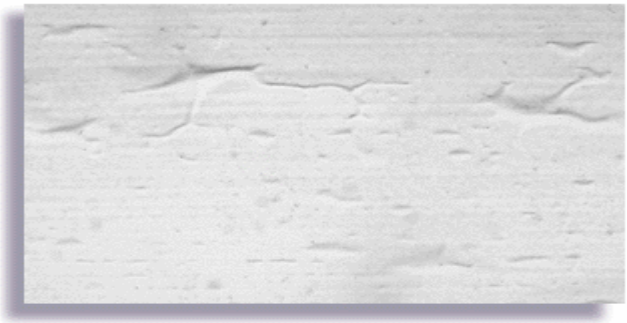
Our off whites will cover most substrates easily in two coats if applied evenly and at recommended spreading rates. The coverage is even better if applied over a properly applied sealer or primer coat.

Unfortunately, the only way to convince people that the paint is OK is to somehow force them to try and reproduce the results using controlled application rates. Any paint that is thinned can be applied very thinly and poor hiding is likely. The key is to apply paint unthinned at see Data Sheet spreading rates.

We do have some colours tinted off deep tone bases that are poor for hiding power but in 99% of cases we would bet that our colours have much better hiding than any other paint companies.

4. Drying problems

- **Wrinkling:** This normally occurs when solventborne paints are applied too heavily. Solventborne paints dry by loss of solvent then by chemically reacting with oxygen in the air. Usually all solvent has left the film before the chemical cross-linking begins. If applied in a heavy coat in warm conditions



the solventborne can cross-link on the surface while there is still solvent in the coating. This top layer continues to harden and slows oxygen access to the bottom of the coating. The skin grows in size by combining chemically with mobile portions of solventborne resin underneath. The result is wrinkling. Another form of wrinkling occurs if a previous coat of solventborne is repainted too soon. The solvents in the second coat tend to fry (partially soften) the top layer. Recoating an solventborne with a paint that contains very strong solvents (such as Resene Uracryl or Resene Vinyl Etch (See Data Sheet RA31)) can also result in wrinkling.

- **Splitting:** Any paint applied heavily across an internal corner or even right angle can end up splitting because the top layer dries while the paint at the bottom still contains solvent or water. Because most paints are only about 40-50% in volume solids the shrinkage that occurs results in the surface splitting open.

- **Slow dry of solventborne paints:** For solventborne paints to dry they need to have special driers added during manufacture. Too much or too little can effect the dry. Some pigments tend to absorb some of these driers and old black or aluminium paints may lose drying power as they age. At temperatures below about 5°C it is too cold for solventbornes to chemically cross-link and the drying process is postponed until temperatures rise. Be aware of this if trying to recoat solventborne in cold weather.

  Notes:
  Some timbers such as Matai and Totara (and cork) contain products called anti-oxidants that prevent the oxidation reactions that are responsible for solventbornes drying. This is not a problem if timber is first primed with Resene Quick Dry (See Data Sheet D45) – waterborne primer undercoat. Composite wood products such as particleboard and customwood contain waxes, which can also effect the dry of solventbornes and polyurethane solventborne varnishes. Priming with Resene Particle Board Sealer or Resene Quick Dry can prevent this.

- **Slow dry of two component paints:** These paints (for example Resene Uracryl 403) are not effected in their drying by anti-oxidants or waxes. Low temperatures will slow their rate of cure in the same way as for solventborne paints. Otherwise slow dry is probably failure to use the correct mix ratio. Two component paints rely on having exactly the right amount of hardener added for the amount of base present. In many cases individual components just never dry at all. The base for Resene Armourcote 510 (See Data Sheet RA40) is a good example of this. Using the wrong hardener may also affect the dry as well as other properties. Note that two pack products are normally used because of their better durability and chemical/physical resistance properties. If they are not drying properly this is a signal that some mistake has been made and that long-term performance may be seriously compromised.

- **Slow dry of waterborne paints: Waterborne** paints dry by first losing water and then by the process of coalescing. After the coalescing process has finished the coalescing solvent leaves the film and full hardness is developed. Typical conditions in which Waterborne paints should not be used are when temperatures are less than 10°C, when washing is not drying on the washing line, when dew is forming, or when water splashed onto a concrete drive does not dry up. If you are actually using the paint and it is still very wet after 30 minutes then painting should cease. For waterborne paints to dry properly the surrounding air needs to be dry enough to allow water to escape from the coating. Very serious problems may result from slow drying conditions. The worst is a total failure of the coalescing process in which case the paint may dry as a powder. Otherwise during the very long drying time, surfactants may accumulate at the coating surface layer and create cosmetic problems (surfactant leaching) until they are washed off or weathered away. Painters in this situation should be grateful the paint hasn't totally disintegrated.

- **Pot life problems:** These are associated with 2 component paints. The pot life of a 2 pack paint is exceeded when the mixed paint either goes solid (or thickens up a lot) or when gloss or other properties are badly effected. This is not always evident from the look of the wet paint. Typical reasons for this are abnormally high temperatures, or mistakes in mixing the two components together. If on the other hand if mixed paint never gels this can be an indication that a mistake has been made in the mixing or even worse that the hardener was not added at all.

5. Long term performance problems

- **Factory Primers on Timber:** A good primer is mandatory for a paint system to perform well. Unfortunately, not all wood primers are equal and some factory applied primers can perform very poorly. A factor that possibly makes their performance even worse is that they can be left for extended periods before they are painted. Most primers are not designed as topcoats and problems occur such as excessive chalking, mould growth and erosion of the primer and substrate cracking. If there is any doubt about preprimed timber thoroughly wash and sand back the primer and reprime.

- **Weathered primers:** See above comments. With metal primers the anti-corrosive pigments can be weathered away leaving no long term protection for the substrate metal.

- **Flaking paint:** Flaking paint obviously occurs because there is a lack of adhesion somewhere in the paint system. The paint system includes each layer of old paint, the original primer and the surface layer of the substrate. A lack of adhesion may be present at any old paint or substrate layer and can be caused by a number of

factors. The most common is failure to wash away surface contaminants such as dirt, chalk, mould, grease, etc. A lack of adhesion may also result from the old paint or substrate being too hard or smooth to get a key for adhesion. Examples of this are old epoxy paints or old, unweathered, glossy solventborne paints. Sanding or the use of Resene Waterborne Smooth Surface Sealer (See Data Sheet D47a) avoids this problem. Another common cause of flaking paint is the presence of a poorly bound substrate. These substrates are identified by being easily removed by use of a light fingernail. Some typical examples are: Badly weathered timber where wood fibres are just sitting on the surface (sanding and Resene TimberLock (See Data Sheet D48) needed); Old badly weathered concrete on roofing tiles (Resene Sureseal (See Data Sheet D42) needed); Poor quality paperfaced plasterboard finishing compounds (Resene Sureseal needed).

Paint may also flake if the old paint system is an solventborne type, which has become glassy and brittle with old age. These fail by shattering like glass if slightly disturbed. We get many problems about paint flaking off after painting with Resene Hi-Glo (See Data Sheet D31). The common allegation or insinuation is that the very strong solvents in Hi Glo (they are actually pitifully weak solvents and there is very little) have softened or even dissolved up the old paint 5-10 layers down causing flaking. This is absolute garbage! While most flaking problems are not the direct fault of the present painter they were generally caused by sloppy surface cleaning by a previous painter. Despite all the abuse it gets paint does often stick even when applied over all sorts of dirt and contaminants. The adhesion will not be 100% however and eventually the slightest stress will be the last straw and flaking will occur.

- **Blistering problems:** Blistering paint looks the same as your skin does if you get burnt. The paint skin bulges out in a circular bubble which can often be full of water. With solventborne paints the most usual cause is painting over wet substrates. This can also happen with Waterborne paints. A substrate may get wet later on as a result of a water leak (possible caused by failing flashings or sealants or even a burst water pipe inside a wall). Another cause of blistering waterborne paint is when it is caught by dew or rain before it has had time to dry properly. If these blisters are less than 1mm in diameter they may die back and never be seen again. This is one problem where procrastination can be rewarded.

Very fine blisters such as are shown on half the panel (left) have been caused by the paint being caught by early rain or dew. They will probably settle down over time.

Massive blistering on a concrete wall is called **bagging.** This is caused when large volumes of water get into a porous concrete base coated with a very thick waterborne coating. As the water can't easily escape

through the coating it blows it off. The giant blisters can be metres across. Investigate for faulty flashings and cappings to find how water is getting in before repairing.

- **Osmotic blistering:** This is a rare form of blistering and is caused by painting over salts. Blisters need to be removed and salts washed away. Only occurs underwater.

- **Peeling paint:** This is a loss of paint due to poor adhesion. Where there is a primer and topcoat, or multiple coats of paint, peeling may involve some or all of the coats.

  Possible causes are Seepage of moisture through uncaulked joints, worn caulk or leaks in roof or walls, excess moisture escaping through the exterior walls (more likely if the paint is solventborne), inadequate surface preparation, use of lower quality paint, applying a solventborne paint over a wet surface or Earlier blistering of paint.

  The best solutions is to try to identify and eliminate the source of moisture, prepare surface by removing all loose paint with a scraper or stiff wire brush, Sand rough edges and apply the appropriate primer, repaint with a top quality waterborne exterior paint for best adhesion and water resistance.

- **Fading paint:** In common with all exterior surface coatings the colour of your paint finish may be affected by U.V. light. Resene uses the finest pigments commercially available but even these are liable to change after constant exposure to sunlight. Any changes will be gradual but after a few years the difference between shaded and exposed areas may become noticeable.

  Resene paints are designed to resist fading; however the combined presence of strong U.V. light and lime in the surface can lead to premature fading. Sometimes lime staining is mistaken for fading. Lime staining occurs when the lime in the surface has leached through and is deposited on top of the paint surface as a white deposit that looks similar to fading. If this occurs, the lime must be blocked off with a suitable paint system. Resene recommends all fresh plaster surfaces are coated with Resene Limelock first.

  Resene Sun Defier (See Data Sheet D502) U.V. Protective Glaze can be used as a finish coat over freshly painted bright organic hues and shades to protect these more vulnerable pigments against fading.

- **Chalking paint:** Formation of fine powder on the surface of the paint film during weathering, which can cause colour fading. Although some degree of chalking is a normal, desirable way for a paint film to wear, excessive film erosion can result from heavy chalking.

  Possible causes include the use of a low quality highly pigmented paint or use of an interior paint for an outdoor application.

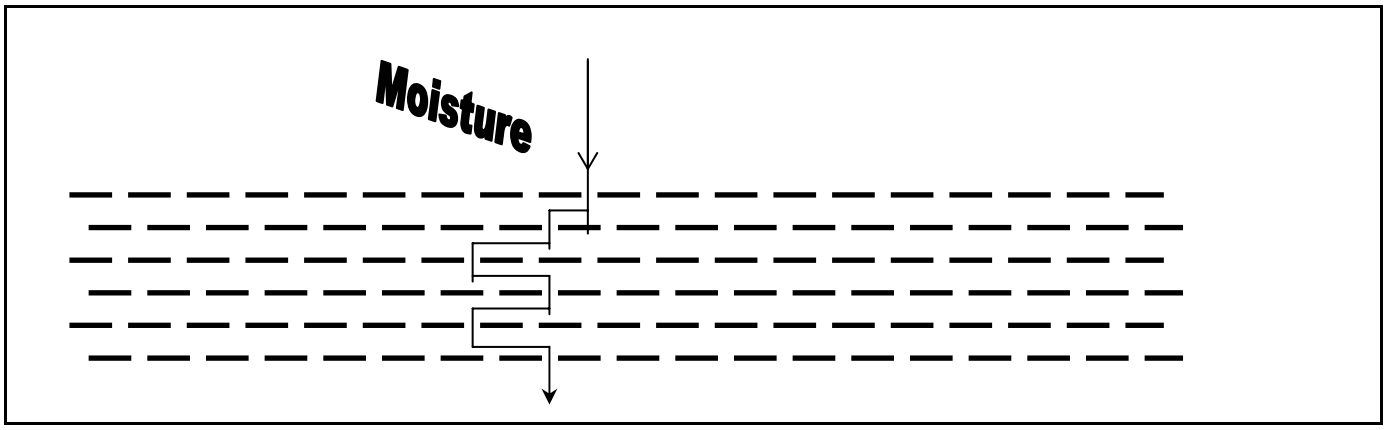
Solutions include firstly removing as much of the chalk residue as possible, scrubbing with a stiff bristle brush (or wire brush on masonry) and then rinse thoroughly or use power washing equipment. Check for any remaining chalk by running a hand over the surface as it dries. If noticeable chalk is still present, apply a quality primer (or comparable sealer for masonry) then repaint with a quality exterior coating. If little or no chalk remains and the old paint is sound, no priming is necessary.

- **Loss of gloss:** Loss of gloss is mainly related to the performance of the paint's binder. Paints that have chalked badly will naturally be lower in gloss because their surface is roughened and pitted as pigment particles are torn out. Usually only gloss paints are subjected to claims of loss of gloss. Again the use of quality waterborne paints will minimise this type of problem. If gloss retention is very important to customers the use of Resene Uracryl 403 may be appropriate, substrate and old paint system allowing. Long term gloss loss is to be expected with most exterior paints just as some degree of chalking occurs. Occasionally other factors can cause paint to flatten off. Some primers we know of break down to give off hydrochloric acid which not only corrodes the galvanised iron but also flattens the waterborne roof paint used over the top. Bad white corrosion from an unprimed roof or bad efflorescence from concrete can also flatten off paints. These latter causes should be very obvious.

- **Erosion of the coating:** Some coatings such as our exterior timber stains (Resene Waterborne Woodsman (See Data Sheet D57a)) are actually designed to fail by eroding away. The idea behind this is that technically it is almost impossible to protect timber from U.V. damage by anything less than a solidly coloured paint (white is always best). As stains have to be transparent to allow customers to see the grain of the timber some U.V. damage is going to occur. If the stain did not erode away it would fail by dramatic flaking which would cause headaches when it was time for repainting. Any users of Resene Woodsman should be made aware of the need for constant maintenance. All exposed, exterior paints will tend to erode away over time. The rate depends on the toughness of the binder, the pigment loading (PVC). The type of pigments used and the local environment the paint is in. Erosion rates for solventborne paints are about 3 microns a year and for waterbornes it is about 1 micron a year. With good quality paints you don't usually need to worry about coating erosion. 'The Boss' will have demanded a new colour scheme long before this is a worry.

Erosion can bring a sparkle to the eye

Micaceous iron oxide (miox) paints contain relatively large, sparkly flakes of black miox. These give the paint much improved resistance to water permeability. The diagram of a micaceous iron oxide coating shown below illustrates how difficult it is for moisture to get through the layers of miox. The flaky pigment also reinforces the coating something like embedding a layer of fibreglass mat would do. Gradual erosion of the coating occurs leaving gutters and sometimes nearby pathways littered with sparkly flakes of miox.



- **Yellowing of solventborne paints:** All standard solventborne paints such our Resene Super Gloss and Resene Lusta-Glo (See Data Sheet D33) will turn yellow unless exposed to U.V. light. This light does not have to be direct. Typical yellowing problems can arise when these products are used for the interior of cupboards or on skirting boards behind furniture. Many people, including tradesmen will claim they have never seen the problem before but be reassured that it has always happened. Resene Enamacryl (See Data Sheet D309) and Resene Lustacryl (See Data Sheet D310) are non-yellowing alternatives for solventborne paints. Yellowing of solventbornes is made worse if waterborne paints containing ammonia are used in the area before the solventborne paint has had time to thoroughly cure. Polyurethane varnishes including Resene Polythane, Resene Qristal (See Data Sheet D52) and Resene Aquaclear (See Data Sheet D59) all tend to yellow on aging. Some timbers also tend to yellow underneath clear coatings.

- **Sharp edges:** This is a bad problem on exterior timber but sharp edges can also be a real headache on steelwork as well. The problem is that paint tends to flow away from sharp edges and as a result the film build can be about 10-30% of what it should be. On exterior timber this can lead to premature erosion of the coating over edges and the lower coating thickness will allow water into the timber. The timber expands and eventually cracks in the coating and timber may develop. This lets even more water in and the problem escalates and bad flaking may result. On steelwork premature rusting may occur. The only sensible solution is to remove sharp edges as part of the surface preparation process.

- **Timber end grain:** This can be 10-50 times as porous as other timber surfaces and it is very important to properly prime all end grain of exterior timber in particular. Water entering timber end grain can carry bacteria as well as causing the timber to go through cycles of expansion and contraction as it gets wet and dries out. Doors and windows not looked after may not close properly in wet weather.

- **Alligatoring:** Pattern of cracks in a coating resembling the skin of an alligator. Sometimes call **crocodiling** or **mudcracking**. Usually caused by applying solventborne paints over soft PVA type waterborne paints. Can also simply be the result of an old solventborne paint becoming too brittle over time to cope with life. Best rectification is to totally remove paint and start again.

- **Burnishing problems:** May also be called **polishing up.** Typically this occurs with flat or low gloss paints used in areas of high traffic such as stairwells where people tend to trail their fingers along a wall as they walk. Problems can be avoided by changing to higher gloss level paints. Solventbornes will perform better than waterbornes.

6. Appearance problems of newly applied paint

- **Discolouring:** Fading and chalking are examples of discolouration but in the shorter term timbers such as Cedar and Redwood will bleed if pale coloured waterborne paints are applied directly to them. Wood Primer should be used to seal stains in these timbers. Painting over fresh tanalised Pine can also result in stain bleeding. This should not happen with properly dried timber. Polysulphide sealants may also cause staining if painted over. Other sealants may not cause discolouration directly but they can bleed plasticiser to make the paint sticky. Sticky paint then attracts dirt. Best advice is to not paint over sealants at all.

- **Gloss or colour problems with touch up paint:** Touching up small damaged parts of larger walls is very difficult unless some of the original paint is kept. Even then gloss differences and lapping in marks will be visible. Gloss levels of semi-gloss type paints take time (about 2-3 weeks) to settle down. Best advice is to apply a full coat over the smallest area with a natural boundary such as a doorway, down-pipe, joint etc.. Touching up the middle of a wall with a different can of paint to the original is likely to result in slight colour difference and a gloss difference that will certainly attract attention to the colour difference. In exterior situations slight fading or chalking of the old paint adds another dimension to the difficulty of accurately touching up small areas.

- **Patchy or ropey appearance:** Some types of problems are hard to categorise and may fit into more than one basket. A patchy finish is usually related to a wet edge problem whether it is from trying to paint in hot, dry conditions or from just over-brushing the result can look the same. Patchiness may also be the result of an unevenly sealed substrate. In the example with the Resene Polythane over the Resene Particle Board Sealer with holidays the holiday areas would have also looked flat in gloss compared to other areas. This can happen when re-varnishing timber if you have areas that have flaked back to bare timber or if bare timber has even been sanded using say P40 grit paper in one area and P220 grit in another. The coarser the grit of the paper the more the varnish (this applies to stains as well) penetrates the timber and deepens its colour. Patchiness is also likely as a result of the Level of Finish of paperfaced plasterboard not being high enough.

- **Salt Staining:** Failure to wash salt deposits off a substrate before painting in a waterborne paint can result in a streaky appearance that may only be visible when you look along a wall rather than look head on. These can usually be washed off but soon reappear. There should be warning signs when painting over a salt stained surface because salt and the waterborne binder are quite incompatible. Waterborne paint may crawl, ciss or go snotty when salt is present. Solutions are to either remove the paint and wash off the salt or apply a sealer coat of Resene Enamel Undercoat (See Data Sheet D44).

7. Weather related problems

- **Micro-cracking:.** This is usually a problem with Waterborne paints that have been caught by bad weather and failed to coalesce properly. Typical conditions would be met if you began painting at about 3-4pm on a calm, sunny, winter's day. Often the micro-cracking can only be seen through a 10x magnification hand lens (or better). It is the result of the waterborne not coalescing properly.

- **Micro-blistering:** This may effect waterborne paints that have been caught by rain before they have dried properly. Blisters less than 1mm in size can often dry back, if weather improves quickly, and not cause any further problems. It pays to leave these problems a few days before seeking help.

- **Surfactant leaching:** Waterborne interior products in particular are vulnerable to surfactant leaching, where some areas of the paint surface appear to be covered in white streaks, giving a watermark effect. Surfactant leaching only affects the appearance of the paint finish, not its durability. It cannot be accurately predicted or prevented but tends to occur when moisture settles on a film, such as in a steamy room like a bathroom when there is moisture in the air on a cold and wet day or in humid conditions. Colours with higher levels of tinter are most prone to surfactant leaching.

  Surfactant leaching is caused by water sitting on freshly applied waterborne paints. Water softens the fresh paint and draws out water soluble surfactants. As water dries off these are deposited on the surface. These deposits are easily removed early on by simply cleaning the surface following the interior paintwork instructions. The problem may occur once or twice again before all leachable material is completely removed. If left, the deposits can etch the surface and leave a permanent mark. This should diminish over a few months and is only of cosmetic concern.

  Surfactant leaching is usually associated with marginal painting conditions. Tinted paints are more prone to surfactant leaching than are white paints because of the ingredients that are present in tinters. To prevent surfactant leaching, it is best to avoid application in the late afternoon if cool, damp conditions are expected in the evening or overnight. Ensure adequate ventilation is maintained during the drying period. If surfactant leaching

does occur, clean the surface as soon as possible to avoid permanent marking using these cleaning recommendations.

- **Tips for Avoiding Weather Related Paint Problems**
  - Often caused by rain or early dew. Watch the weather forecast.
  - Dew is likely in the early evening on warm, calm days in spring winter and autumn.
  - Dew is unlikely if there is a moderate wind blowing or it is overcast.
  - Conditions are too damp for painting if:
    - Washing is not drying on the line.
    - Concrete driveway does not dry out.
    - Waterborne paint has not dried at all after 30 minutes.
    - There is evening dew on the grass.
    - It is raining, snowing, hailing, sleeting etc.
  - Don't try and apply dark colours (or any other colours really) in direct sunlight on hot days. You are likely to have wet edge problems.
  - Plan the job so the north wall is painted early in the day etc.
  - Don't paint if you have been caught before in similar conditions.

8. Substrate Related Problems

- **Corrosion in sheltered areas:** Most New Zealanders live in areas that are reasonably close to the sea. Salt spray carried by the prevailing wind can cause bad corrosion problems because it is often blown onto the underside of steel or galvanised steel structures. These areas also tend to accumulate wind blown dirt and can therefore become a trap for moisture as well as salt. The result is that these areas (underside of covered walkways, canopies, underside of guttering, etc.) will potentially corrode 2-3 times faster than fully exposed areas where deposits of salts are washed away by rain. These problems should be anticipated and can be minimised by a programme of regular washing down to remove salts and dirt. Painting with heavy duty paint systems will also help.

- **Levels of finish of paperfaced plasterboard:** Paperfaced plasterboard is produced in a range of configurations to meet differing situations. The surface is easy to paint but textural variations between the paper faced board and the smooth plaster joints can create some issues under certain lighting conditions. Level of finish is a term used to describe the finished surface of a stopped plasterboard wall. These are defined in AS/NZS 2589 and are clearly spelled out in the GIB® Site Guide March 2006. It is important to correctly specify the level of finish at the design stage as there are several construction factors that need to be considered.

- **Gum bleeding and LOSP pine**: Gum exudation or bleeding can occur on unstable timber. This can be as the result of LOSP preservative treatment or may simply be because certain pieces of timber are not suitable for exterior use. Gum exudation cannot be

prevented by use of special paints but can be minimised by coating in pale colours rather than dark.

- **Wallpapers:** Painting over most wallpapers with waterborne paints is normally easy peasy. Paper is a really good surface to paint over. Some types of wallpaper can give problems. Vinyl papers in particular are notorious for bleeding plasticiser. Plasticiser is a bit like engine oil in that it never dries and remains mobile. It will move into a paint and slowly make it sticky or patchy in appearance. Our solution is to remove the paper. Other wallpapers may have gold glitter which can turn black if ammonia containing paints are applied over it. Resene Sureseal will seal this off. Best advice is to do test patches on wallpaper before painting.

- **Sealants:** Painting over sealants should be avoided. Elastomeric construction sealants are immensely important products; indeed many modern building practises would not have developed without the availability of these tough, adhesive, resilient materials. So why does the paint industry hate them?

  There are many times that, for aesthetic reasons, it is desirable to paint these materials and there lies the rub. Many sealants contain plasticisers to achieve their required physical properties. These materials are generally content to stay within their domains inside the sealant but deep down they can have a roving eye and a faithless heart. They can become fatally attracted to paint films lying in intimate contact on the sealant's surface and migrate into them.

  This loss of plasticiser is never sufficient to jeopardise the properties of the sealant but it can drastically affect the paint film. The paint binder can swell and soften causing some gloss changes in sheen paints but more importantly, a drastic lowering of the paint's dirt resistance. Dirt particles stick to the softened film, bringing exactly the attention to the joint that was sought to be avoided by painting in the first place.

  Paints and glazes have different susceptibilities to the effects of plasticisers with harder paints being less susceptible. However, therein lies the second rub.

  If an elastomeric sealant, coated with an excellently adhering coating is stretched beyond the elastic limit of the coating, the coating will crack. Due to the excellent adhesion of the coating small tears will occur in the sealant, at the site of the cracks, to accommodate the movement. Just as a rubberband will become severely weakened when a small notch is cut in its side, so is the sealant weakened by these crack-induced notches. Further, normal expansions of the joints can lead to these notches propagating deep into, and eventually through the sealant, leading to joint failure.

  It seems generally agreed that, although some elastomeric sealants are paintable from the perspective that paint will adhere to them, best elastomeric sealant performance is

achieved by leaving them unpainted. Coating with high-build elastomeric coatings is a possible solution but these soft coatings are at risk should the sealant contain a plasticizer with wanderlust.

- **Concrete plaster:** These substrates should be ideal to paint with waterborne but are too often real headaches. Many new building materials and architectural designs result in buildings without soffits, poor attention to flashings and lavish use of sealants to compensate for poor design or construction technique. As a result many new concrete plaster buildings leak. Problems from water leaks in new buildings are well documented by BRANZ. Unfortunately they also effect us as the water that gets into these buildings often escapes slowly through the paint coating resulting in disfiguration from efflorescence. Rectification of this type of paint problem needs to be proceeded by proper waterproofing of the building. Paint, for example should not be used as means of waterproofing flat, horizontal surfaces such as parapets.

- **Old bare weathered timber surfaces.** These are not sound surfaces to paint over and paint may flake off in about 18 months. When timber weathers the surface is broken down and under a microscope may resemble a straw bale with the binder twine cut. This deep pile of fibre harbours dirt, mould and possibly salt. Remedy by treating for mould, thoroughly washing, sanding to remove the bulk of the weathered timber fibres, then finally Timberlock'ing before priming and repainting.

- **Efflorescence:** This is only a problem when painting over concrete. Efflorescence occurs when water somehow gets into concrete and then dissolves lime within the concrete matrix. As the water dries out of the concrete this lime is carried to the surface and deposited there. Unfortunately it then reacts with carbon dioxide in the air and becomes an insoluble white deposit. Remove by wire brushing and before repainting take action to prevent further water getting into the concrete.

- **Knotty timber:** Knotty timber generally has very poor durability in exterior situations. Knot areas are like end grain areas in that they are much more absorbent. Knots tend to be unstable and crack or sometimes fall out. Gum bleeding or sometimes staining may occur around knots. Best advice is to choose timber without knots but otherwise give an extra coat of primer.

- **Rusty nails:** Resene advice for rusty nails in timber is to either punch them right in or pull them out. The latter is always preferable. Remember to put in a new nail. Rust staining around a nail head can be a sign that timber is rotting around the nail shaft. Remember when replacing nails to use galvanised nails but on Cedar to use stainless steel. Rusty nails and bolts can cause unsightly staining far out of proportion for their size. Bad iron stains in concrete can be removed by carefully treating with oxalic acid. Note that oxalic acid is poisonous. Nails on fibrous cement sheets can also rust and can be a real problem to fix especially if already painted over. Usually galvanised nails are

used and nail heads may be damaged during fixing or possibly be of low quality in the first place. Rectification requires either removal or individually wirebrushing each one clean and spot priming with Resene Galvo One (See Data Sheet D41). Best advice with fibrous cement sheets is to spot prime nail heads after assembly with Resene Galvo-Prime (See Data Sheet D402).

- **Solventborne paint flaking off galvanised steel:** This is usually the result of not using a proper galvanised iron primer. Solventborne type paints actually chemically react with the metallic zinc to form soaps.

- **Saponification:** This normally only occurs with solventborne paints which have been applied directly to concrete that is still fresh or damp. When an solventborne saponifies it chemically reacts with the free lime in the concrete and turns into soap. The surface will feel greasy and the coating dissolve in water if badly effected. Note that waterborne paints have very good resistance to **Lime Burn** as this can also be called.

- **Old concrete:** Concrete roofing tiles can become very powdery and therefore difficult to get good adhesion to. Use Resene Sureseal to help bind up the surface. Old unpainted concrete can develop other problems such as spalling where the reinforcing steel starts to corrode and crack the concrete open.

- **Rusting steelwork:** Old rust harbours salt and moisture. All traces of rust must be removed and salts washed out with lots of water before repainting. Regardless of the primer used rust will reappear in a few years unless preparation is almost perfect. Never underestimate rusts ability to escape from underneath a new paint system.