Concrete Efflorescence Fact Sheet

1.0 What is Efflorescence?

Efflorescence is the appearance of white salt deposits on or near the surface of concrete causing a change in appearance.

Efflorescence is the phenomenon that occurs when salt in concrete or groundwater is deposited as an unattractive white powder or stain on the surface of a wall, floor or driveway/path. Stains can be white, grey, pale yellow or even green depending on the type of soluble salts in the concrete, clay brick or paver or in the groundwater. These salts form naturally in the concrete, clay and groundwater and are more or less concentrated depending on geographical location and the source of the raw materials in the concrete/clay.

There are two main types of efflorescence that affect concrete.

Primary efflorescence – salt in concrete or clay products is dissolved or carried by capillary action to the surface by water and left when the water evaporates. This type of efflorescence generally occurs for about 2 to 3 years and reduces naturally as the available salts are depleted.

Secondary efflorescence – salts in ground water or another source are carried to the surface of concrete or brickwork by hydrostatic pressure or osmosis/evaporation (also referred to as evapotranspiration) and left when the water evaporates. This type of efflorescence continues as long as the source of the salty groundwater remains available.

Water carrying soluble and non-soluble salts leached from the earth flow naturally in the ground. As this water travels under a building, the downward pressure of the building's weight results in hydrostatic pressure. The waterproof membrane under a house slab and its footings prevent rising damp in the building, however most concrete and paved driveways, patios and paths do not have a waterproof membrane underneath. When groundwater under pressure reaches a concrete drive or gap between the drive and a footing, it will make its way to the surface.

When water containing salt evaporates, salt crystals are formed on the surface which appear as a fluffy white powder or white stain deposit. These crystals continually grow as long as the salt and water source is available. The type or types of salt will determine the nature and appearance of the efflorescence.

2.0 Typical Appearance of Efflorescence Salts

2.1 Hard Calcium Carbonate deposits

Calcium salts react with Carbon Dioxide in the air and form non soluble Calcium Carbonate. This is the hard white or yellow efflorescence seen on concrete and bricks. Because it is not soluble Calcium Carbonate cannot be washed off the surface. A mild solution of muriatic acid (Hydrochloric Acid) is normally required to remove Calcium Carbonate.

Calcium Carbonate salts

2.1 Fluffy white crystalline salts

Normally fluffy white salts are water soluble like Sodium Salt crystals. This white powder is very unsightly on coloured paving or brickwork, as seen in the photographs below. Water soluble salts can be easily washed off the surface using water and a brisk scrub.

Fluffy white sodium salts

3.0 Examples of Efflorescence

The following are examples of efflorescence on buildings and concrete paving;

3.1 Efflorescence on walls and paving – Diagram 1

Where ground water under hydrostatic pressure meets a wall, moisture can rise up the wall leading to efflorescence - see below. When the water travels under a house, it builds hydrostatic pressure which can rise through a garage slab or joint, causing efflorescence on the floor or wall inside a garage or on the surface of a driveway or pathway. See .

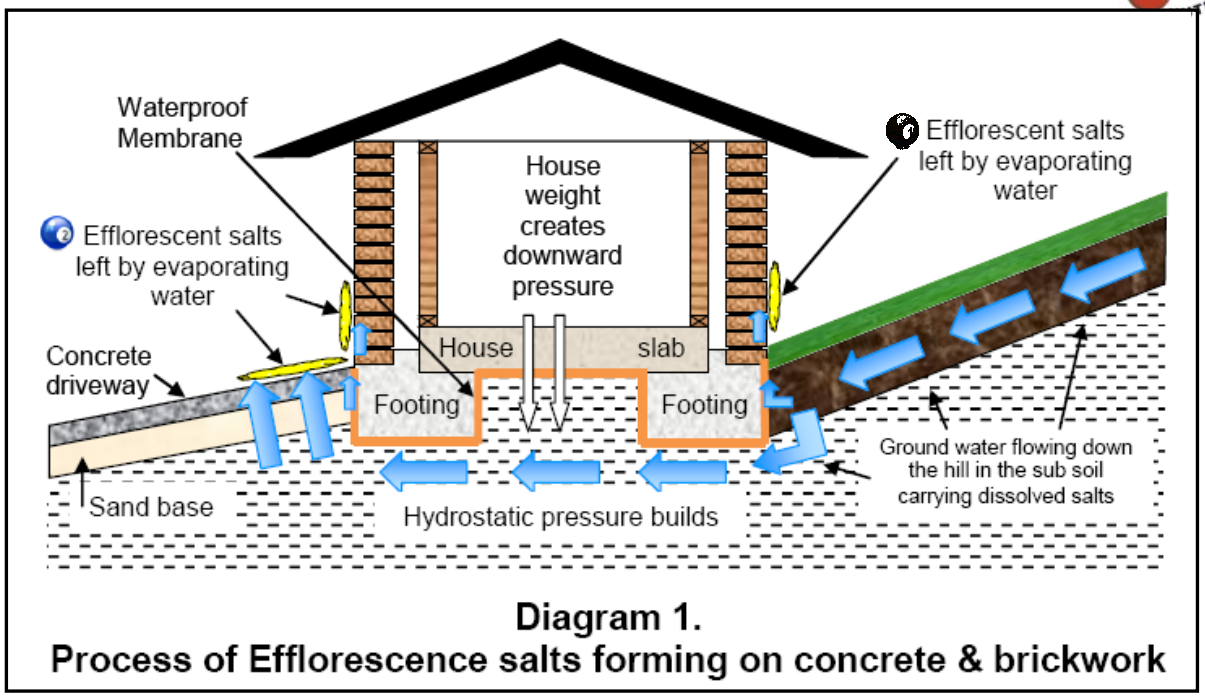


Diagram 1.
Process of Efflorescence salts forming on concrete & brickwork

3.2 Efflorescence on a garage floor – Diagrams 2, 2a and 2b.

Most houses built on a concrete slab have a waterproof membrane underneath to prevent rising damp. When a garage is constructed adjoining a house, a waterproof membrane is not mandatory and it is often forgotten. This allows moisture in the ground to rise up through the concrete floor, particularly if there is ground pressure (also called hydrostatic pressure). It is also common not to seal the gap between the house slab/footing and the garage floor. These concrete slabs are often poured at different times and are not joined or sealed correctly. This is an area where moisture can rise up and enter the concrete garage slab, leading to a rising damp effect. The rising damp can affect both the concrete floor and an adjoining brick wall, unless a sufficient damp proof barrier has been installed.

When the ground water containing the salt evaporates, salts crystals are deposited on the surface of the floor or wall. These salts crystals can continue to grow, provided the source of the water and salt is available. If the surface has been coated with a sealer or concrete paint, the crystal can damage and lift the coating causing an unattractive appearance. Reapplying the sealer or paint will not usually resolve the problem, as the efflorescence will usually continue for some time.

Salts on a brick wall caused by rising damp

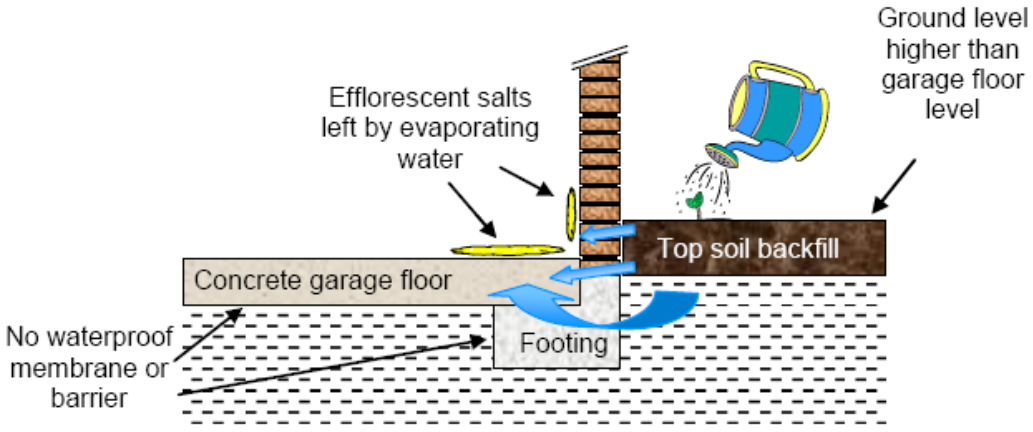


Diagram 2.
Common problem of Efflorescence on concrete garage floors

Moisture can also enter a brick or concrete wall or concrete slab due to a structural fault such as a leaking roof or a broken tap or pipe as shown in Diagrams 2a. and 2b. below.

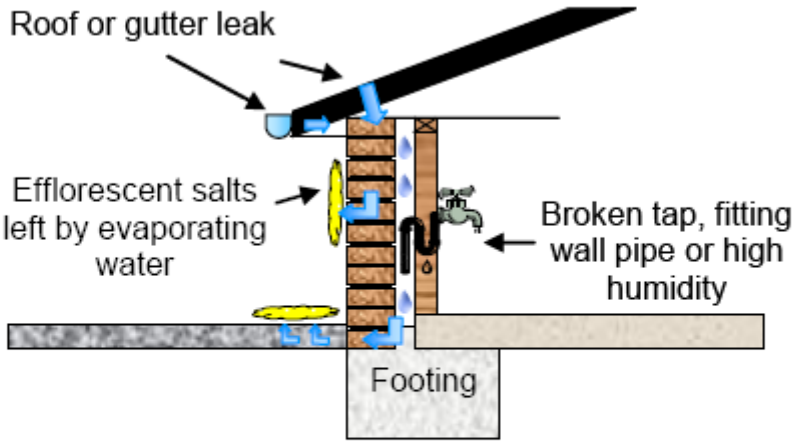


Diagram 2a.
Process of Efflorescence salts forming on concrete & brickwork

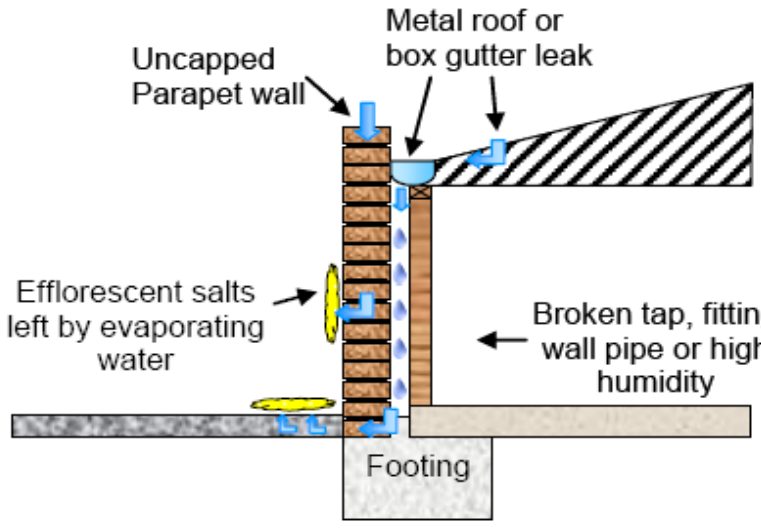
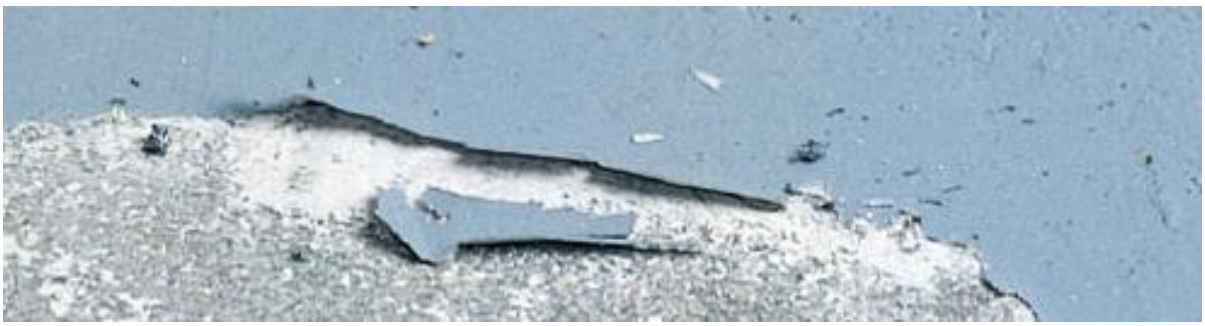


Diagram 2b.
Process of Efflorescence salts forming on concrete & brickwork

3.3 Efflorescence on a concrete or paved path adjacent to a garden or grass area - Diagram 3.

Concrete paths and driveways almost never have a waterproof membrane underneath. Therefore moisture from the ground or adjoining garden or lawn can easily saturate the concrete. Salts can be transported through the concrete and are then deposited on to the surface very easily.

Saw cuts, expansion joints and concrete cracks are weak points where water can penetrate very easily. Apart from unsightly white stains, this efflorescence can affect concrete sealers and coatings. Coloured decorative concrete is particularly at risk. A constant source of water and salts can lighten or darken decorative coloured iron oxides in the concrete. This can unsightly darkening particularly along cracks and joins due to colour variation. It can also lead to delamination of surface coatings, including clear or coloured concrete sealers. Nutech PaveCoat® concrete sealer is moisture vapour permeable and is less likely to delaminate, however thick coats and non soluble salts can still result in sealer delamination in some situations.



Sealer lifting due to salts underneath. Poor surface penetration and lack of adhesion very apparent due to incorrect application.

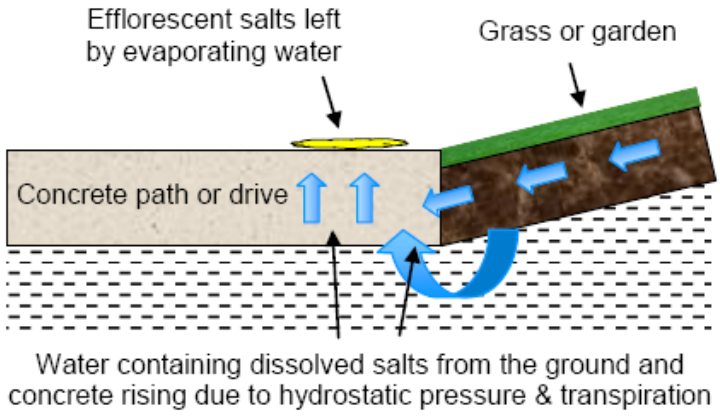


Diagram 3.
Efflorescence forming on a concrete path or driveway

Salts under clear sealer on black stencil concrete

Salts on slate impression concrete where the sealer has delaminated

Concrete surface crazing showing colour variation due to moisture & salts

Salts on unsealed concrete adjacent to grass

Salts patches on coloured concrete paving

4.0 How Does Efflorescence Affect Concrete Sealers

The following Diagram 4 shows how salt crystals growing under a coating can lift and delaminate the paint film. Growing salt crystals will lift single and two pack coatings including acrylic, polyurethane and epoxy coatings.

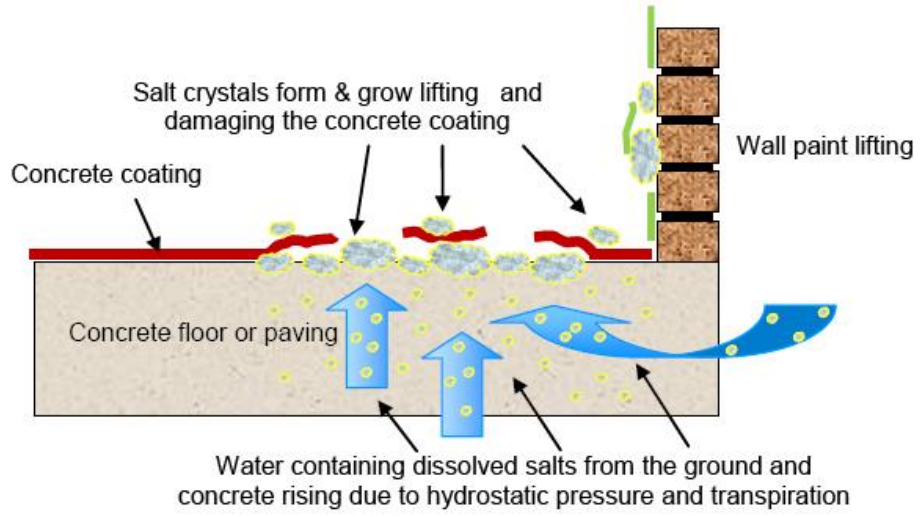


Diagram 4.
Efflorescence causing concrete coating & paint to lift

Where efflorescence damage has started, the process will continue as long as the source of the moisture and the salt remains.

Strong alkaline salts also damage most single pack acrylic paints over time if left untreated.

5.0 Solving Efflorescence Problems

Simply recoating will not usually solve a delaminating sealer problem and applying a sealer will not prevent efflorescence.

The most effective solution is to remove the source of the moisture and salts.

The following Options are available;

1. Wash off surface salts using a mild soapy solution or a very dilute acidic solution. This can include Hydrochloric Acid (1 part clean water to 100 parts Hydrochloric Acid) or household Vinegar.
2. Install an interceptor cut-off drain to stop ground water – see Diagram 5 on Page 9.
3. Lower the exterior ground level and re-grade the surface away from the building or concrete to reduce ground water movement

4. Incorrectly applied concrete paints sitting on the surface will be delaminated easily by efflorescence. A correctly applied moisture permeable concrete sealer like Nutech PaveCoat which has penetrated deeply into the concrete surface is much less likely to fail.

5. Rectification will require steps 1 and/or 2 above and then the following procedure;
   - Strip off the old sealer,
   - Clean the surface correctly including an acid etch to ensure 1st coat penetration
   - Apply 2 or 3 good coats of PaveCoat (or other suitable Nutech floor coating which is moisture vapour permeable to reduce low off.

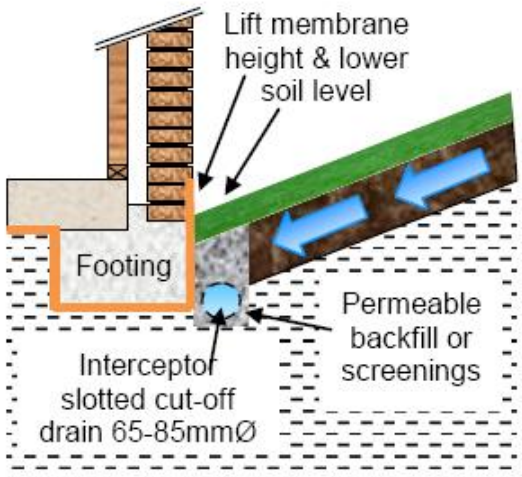


Diagram 5.
Prevent groundwater flow

6.0 WARNINGS

Using a moisture impermeable floor coatings such as an epoxy or polyurethane without a sub floor moisture barrier or a correctly applied impermeable primer can lead to delamination blisters caused by osmotic pressure. Osmotic blisters form when moisture and salts permeate through a primer due to voids, bubbles and other defects as shown in Diagram 6.

Typical osmotic blisters in Epoxy floor coating

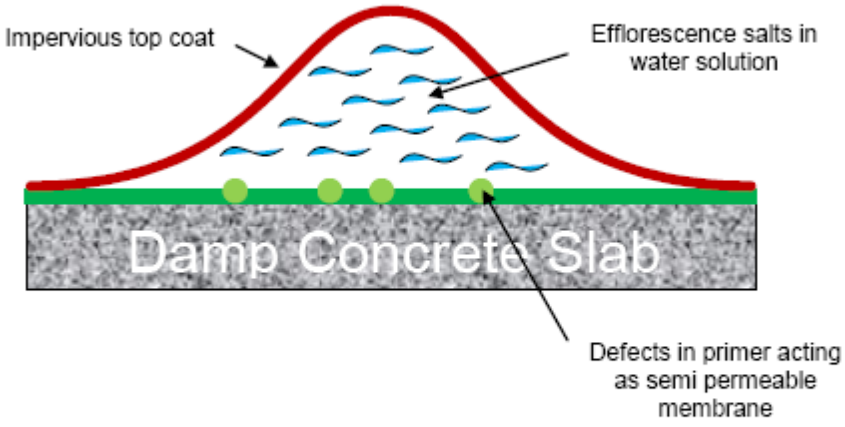


Diagram 6.
Blister Formation in 2k Epoxy Coating

7.0 SUMMARY

There is no simple 'one solution fits all' answer to solving Efflorescence salt problems on walls and floors. The problem is never caused by the floor coating or sealer and simply applying another coat will usually not resolve the issue.

Discussing a situation in detail with a Nutech Professional will provide information which can help minimise or reduce the problem.