

If you cut patterns before staining, cut them just before cleaning the surface in preparation for the stain. Sawing dust contains free lime that can adhere to the surface, causing colour distortion. If you cut after staining, do it after the first coat of sealer has been applied.

Dramatic effects also can be achieved by applying stencils to surfaces after staining and then sandblasting to reveal plain or coloured concrete in areas not covered by the stencils. These stencils are usually made from plastic materials and have adhesive backings that stick to the floor surface. One coat of sealer is recommended before sandblasting to improve stencil adhesion.

Stain application

Stain manufacturers differ on when to apply stain. Some say that a new slab must cure for 28 days before work is started. Others suggest 14 days. Installers sometimes prefer to do their work as soon as possible after the concrete is placed.

When choosing how to apply stain, keep the following things in mind:

- Colours are more intense if stain is applied soon after concrete is placed. Stain diluted with water and applied immediately can often achieve the same results as full strength stains applied later.

- Water drives the chemical-stain reaction. To achieve colour consistency, make sure the moisture content of the concrete is roughly the same for every placement coloured. If one concrete placement is stained 2 days after it's placed, then other placements should be stained when they are 2 days old for colour consistency.

- Staining, sealing, and covering finished work before other construction trades return to the area saves on cleanup, achieves a better-looking installation, and makes damage repair during the rest of construction easier to handle.

There are many ways to apply stain, with each method providing a different final appearance. However, there are some general guidelines.

Sprayers often are used to apply stains, but they should be rated for acid and have no metal parts. Acid will quickly destroy metal parts, which can affect the colour of the stain. Miller advises using a spray tip with a circular pattern that goes from left to right and then right to left, with someone scrubbing the stain into the surface using a medium-bristle brush in a circular motion just behind the spray. It's important to scrub in the stain not just push it around. An additional spray pass just behind the scrubbing removes brush marks. This method ensures good penetration and minimal marking from either the sprayer or brush.

Additional water can be used to create different concentrations of stain colour. Wetting the concrete before stain is applied is one way to do this. Following the application with water from a spray bottle is another way.

Stains applied by paintbrush will penetrate well, but care must be taken to minimize brush marks, which are not usually regarded as creative or desirable effects.

Whatever stain application method is used, be sure to carefully mask surrounding areas to avoid accidental staining. Acid stains can be difficult, and in some cases impossible, to remove.

The increased interest in chemical-stain finishes is in the direction of more subtle effects. Installers frequently dilute stains with water to produce less intense effects. For example, one contractor often applies the stain the day after the concrete is placed, starting with a 3% stain dilution (3 parts commercial stain to 97 parts water by volume), and then adding more acid to increase the strength to 10%. In this manner, the contractor can gradually build up colour to meet owner expectations. Second and third colours can also be added in the same fashion to create colour overlays.

Sometimes a stained overlay is the best solution for concrete surfaces that show damage or have been abused during construction. Commercially available overlay materials can be integrally coloured, textured, and stained to provide a new range of decorative possibilities. The overlays have high flexural strength and wear resistance. As with everything

involving stains, however, it's wise to create a sample to ensure compatibility of the overlay cement with the stain and to get owner approval for the result.

Using dyes and tints

Miller states that using a chemical stain should also involve using dyes and tints, because the two work hand in hand. Dyes and tints provide colour variations not available in chemical stains, can be used to treat areas that did not stain well, or can lighten the stain colour.

Dyes are not chemically reactive with concrete, and their appearance is translucent. They can be organic or inorganic and diluted with either water or solvents. Jones says dyes are azochromium colouring agents fine enough to penetrate concrete surfaces, and they can create bright colours not possible with stain, such as reds and yellows. Some dyes are UV-resistant, but those that aren't can be coated with UV-resistant sealers to make them colourfast.

Universal tints, often available in paint stores, are opaque, and the colours produced can mask deficiencies left by acid stains. Tints can also lighten the colour of the stained surface.

Cleanup

When most of the chemical reaction is complete, a layer of coloured residue with a mildly acidic pH will remain on the surface. This layer must be thoroughly cleaned off with a scrubbing machine and water mixed with detergent so the sealer will bond properly when applied to the surface. Water-based sealers, in particular, have little tolerance for residual acid. Using pH paper or pencils to test the surface pH is a good way to ensure that conditions are right.

To the water-and-detergent cleaning mix, add a tablespoon of baking soda per gallon of water to neutralise any remaining acid. Scrub with a buffing machine using soft buffing pads (green or white) or a scrub brush, and pick up the residue with a wet vacuum. Rinse until the water is clear. Allow the floor to dry 1 or 2 days before sealing.

Applying sealer

Surface sealers for exterior applications should be acrylic to allow moisture in the slab to escape. Solvent-based acrylics generally perform better than water-based products for outdoor use. Silicone-based penetrating sealers are recommended for applications where a shiny or wet look is not desirable. A good indoor application consists of one coat of solvent-based acrylic followed by a topcoat application of water-based acrylic. Floor maintenance can be performed with additional applications of water-based acrylic sealers or waxes.

For interior slabs, three primary types of sealers are used: acrylics, urethanes, and epoxies. Acrylics are UV stable, inexpensive, and easy to apply or re-apply, as necessary. But they have the softest surface of the three and require the most maintenance. Solvent-based acrylic sealers are softer than water-based products. They also provide a wet look that greatly enhances the appearance of coloured finishes.

THE Art of Acid-Etch Staining

By Joe Nasvik How-to hints for producing stained surfaces that satisfy customers.



Figure 1: The magic of Acid-etch Chemical Staining

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Introduction

Picture a concrete colouring material that produces a unique look whenever it's applied. No two floors or walls look the same after being treated with this material. That's the magic of the acid-etch chemical staining process—an infinite number of possible results limited only by the creativity of the installer. It's why installers get so involved with the process, and it's why their customers must have realistic expectations about the outcome. They should expect variability, not uniformity.

"We're trying to make concrete look interesting, not like some other material," says Mike Miller, president of The Concretist, a well-known consultant to the decorative-concrete industry. He often combines colours from acid-etch stains, dyes, and tints in his work, and extends the range even further by applying the stains to concrete already coloured integrally or with colour hardeners.

The variegated and natural look of the end product is its most attractive feature, but this variability can also lead to disagreements among owners, specifiers, and installers. Because so many variables can affect the final colour, contractors should provide an approval sample of stain applied to a small, concealed part of the concrete to be treated.

How stains work

Chemical stains can be applied to new or old, plain or coloured concrete surfaces. Although they are often called acid stains, acid isn't the ingredient that colours the concrete. Metallic salts in an acidic, water-based solution react with hydrated lime (calcium hydroxide) in hardened concrete to yield insoluble, coloured compounds that become a permanent part of the concrete. Several companies manufacture chemical stains that are variations of three basic colour groups: black, brown, and blue-green.

The acid in chemical stains opens the top surface of the concrete, allowing metallic salts to reach the free lime deposits. Water from the stain solution then fuels the reaction, usually for about a month after the stain has been applied.

Other factors that affect the outcome include:

- Cement properties and amount
- Admixtures used
- Type of aggregate used
- Concrete finishing methods
- Concrete age and moisture content when stain is applied
- Weather conditions when stain is applied
- Efflorescence

In general, cements that produce larger amounts of calcium hydroxide during hydration will show more stain colour, and higher cement contents produce more intense colours.

Air-entraining or water-reducing admixtures don't pose a problem. However, calcium-chloride accelerators can cause very mottled, darkened areas, and for this reason aren't recommended. Nonchloride accelerators don't cause this mottling effect.

If they're near the surface, calcium-based aggregates, such as limestone, take stain readily and deepen the colour of the concrete above them. Siliceous aggregates, such as gravel, don't react with the stain.

Open finishes achieved by floating followed by minimal troweling take more stain and produce denser colours than do hard-troweled surfaces. However, open finishes lose colour faster because the concrete wears away. Because of this, Gary Jones, president of CP Concrete Systems in Burnaby, British Columbia, Canada, prefers staining hard-troweled surfaces because the stain colour lasts longer.

"Colours on troweled surfaces also look richer than those on floated surfaces," says Jones. "But you have to sand the surface or use a higher acid concentration to ensure adequate stain penetration.

Slabs placed in wet weather result in a richer stain colour if the concrete is stained soon after it's placed. However, wet slabs are more likely to effloresce, lightening the colour and causing a more mottled effect in areas where the stain doesn't take because efflorescing salts hinder penetration. On sunny days, the concrete can become hot and dry, and the stains won't penetrate as deeply into the concrete. The continued presence of water will cause the reaction to continue for a long time, and concrete stained blue-green will gradually turn brown or even black. Initially, this provides nice variation to the appearance, but eventually, nearly all the blue-green colour may change to brown and black. Because of the possible colour shifts, some manufacturers advise against using these colours for exterior concrete. Interior slabs must be placed on a well-drained base or sub-grade and have a low moisture content before stain is applied. Jones believes the brown-coloured "flowering" of blue-green stains is caused by oxidation of a copper component resulting from water vapour passing through the slab. Others believe the brown colour is caused by a fungus, which can be eliminated by using sealers containing fungicide.

Equipment needed

Acid-etch stain finishes don't require much equipment for application. For surface preparation, you may need a grinder or a buffing machine equipped with sanding pads. Power-washing equipment also is useful. Any equipment that comes in contact with the staining liquid, such as sprayers, must resist hydrochloric acid. Brushes used to apply or spread the stain should have acid-resistant, uncoloured bristles.

Workers should wear the proper safety equipment including acid-proof gloves, goggles, boots, and facemasks to filter acid vapours. And good-quality wet vacuums are highly recommended for cleanup.

When to stain

The work of other trades also can affect staining results. For instance, dry-wall dust on a surface to be stained will react with the stain, colouring the surface differently wherever it's present. And spills of grease and oil, other lime-based materials, paint, or caulk before or after staining will produce unwanted colour variations. A good relationship with the owner or project manager helps to prevent such mishaps. Project management should ensure that the floor isn't damaged before or after staining and keep other trades away from areas where surface preparation and staining are in progress.

If an installer other than the concrete contractor applies the chemical stain, the contractor and installer must agree on the following:

■ **Pour schedule.** To get a rich colour, some installers began staining with diluted materials as early as a day or two after the concrete has been placed. For uniform results, they need to stain each placement at exactly the same age.

■ **Jointing method.** For slabs requiring sawed control joints or pattern lines, dust or sawing slurry must be removed before any of it bonds to the slab. Otherwise, stain colour at the joints will differ from the colour of the rest of the surface.

■ **Finishing process.** Although Jones likes to work on a hard-troweled surface, some installers prefer finishes that more readily accept the stain. Uniform finishing throughout the job helps to ensure more uniform stain penetration.

■ **Curing method.** Do not use plastic sheeting, liquid membranes, or wet curing methods because they can trap moisture and cause efflorescence.

It's often best to install chemical-stain finishes and a first coat of sealer, and then protect the floor surface with a cover before allowing other trades on the floor. Unfortunately, any protective material will affect the final appearance of the stained floor to some degree, usually by leaving an outline of its shape on the floor and by darkening the surface a bit. Don't use any cover material that

doesn't allow water vapour to escape. Breathable cloth tarps are perhaps the best covers for preventing discolouration caused by the work of other trades.

Surface preparation

It has been said, "Every step successfully completed leads to the successful completion of the next step". This is certainly the case with chemical-stain work; proper surface preparation is a vital step. First, throw a little water on the surface in several locations to see if the concrete absorbs water. If it doesn't, curing agents or sealers may be blocking the entry of stains and must be removed. Also remove any grease and oil, paint drops, taping compounds, caulk, or other surface contaminants. Scraping, applying solvents or stripping agents, sanding, and grinding are the principal removal methods. To pick up contaminants more easily, use stripping agents that will mix with water. If you choose to grind the surface, avoid making grinding marks that will reflect through the coloured finish by using either a cup grinding head with a fine-grit (diamond or black abrasive) or diamond pad. Use a light touch, laying the cup flat on the concrete and moving it in small diameter circles until the blemish disappears.

If a slab must be patched, use acrylic-modified, low-shrinkage materials that will accept stain. These patches will always show in the finished product, and the owner should be made aware of this. To open up the surface for stain penetration, many installers prefer to sand floors using floor buffing machines with #60, #80, or #100 paper or screen-mesh sandpaper that allows dust to pass the pad. This process can add its own pleasing effect to the final appearance by accentuating high and low areas on the surface. (More material is removed from high spots, giving them a richer colour).

The final preparation step involves carefully washing the surface with water and detergent. Don't use acid to clean the surface because it will diminish the effect of the stain. It's best to scrub with a buffing machine using strip pads (preferably black) and to pick up the effluent with a good-quality wet vacuum. The surface must be clean and free of streak marks, footprints, and all residue. Anything remaining on the surface will affect stain penetration.



Figure 2:Thorough scrubbing with a detergent solution removes contaminants that might prevent stain penetration. Hard-troweled floors may require sanding to open the surface before stains are applied.

Sawing and patterning

Decorative cuts and sandblasted patterns achieved with stencils can enhance the appearance of stained surfaces. Timing of these operations, though, depends on the desired effect. When you want the overall stain finish to be as evenly coloured as possible, cut lines and patterns after staining is complete. Stains penetrate differently around indentations. If there is to be a colour change at a pattern line, cut the line first to form a barrier to stain movement. If sawed joints are to be grouted, complete the staining and sealing before grouting to help prevent grout accumulation on the unprotected stain.

Pattern lines are generally laid out with pencil or chalk. Mark only where you cut, and don't use chalk colours that are difficult to remove, or adhere lines to the concrete surface using clear fixative sprays. Many tools are available for cutting pattern lines in concrete. Most installers use grinders or hand-held saws with tables that ride against guides. Dry-cutting diamond blades that do minimum damage to the edge of the cut are a good choice. Dust-collection devices that attach to grinders and saws capture almost all of the dust. A 1½-inch extruded aluminum "L" angle, available in most hardware stores, makes a good saw guide.