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ACI RAP Bulletin 13

FIELD GUIDE TO
CONCRETE REPAIR
APPLICATION PROCEDURES

Methacrylate Flood Coat

Field Guide to Concrete Repair Application Procedures

Methacrylate Flood Coat

Reported by ACI Committee E706

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Introduction

Methacrylates are liquid resins used in the construction industry to seal concrete slabs and structurally heal narrow, shallow cracks. They are supplied in two- or three-component packaging and are mixed on site immediately before application. The most common types of methacrylates are high-molecular-weight methacrylates (HMWM) and reactive methacrylates. Both types are similar in application and performance to ultra-low-viscosity epoxies. Penetrating by gravity alone, methacrylates fill the pores in horizontal concrete surfaces and bond small cracks.

Before any concrete repair is carried out, the underlying cause of the damage must be determined and the objective of the repair must be understood.

Typical causes of concrete cracking include corrosion of reinforcing steel, damage due to freezing and thawing, sulfate attack, and alkali-aggregate reactions (AARs). Cracking problems can also be caused by improper practices during original construction such as poorly selected concrete mixture proportions (or adding too much water at the site), inadequate subgrade preparation, and poor joint design or construction. Cracking can also be caused by external forces such as structural overload.

What is the purpose of this repair?

Flood-coating a concrete slab using methacrylates is used when there is a need to fill and bond small cracks, such as shrinkage cracks, as well as to seal the slab against the penetration of water, salts, or deleterious chemicals. Methacrylates have the added benefit of repairing some cracks and improving resistance to traffic wear. Cracks bonded using methacrylates can usually resist stresses caused by traffic vibration, but not structural stresses. Prior to installation, special care should be taken to ensure the cracks are open, clean, and free of any contaminants or other bond-inhibiting materials such as oil and grease. If structural repair of cracks may be required, consult a qualified structural engineer for evaluation. Ensuring a full-depth structural repair using gravity feed methods can be difficult, and although vacuum injection of methacrylates can be done, pressure injection using epoxies may be a preferred option (see RAP Bulletin 1, "Structural Crack Repair by Epoxy Injection").

When do I use this method?

This repair is best applied to horizontal concrete surfaces, although it may be used on sloped concrete surfaces such as parking garage entry ramps. Because of the very low viscosity of the materials (typically less than 30 centipoise), care must be taken on sloping surfaces to prevent the material from flowing out of cracks.

This repair is well suited to bridge decks, parking garages, industrial floors, or other concrete slabs that have a large number of random cracks but no evidence of steel corrosion or AAR, such as the roadway shown in Fig. 1. The effect of the methacrylate on skid resistance should, however, be considered for bridge decks exposed to heavy traffic and high speeds. The methacrylate flood coat will seal the slab and fill open cracks, with the intent of keeping water, salts, and chemicals out of the concrete. Methacrylates are not effective, however, in repairing moving cracks caused by thermal changes, structural loads, restraint, or lack of relief (control or expansion) joints. While most methacrylates can resist movements up to about 5% to 10% of the crack width (and some specialized bridge deck methacrylate systems can resist movements up to 25% to 30%), the rigid bond created by the methacrylate resin will not withstand larger crack movements. Other crack repair techniques such as structural repair, adding expansion joints or installing flexible joint sealants should be considered for these types of cracks. If evidence of steel corrosion or AAR is observed, these areas should be reviewed by a design professional and repairs performed before the application of the methacrylate.

Fig. 1—Methacrylate flood coats are well-suited to concrete slabs that have a large number of random cracks but no evidence of steel corrosion or AAR.

How do I prepare the surface?

The concrete surface should be clean, dry, and free of all oil, grease, dust, paint, sealers, or other bond-breaking material. Shotblasting or sandblasting is recommended to produce a concrete surface profile (CSP) of CSP-3 to CSP-5, as defined in International Concrete Repair Institute's (ICRI's) *ICRI Technical Guideline* No. 310.2, "Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays." CSP-5 is recommended for bridge traffic surfaces. Waterblasting alone is normally not sufficient or recommended. After shotblasting or sandblasting, deeper cracks should be cleaned with compressed air to remove all dust and debris. The compressed air must be free of all oil and moisture to avoid contaminating the surface.

How do I select the right material?

Two types of methacrylates are commonly available: reactive methacrylates and HMWMs. While reactive methacrylates are produced in two-component forms only, HMWMs are available in both three-component and premixed (pre-promoted), two-component formulations.

Methacrylates can be modified for a longer or shorter set time. The anticipated ambient temperatures should be considered, and

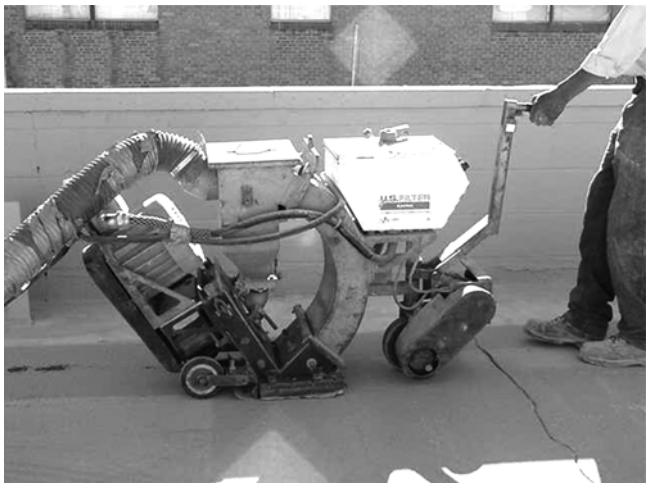

Fig. 2—Typical sandblasting equipment.

shorter set time (shorter pot life) materials should be used when it is necessary to open the slab to traffic quickly.

Pot life is approximately equal for all methacrylate formulations. Pot life is, however, greatly affected by temperature. Methacrylates should typically be used within a temperature range of 35 to 95°F (2 to 35°C). Applications should be made in the cooler times of the day when placing this material in hot weather, especially when bonding deeper cracks up to about 1/2 in. (13 mm), to allow the material to completely fill the crack. Aggregate can be broadcast into the flood coat to improve traction on surfaces to receive vehicular traffic.

Methacrylates can have a strong odor. Care should be taken to keep the public away from direct contact with the work area. Applying the material should especially be avoided in enclosed areas or in close proximity to building air intake vents.

What equipment and materials do I need?

- Shotblasting or sandblasting equipment (Fig. 2) for surface preparation;
- An air compressor with oil and moisture filters for cleaning cracks;
- Dry aggregate passing a No. 30 (600 μm) sieve for filling larger cracks 1/8 in. (3 mm) or wider;
- Clean mixing and measuring buckets (proper proportioning is critical);
- A low-speed drill and mixing paddle;
- A generator or other access to power;
- Methacrylate—approximately 1 gal. per 100 to 150 ft^2 (1 L per 2.5 to 3.7 m^2) of surface area;
- Flat squeegees or rollers for application of resin;
- Dry aggregate passing a No. 8 to No. 60 (2.38 mm to 250 μm) sieve for traction. The aggregate size varies depending on the concrete surface profile and the product used; follow manufacturer's recommendations. Aggregate should be broadcast (Fig. 3) at a rate of approximately 15 to 20 lb per 100 ft^2 (0.7 to 1.0 kg per 1 m^2) of concrete surface;
- Protective footwear with raised cleats for walking on wet surfaces; and
- Safety equipment (see the following section).

Fig. 3—Aggregate broadcast onto the surface before the resin cures can increase traction.

What are the safety considerations?

Methacrylates are hazardous materials and should be treated as such. Job-site safety practices should include the following where applicable:

- Keeping Material Safety Data Sheets (MSDS) on site and strictly adhering to all requirements;
- Wearing protective clothing—safety glasses and gloves as a minimum;
- Wearing full-face respirators if working in enclosed, poorly ventilated areas;
- Providing eye wash facilities for workers;
- Keeping materials away from heat, flames, and other sources of ignition because they are flammable and produce flammable vapors;
- Ventilating closed spaces to keep fumes away from workers and the public;
- Notifying the occupants of the structure being repaired (and any adjacent buildings) prior to beginning work; and
- Mixing three-component formulations with extreme care as they can react violently if mixed improperly. The promoter should be thoroughly mixed into the resin before adding the catalyst. **The catalyst and the promoter should never be mixed directly together**. As with all construction chemicals, all manufacturer's instructions should be strictly followed.

Preconstruction meeting

Prior to starting the repair, a preconstruction meeting is recommended. The meeting should include representatives from all participating parties (such as the owner, engineer, contractor, and materials manufacturer), and specifically address the parameters, means, methods, materials, and safety precautions necessary to achieve the repair objectives.

Repair procedure

1. Shotblast or sandblast the surface to achieve a CSP-3 to CSP-5;

2. Blow out cracks with oil- and moisture-free compressed air to remove all dust and concrete chips;

3. If the underside of the slab is accessible, seal the bottom surface of all full-depth cracks with a material such as epoxy paste;

Fig. 4—Aggregate should be broadcast over the surface before the resin becomes tacky but at least 20 minutes after applying the final coat.

4. Pre-fill all cracks 1/8 in. (3 mm) wide or wider with clean, dry aggregate;

5. Mix the resin in strict accordance with the manufacturer's recommendations (see the section titled "What are the safety considerations?");

6. Using a flat squeegee or roller, flood coat the slab with the mixed resin. (A coarse broom can be used for roughened or broom-finished surfaces). Cover approximately 100 to 150 ft^2 per gallon of resin (2.5 to 3.7 m^2/L). Allow resin to pond over cracks until completely filled. Remove excess resin before it gels;

7. If cracks are over 1/2 in. (13 mm) deep or if the concrete surface is very porous, apply a second flood coat of resin;

8. Prior to the surface becoming tacky, but at least 20 minutes after applying the final coat of resin, broadcast aggregate (Fig. 4) onto the resin at the rate of 15 to 20 lb per 100 ft^2 (0.7 to 1.0 kg/m^2); and

Allow material to fully cure before allowing traffic on the slab. Cure times will vary depending on product and ambient temperature, but cure times of approximately 1 hour for reactive methacrylates and 3 to 4 hours for HMWMs at 70°F (21°C) are typical.

How do I check the repair?

Perhaps the most important check is to audit the quantity of material used and compare it to the area of slab repaired. Depending on the amount, width, and depth of cracks in the slab, typical coverage would be from 100 to 150 ft^2/gal. (2.5 to 3.7 m^2/L) of material used. When full depth penetration is critical, cores may be taken to verify the depth of penetration into cracks.

References

ACI Committee E706, 2003, "Structural Crack Repair by Epoxy Injection (ACI RAP Bulletin 1)," American Concrete Institute, Farmington Hills, MI, 7 pp.

ICRI, 1997, "Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays," *ICRI Technical Guideline* No. 310.2, International Concrete Repair Institute, Des Plaines, IL, 41 pp.