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The Concept of Industrial Floor Joint Fillers

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FORWARD

The June 1978 issue of Concrete Construction magazine featured our article "The Concept of Industrial Joint Sealants." That article is generally acknowledged to be the basis of ACI and PCA's subsequent endorsement of semi-rigid epoxies to fill joints in industrial concrete floors.

The 20th anniversary of this landmark article has brought much change in the industrial floor industry. First, the term "joint sealant" has given way to the more appropriate term "joint filler." Second, semi-rigid fillers have become so accepted as the industry standard that it is uncommon (but not unheard of) to find any other type of filler specified. Finally, the dramatically increased demand on industrial floors (larger material handling vehicles carrying heavier loads, AGV systems, JIT manufacturing, etc.) have focused more attention on the durability of joints.

It is with these changes in mind that we present the following update of our original article. Despite all the changes of the past twenty years, the basic principles of joint filling remain as valid as ever, and more important than ever.

THE EVOLUTION OF THE JOINT FILLER

In the 1940's and 50's most floor joints were filled with hot-melt asphalt or lead (molten-and-poured, strips, etc). By the early 1960's, elastomeric sealants (polyurethanes, polysulfides) were being used to seal joints and rigid epoxies to structurally bond concrete. Eventually these products started being used to fill floor joints. Despite good intentions, elastomeric sealants and epoxy adhesives proved to be less than adequate, and often disastrous.

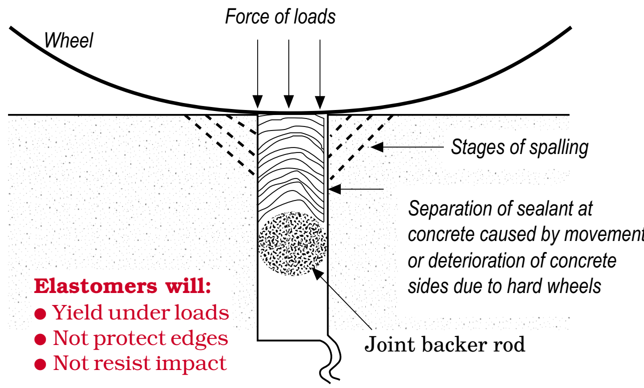
ELASTOMERIC SEALANTS ALLOW EDGE DAMAGE

Elastomeric sealants typically have expansion capability of 25-50%. The reasoning for using elastomerics in floor joints was that they would accommodate the movement of the joint as the concrete went through its shrinkage process. It didn't work that way.

A good rule of thumb says that conventional concrete shrinks 1/8" every 20 LF. In the case of an original 1/8" wide joint spaced at 20' centers, each joint would open to 1/4", or 100% expansion. Since elastomerics can only expand 50% at best, they failed adhesively or cohesively.

But even if the elastomerics had been able to accommodate 100% expansion, they were still inappropriate for the floor joints because industrial floors are also subject to material handling vehicle traffic. As vehicle wheels became smaller and harder, the impact and loading broke off the edges of the joint.

Figure 1. Elastomers give no joint edge protection.



This process is called spalling. (See figure 1.)

As vehicles crossed the joint, the relatively soft (Shore hardness A20-45) elastomeric sealant deflected under load, leaving joint edges exposed to wheel impact).

Even if the entire joint was filled with an elastomeric, which would reduce its expansion capability to 10-20%, it would still deflect under load. Elastomerics are clearly not the answer for industrial floor joints.

HIGH STRENGTH EPOXIES RESTRICT MOVEMENT

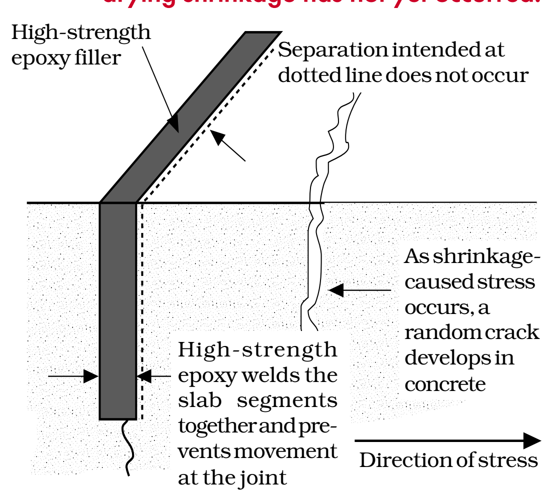
Many of those who discovered the inadequacies of elastomerics decided to go to the opposite extreme and use a hard filler that would fully support traffic. The logical choice was epoxy adhesives. Epoxies are noted for their hardness, tensile strength and adhesive bond to concrete. It turned out that these attributes were actually big negatives.

As we stated earlier, conventional concrete can shrink 1/8" every 20 LF. This shrinkage takes place over a long period of time, usually at the following (approximate) rate: (6" slab)

First 30 Days...........25%
Next 335 Days........55%
Total, One Year........80%

The function of a control (contraction) joint is to induce the slab to crack in straight lines at designated joints, usually 15-20' centers. A control joint is effective only if the slab can separate at these "guided cracks" during the entire shrinkage process. The structural epoxy adhesives prevented this separation.

Figure 2. Don't use high-strength, rigid epoxies if all drying shrinkage has not yet occurred.



As the slab continued to shrink, the epoxy adhesives "welded" the slab segments together. Since the strength of the epoxy was greater than the internal strength of the concrete, the concrete cracked, usually parallel to the welded joint. This resulted in both a joint and a crack where only a joint had existed. Many floors suffered massive cracking due to the use of high strength epoxy joint fillers.

THE CONCEPT OF A BETTER JOINT FILLER

Metzger/McGuire was a major caulking/sealant contractor in the 1960's, and recognized the shortcomings of the elastomerics and epoxy adhesives they were installing per specifications. We decided there was a need for a unique filler to accommodate the unique needs of joints in industrial concrete floors. We began by defining what a floor joint filler must do:

> The primary function of a floor joint filler is to restore the original (pre-jointing) continuity and load-bearing capacity of the floor surface. This means the proper filler must support all traffic without deflecting under load. At the same time, the filler must not restrict the slab from opening at the joints during the shrinkage process.

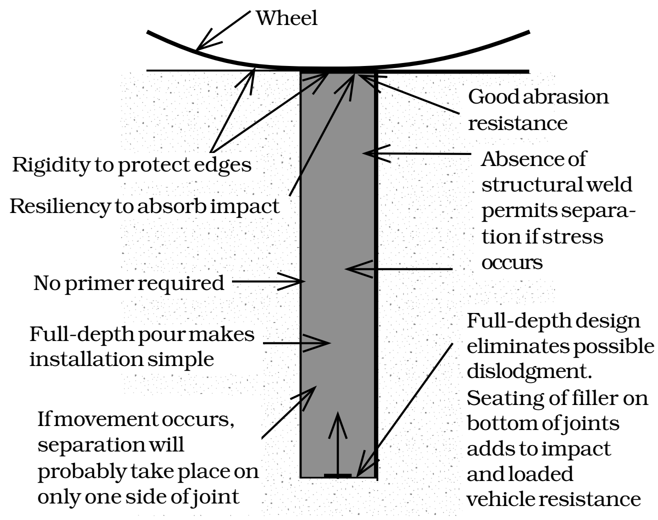
In brief, the proper filler must be hard enough to support traffic, but flexible enough to accommodate as much as 50-100% movement. It is obvious that no filler can be hard and soft at the same time. This meant that a compromise had to be made. The chart below (The Genesis of Semi-Rigid Epoxy Fillers) illustrates the thought process we used to create **MM-80**.

Summary:
Filler should be a two-component, flexibilized epoxy having a hardness of Shore A80-90 and a low range adhesive strength of 250-300 psi. Filler shall be of pourable viscosity, not require a primer and be traffic ready in 8-12 hours at 70˚F.

JOINT FILLING IN 1998

After thirty years and hundreds of millions of lineal feet of installations worldwide, MM-80's basic criteria still remains the standard for the industry in 1997. But some changes have occurred. Due to the introduction of high rack vehicles and AGV's, and the material handling industry's trend towards smaller and harder wheels, Metzger/McGuire has increased **MM-80**'s shore hardness to A85-95. All other criteria (low adhesive strength, full depth filling, etc) remain valid principles of proper joint filling.

Figure 3. The semi-rigid epoxy floor joint filler concept employs the basic elements shown.



Another important development in the past twenty years is that shrinkage-compensating concrete floors have become more common. This type of floor often uses "fewer joints" as its selling point, with joint spacing pushed to 25', 35', even 40' centers. Joint protection can be even more critical with these floors because the concrete still shrinks and widely spaced joints each open wider than with small joint grids.

The 1990's also saw the introduction of polyurea joint fillers. These fillers offer the advantage of faster set, and thus earlier floor access. Unfortunately, some are promoted as both traffic supportive and expansive. The laws of physics still apply; a material cannot be both. Polyurea filler selection must be based on which is the greater need.

JOINT FILLING IN THE NEW MILLENNIUM

It is impossible to predict what changes will occur in both the concrete floor and the floor joint filler industries. Until concrete can be placed without shrinkage occurring, there will be a continued demand for quality semi-rigid fillers that can meet the changes that evolve in the material handling industry. As with the past thirty years, you can rely on Metzger/McGuire to provide you with the best filler products, the best technical support and the most comprehensive education and information available.

The Genesis of Semi-Rigid Epoxy Fillers

Requirement	How to Achieve
• **Support loads without deflection**	Use a filler that is relatively firm (semi-rigid), with a hardness of Shore A80 or greater.
• **Allow for continued joint opening during shrinkage**	Have a relatively low adhesive strength so that the filler will separate adhesively from the concrete, rather than weld the slab panels together.
• **Compensate for low adhesive strength so that filler remains supportive after separation**	Fill joint full depth to take advantage of additional support provided by base of saw cut. For full slab construction joints, increase filler depth to 2".
• **Filler must have excellent resistance to abrasion, impact, wear**	Use an epoxy, a product noted for its durability. A semi-rigid property will help absorb impact.
• **Filler must be able to fill full joint depth**	Make filler of a pourable viscosity.
• **Make filler user friendly**	Filler should not require a primer. It should be fully traffic-ready the next morning. Two component epoxies meet both criteria.