The concept of industrial floor joint sealants

The main requirements of these materials are to fill the joint space and support the joint edges to prevent spalling

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The September 1977 issue of CONCRETE CONSTRUCTION contained an article entitled "Good Warehouse Floors Don't Just Happen." It is equally true that good floor joints don't just happen. Traditionally the treatment of joints in industrial and warehouse concrete floors has been either totally ignored or done by selecting the sealant haphazardly. Yet incorrectly sealed joints will cause premature deterioration of even the best industrial floor.

In numerous floor inspections across the country it has been found that approximately 90 percent of all floors have spalling at the joint edges. In many cases when the problem is pointed out, one of the following responses is given:

- "Don't worry about the joints; the spalling is only minor."
- "Forget about the joints; there is no way to prevent them from spalling."

These responses indicate either a lack of knowledge of concrete or an unwillingness to expend a little effort to help the client and the industry.

To rebut the first of these common statements, there is no such thing as a minor edge spall; there are only major edge spalls in early stages of development. Spalling never gets better with neglect; it only gets worse if not corrected when first detected. To rebut the second statement, joint edge spalling is not inevitable. It can be reduced or even prevented if the requirements of industrial floor joints are understood and a sealant is tailored to the specific needs.

Joint materials in current use

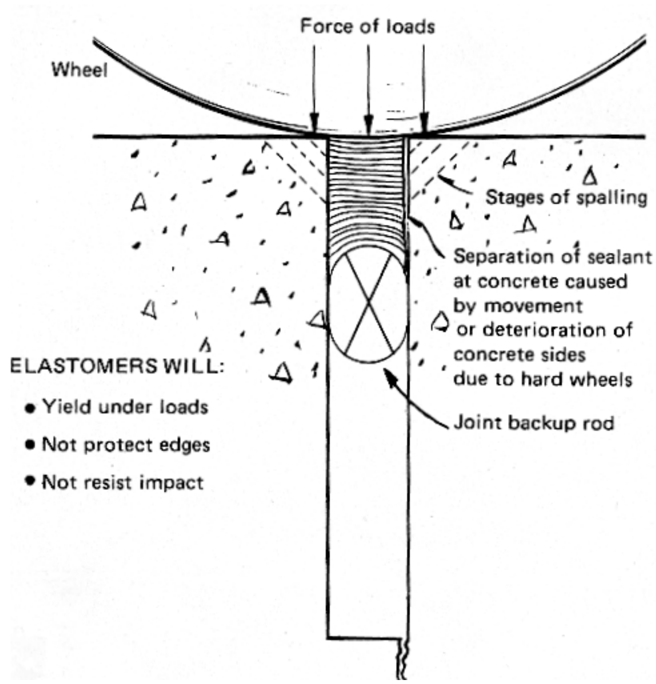
Numerous floor inspections have revealed a wide variety of joint fillers and sealants in use, including paraffin, fiberboard strips, portland cement mortar, asphaltic sealants and even residential-grade latex caulks. The two products found most frequently are soft elastomeric construction sealants such as polyurethanes and polysulfides on the one hand and extremely rigid high-strength epoxies on the other. All of these products have a common element: They were designed for purposes other than use in industrial floors and were merely put in the floor "to fill the joint." They do not meet the unique requirements of an industrial floor joint.

Elastomeric sealants not useful

Elastomers are typically soft, with Shore A hardnesses in the range of 20 to 45, and can be stretched like rubber bands if removed from the joint. They are primarily designed for use in exterior walls or slabs where wide temperature changes create thermal movements that extend, relax or compress them.

If we analyze the behavior of a typical industrial floor joint we find that it is rarely exposed to thermal expansion or contraction. Normally, a joint opens only as the concrete shrinks from moisture loss. This shrinkage usually occurs only once although it may occur gradually over a period of as much as a year. Therefore it is reasonable to conclude that the basic concept of using an extensible elastomeric sealant is not as a rule pertinent to an industrial floor joint application, and we can dispense with the need for extensibility by waiting until after the shrinkage has occurred to install the sealant.

Figure 1. Elastomers give no joint edge protection



What we do need, however, is rigidity to help protect the joint edges from damage caused by the impact of hard-wheeled plant vehicles (Figure 1). This often leads to selection of an epoxy of the common high-strength, rigid type, a definite mistake.

High-strength, rigid epoxies cause problems

In the construction industry we suffer from the epoxy syndrome: “harder plus stronger equals better.” In most construction applications this equation is valid since the primary function of epoxies is to create an extremely hard structural weld between adjacent surfaces. Unfortunately, this concept is not applicable to industrial floor joints. We want rigidity for edge protection, but we don’t want to structurally weld the parts of a slab together since the entire reason for a control joint is to permit shrinkage-induced movement and to accommodate the anticipated cracking of the concrete.

If an epoxy with high adhesive and tensile strength is used to fill the joints before they have reached their full width caused by shrinkage and contraction of the concrete the superior strength of the epoxy will transfer the stress back to the less strong concrete. The likely result will be the development of random cracks in the concrete parallel to the joint lines (Figure 2) or elsewhere in the slab. The owner is unhappy with the unsightly floor appearance and someone now faces expensive crack repair costs.

Another shortcoming of high-strength, rigid epoxies is that they may not have high impact or abrasion resistance. If they do not, when they are subjected to the constant pounding of hard-wheeled traffic some epoxies can become brittle and crack while others may develop surface crazing or dusting. In addition, such rigid materials permit the shock and impact of hard-wheel traffic to be transferred to the concrete itself and cause the edges of joints to deteriorate.

Composite description of a suitable sealant

If we eliminate both extensible sealants and rigid fillers for the reasons given so far, what is left? The simple answer is a compromise sealant which could best be classified as semirigid (Figure 3). If we review the specific requirements needed in an industrial floor joint sealant we would probably end up with the list shown in the left-hand column of the table. Each requirement can be met by the material or method shown in the right-hand column.

Based on the analysis shown in the table our material could be briefly described as follows: “A pourable, nonprimed two- component epoxy sealant which is to be mixed and installed to the full depth of the joint and

WHAT TO LOOK FOR IN A SUCCESSFUL FLOOR JOINT SEALING SYSTEM

REQUIREMENTS OF AN INDUSTRIAL FLOOR JOINTSEALANT	HOW REQUIREMENTS CAN BE ACHIEVED
Sufficient rigidity for edge protection	Use hard rubber with Shore A hardness of approximately 70 to 90
Resiliency to help absorb impact of hard wheels	
Prevention of brittleness, crazing and dusting	
Impact resistance (ability to stay in position under loads)	Fill entire joint, thus allowing base of joint to add resistance
Moderately low adhesive and tensile strengths to prevent structural welding	Formulate so that adhesive and tensile strengths are lower than those of the concrete itself
Reasonably simple installation procedures	Eliminate primer since adhesion is not a major factor
	Eliminate size or shape considerations by making material a pourable liquid that hardens in place
Controlled cure time to ensure early access	Use two-component liquid sealant with chemically induced
by other trades or owner	cure (Epoxies usually offer the most controlled cure time)
Good abrasion resistance	Use an epoxy
USDA/FDA* approval	Use an epoxy

* U.S. Department of Agriculture and Federal Drug Administration

which cures to form a semirigid rubberlike bar of material with a Shore A hardness of 70 to 90."

A perfect sealant?

A thorough review of this analysis shows that the material described is not a perfect sealant since it does not accommodate movement. On the other hand, if the joint opens and voids develop either within the sealant itself or at the sealant-to-concrete juncture, these voids should not be considered failures per se.

Recently what was called a major floor joint sealant failure was reported in an industrial plant in Omaha, Nebraska. Inspection showed that the sealant in most of the tooled-edge construction joints was fully bonded to the sides of the joint but had undergone cohesive tearing through the middle of the sealant. The tears averaged 1/16 to 1/8 inch in width. Other control joints had been cut with a saw, and these had no cohesive tearing, but approximately 40 to 50 percent of the joints had a 1/32-inch-wide void between the sealant and the concrete. The sealant itself was a semirigid epoxy, with a Shore A hardness of approximately 80, poured to the full depth of the joint.

Considering the hardness of the sealant, it had clearly not been designed to accommodate the delayed shrinkage that had occurred after the sealant was installed. Consequently it lost adhesion to the sawed joints or separated in cohesion in the tooled joints. It did not create the more serious problem of transferring enough stress into the concrete to cause random cracking. The sealant had been designed to reduce spalling of the joint edges and a floor inspection showed that both tooled and sawed joints were in fact approximately 99 percent spall-free. Far from being a sealant failure, the application was an actual success in terms of its design concept and the extreme movement conditions it had tolerated while still performing its job.

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

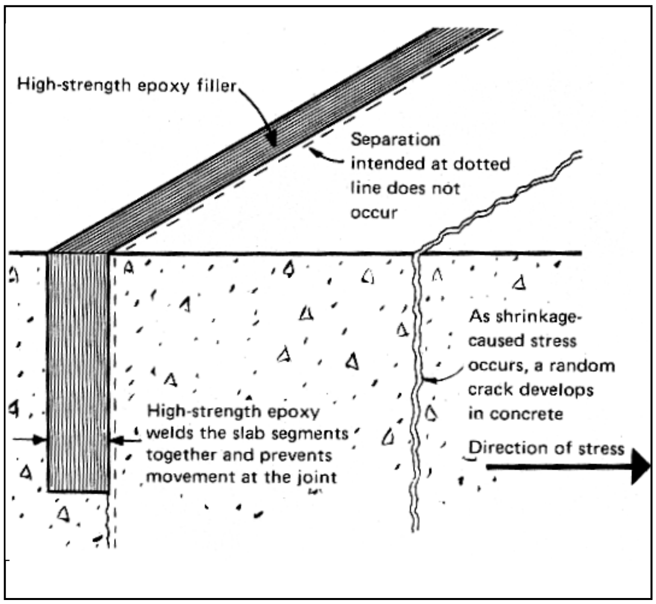
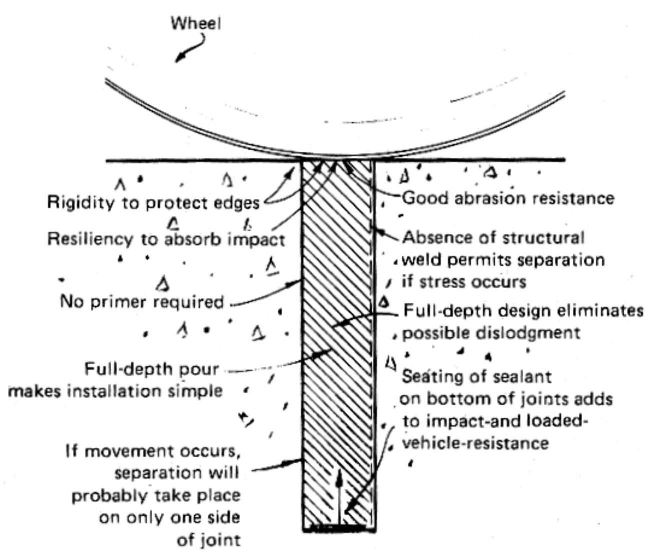


Figure 3. The semirigid epoxy floor joint sealant concept employs the basic elements shown.



Conclusion

To obtain the right sealant for industrial floor joints the sealant must be selected only after a careful review of the specific joint needs and a matching of these needs to a sealant based upon the appropriate design concept. Products such as the semirigid epoxy described in this article are currently available. The designer or buyer should carefully evaluate and be wary of materials that are made to satisfy some other concept of the requirements of a sealant for industrial floors.

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