Admixtures for Concrete

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The American Concrete Institute (ACI) defines an admixture as "a material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing."[1]

Admixtures are used in concrete for bridge structures to provide air entrainment, reduce water content, improve workability, retard setting times, accelerate strength development, provide flowable or self-consolidating concrete, reduce shrinkage, reduce the potential for corrosion, and prevent washout of concrete placed under water. This article summarizes the more frequently used admixtures for concrete used in bridge structures. Further details are given in *Report on Chemical Admixtures for Concrete (ACI 212.3R-16)*.[1]

Air-Entraining Admixtures

Air-entraining admixtures are used primarily to increase the resistance of concrete to damage from freezing and thawing. They may also be used to increase workability and facilitate handling and finishing. The relevant specification is American Association of State Highway and Transportation Officials' AASHTO M 154.[2]

Chemical Admixtures

Chemical admixtures are classified in AASHTO M 194[3] as follows:

- Type A: Water-reducing
- Type B: Retarding
- Type C: Accelerating
- Type D: Water-reducing and retarding
- Type E: Water-reducing and accelerating
- Type F: Water-reducing, high-range
- Type G: Water-reducing, high-range, and retarding

Water-reducing admixtures and high-range water-reducing admixtures are used to allow for a reduction in the water–cementitious materials ratio of the concrete, while maintaining or improving workability. Accelerating admixtures are used to decrease the setting time and increase early strength development. Retarding admixtures are used to increase the setting time to allow more time for transportation and placement. According to a 2012 survey, not all seven admixture types are permitted by every state department of transportation. Types A and F were identified as the most frequently used types.

Shrinkage-Reducing Admixtures

Shrinkage-reducing admixtures have the potential to reduce long-term shrinkage by 25% to 50%. The admixture works by reducing the surface tension effects that contribute to drying shrinkage of the hardened concrete. They are not covered by any AASHTO or ASTM standard.

Corrosion Inhibitors

Corrosion-inhibiting admixtures either extend the time to corrosion initiation or significantly reduce the corrosion rate of embedded metal, or both, in concrete containing chlorides in excess of the accepted corrosion threshold value for the metal in untreated concrete. Performance requirements and test methods are described in ASTM C1582.[4]

References

1. ACI (American Concrete Institute) Committee 212. 2016. *Report on Chemical Admixtures for Concrete (ACI 212.3R-16)*. Farmington Hills, MI: ACI.
2. AASHTO (American Association of State Highway and Transportation Officials. 2012. *Standard Specification for Air-Entraining Admixtures for Concrete*. AASHTO M 154-12. Washington, DC: AASHTO.
3. AASHTO. 2013. *Standard Specification for Chemical Admixtures for Concrete*. AASHTO M 194-13. Washington, DC: AASHTO.
4. ASTM Subcommittee C09.23. 2017. *Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete*. ASTM C1582-11(2017). West Conshohocken, PA: ASTM International.

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