CODE

COMMENTARY

Seawater is listed under Exposure Class S1 (moderate exposure) in Table 19.3.1.1, even though it generally contains more than 1500 ppm SO_4^{2-}. Less expansion is produced by a given cement in seawater compared with freshwater with the same sulfate content (ACI 201.2R). Therefore, seawater is included in the same exposure class as solutions with lower sulfate concentrations. Portland cement with C_3A up to 10 percent is allowed in concrete mixtures exposed to seawater if the maximum ***w/cm*** is limited to 0.40 (refer to the footnote to Table 19.3.2.1).

Exposure Class S2: ASTM C150 Type V cement is limited to a maximum C_3A content of 5 percent and is acceptable for use in Exposure Class S2. The appropriate binary and ternary blended cements under ASTM C595 include the suffix (HS) as part of their designation, which indicates the cement conforms to requirements for high sulfate resistance. Under ASTM C1157, the appropriate designation for severe sulfate exposure is Type HS.

Exposure Class S3 (Option 1): The benefit of the addition of pozzolan or slag cement allows for a greater ***w/cm*** than required for Option 2. The amounts of supplementary cementitious materials are based on records of successful service or testing in accordance with 26.4.2.2(c).

Exposure Class S3 (Option 2): This option allows the use of ASTM C150 Type V portland cement meeting the optional limit of 0.040 percent maximum expansion, ASTM C595 binary and ternary blended cements with the (HS) suffix in their designation, and ASTM C1157 Type HS cements without the use of additional pozzolan or slag cement, but it instead requires a lower ***w/cm*** than that required for Option 1. This lower ***w/cm*** reduces the permeability of the concrete and thus increases sulfate resistance (Lenz 1992). Use of this lower ***w/cm*** permits a shorter testing period to qualify the sulfate resistance of a cementitious system in accordance with 26.4.2.2(c).

In addition to the proper selection of cementitious materials, other requirements for durable concrete exposed to water-soluble sulfates are essential, such as low ***w/cm***, strength, adequate consolidation, uniformity, adequate cover of reinforcement, and sufficient moist curing to develop the potential properties of the concrete.

Exposure Class W1: This exposure class does not have specific requirements for low permeability. However, because of the exposure to water, the Code (26.4.2.2(d)) has a requirement to demonstrate that aggregates used in concrete are not alkali reactive according to ASTM C1778. If the aggregates are alkali-silica reactive, the Code (26.4.2.2(d)) also requires submission of proposed mitigation measures. The Code (26.4.2.2(d)) prohibits the use of aggregates that are alkali-carbonate reactive.

Exposure Class W2: This exposure class requires low concrete permeability. The primary means to obtain a concrete with low permeability is to reduce ***w/cm***. For a given *w/cm*, permeability can be reduced by optimizing the cementitious materials used in the concrete mixture.