8(a). Write about alkali aggregate reaction.

Ans = Alkali-aggregate reaction (AAR), also known as alkali-silica reaction (ASR) or alkali-carbonate reaction (ACR), is a chemical reaction that occurs between the alkalis (sodium and potassium) present in cement and certain reactive minerals or aggregates in concrete. This reaction can lead to significant expansion, cracking, and deterioration of concrete structures over time.

When concrete is exposed to moisture, alkalis from cement, particularly sodium and potassium hydroxides, react with certain types of silica minerals present in aggregates. These reactive silica minerals, such as opal, chert, volcanic glass, and some forms of sandstone, contain a high concentration of alkali-reactive substances. The reaction between alkalis and reactive silica minerals produces a gel-like substance called alkali-silica gel.

The alkali-silica gel absorbs water, swells, and expands, causing internal pressure within the concrete. This expansion can lead to cracking, deformation, and loss of structural integrity. Over time, these cracks can provide pathways for harmful substances, such as moisture, chlorides, and other aggressive agents, to penetrate the concrete, further accelerating deterioration.

Alkali-aggregate reaction can be classified into two types:

1. Alkali-Silica Reaction (ASR): ASR is the most common form of alkali-aggregate reaction. It occurs when the reactive silica minerals in aggregates react with the alkalis in cement. ASR typically leads to the formation of a gel that absorbs water and expands, causing the concrete to crack and deteriorate.

2. Alkali-Carbonate Reaction (ACR): ACR occurs when the alkalis in cement react with carbonate minerals present in aggregates, such as limestone or dolomite. This reaction produces a gel-like substance that can lead to expansion and cracking in concrete.

Factors influencing alkali-aggregate reaction include:

1. Reactive Aggregates: The presence of reactive silica minerals or carbonate minerals in aggregates is a primary factor influencing the occurrence of alkali-aggregate reaction. Aggregates with higher reactivity are more susceptible to AAR.

2. Alkali Content: The alkali content of cement, particularly the sodium and potassium content, affects the severity and progression of alkali-aggregate reaction. Higher alkali content in cement can increase the potential for AAR.

3. Moisture: The presence of moisture is necessary for the alkali-aggregate reaction to occur. Adequate moisture allows the transport of alkalis to the reactive minerals in aggregates, promoting the reaction.

4. Temperature: Higher temperatures can accelerate the rate of alkali-

reaction and increase the expansion and cracking of concrete.

Preventive measures for alkali-aggregate reaction include:

- Using low-alkali cement or supplementary cementitious materials with low alkali content.
- Selecting non-reactive aggregates or treated aggregates with proper testing and screening.
- Implementing proper concrete mix design and proportioning to minimize alkali content and ensure appropriate aggregate-cement ratio.
- Controlling moisture and providing effective drainage to reduce moisture levels in concrete.
- Applying surface coatings or sealants to limit the ingress of moisture and alkalis.
- Conducting laboratory tests, such as the mortar bar test or concrete prism test, to assess the potential reactivity of aggregates.

Alkali-aggregate reaction poses a significant challenge in concrete durability and requires careful consideration during material selection, mix design, and construction practices to ensure the long-term performance and service life of concrete structures.