Stages of Hydration

**Stage 1: Mixing**
- Cement, water, and other admixtures are mixed to form a workable mixture.
- High-range water-reducing admixtures (HRWAs) can be used to improve workability.
- Air-entraining admixtures can be added to create a uniform air-void system.

**Stage 2: Dormancy**
- The mixture is allowed to rest before activation.
- Water loss and evaporation occur, affecting the setting time.

**Stage 3: Hardening**
- Hydration products begin to form, leading to increased strength and stiffness.
- Aluminate and sulfate react, forming gel-like substances.

**Stage 4: Cooling**
- Heat generation decreases as hydration products cool the mixture.
- Temperature peaks may occur, affecting the setting time.

**Stage 5: Densification**
- Hydration products continue to form, consolidating the concrete.
- Final strength and stiffness are achieved.

**Conventional Sawing Window**
- Check for conventional sawing:
  - Check for early sawing (after initial set)
  - Check for conventional sawing (after initial set and before final set)
  - Check for early sawing (after final set)

**Implications of Cement Hydration for Construction Practices**
- Early setting may lead to cracking due to high internal stresses.
- Proper curing is essential for long-term durability.

**Hydration Heat Curve**
- Heat generation follows a characteristic pattern.
- The peak heat generation occurs during the hardening stage.

**Effects of Supplementary Cementitious Materials**
- SCMs reduce the heat of hydration.
- They improve early and late strength development.

**Effects of Chemical Admixtures**
- Admixtures can control the setting time and heat generation.
- They influence the workability and durability of concrete.

**Incompatibilities: Early Stiffening / Retardation**
- HRWAs can cause early stiffening in SCMs.
- Such incompatibilities need to be managed carefully.

**Implications of Cement Hydration for Cracking**
- Proper timing of saw-cutting is crucial to avoid induced cracking.
- Factors such as mix design and curing conditions influence cracking potential.

**Implications of Cement Hydration for the Air-Void System**
- Air entrainment can affect the workability and durability of concrete.
- Adequate air entrainment is necessary to prevent segregation and cracking.