Concrete Atlantic béton Atlantique

Concrete Tech-Tip #2

Chemical Admixtures

What are Chemical Admixtures?

As defined in CSA A23.1/2:24, an admixture is “a material other than water, aggregate, cementitious material, and fibre reinforcement used as an ingredient in concrete, mortar, or neat cement grout and added to the batch immediately before or during its mixing in order to purposely modify its usually characteristics and behaviour”.

Why Use Admixtures?

Admixtures are used to give special properties to fresh or hardened concrete. Admixtures may enhance the durability, workability or strength characteristics of a given concrete mixture. Admixtures are used to overcome difficult construction situations such as hot or cold weather placements, pumping requirements, early strength requirements or very low water-cement ratio specifications.

Admixtures can be used to modify fresh concrete properties:

- Decrease water content
- Increase workability
- Reduce segregation
- Reduce the rate of slump loss
- Improve pumpability, placeability, finishability
- Modify the rate and/or capacity for bleeding
- Retard or accelerate setting time

Admixtures can be used to modify hardened concrete properties:

- Improve resistance to cyclic freezing & thawing
- Improve impact and abrasion resistance
- Inhibit corrosion of embedded metals
- Inhibit expansion due to alkali-silica reaction (ASR)
- Reduce plastic shrinkage cracking
- Reduce long-term drying shrinkage
- Reduce permeability
- Produce colored concrete
- Produce cellular concrete

How to Use Admixtures?

Consult your Ready Mixed Concrete Supplier about which admixture(s) may be appropriate for your application. Admixtures should be evaluated for compatibility with cement(s), construction practices, job specifications and economic advantage before being used.

Care should be taken to avoid using admixtures from various companies in the same mix unless testing has been done to confirm their compatibility.

a. Air-Entraining Agents

Air-entraining agents are liquid chemicals added during mixing to produce microscopic air bubbles in concrete. These bubbles improve durability and increase resistance to damage from freezing, thawing, and deicing salts. They also improve workability and may reduce bleeding and segregation.

- Uses: For concrete exposed to freezing and thawing. Examples include exterior flatwork such as parking lots, driveways, sidewalks, pool decks, and patios exposed to freezing and thawing or deicer salts.

Chemical Admixtures

- Recommended Air Content: 5 to 8% for 20mm nominal coarse aggregate. Refer to CSA A23.1/2 Table 2 for air content requirements.
- Notes: Not necessary for interior structural concrete and care must be taken when trowel finishing air entrained concrete. In high-cement concretes, each 1% of added air reduces strength by about 5%. In low-cement concretes, air may have little effect or slightly increase strength.

b. Water-Reducers

Water-reducers lower the water content to increase strength or increase slump at the same water content. They typically reduce water requirements for a given slump by about 10%, which either increases strength or allows a reduction in cement while maintaining the same water-cement ratio.

- Uses: Increase slump for pumping concrete or offset high water demand in hot weather.
- Considerations: May aggravate slump loss and can act as retarders or contain accelerators to offset retardation.

c. Retarders

Retarders delay the initial set of concrete by an hour or more. They are useful in hot weather to counter rapid setting. Most also act as water reducers.

- Uses: Large pours or hot weather concreting to allow more time for placing and finishing.

d. Accelerators

Accelerators reduce the initial set time of concrete, speeding up strength gain. They are recommended in cold weather to achieve high early strength.

- Notes: They do not act as antifreeze. Calcium chloride is the most common accelerator (max 2% by weight of cement). Pre-stressed concrete and concrete with embedded aluminum or galvanized metal should not use calcium chloride. Non-chloride alternatives are available.

e. High Range Water-Reducers (HRWR / Superplasticizers)

HRWRs reduce water content by 12 to 25%, increasing strength, and can greatly increase slump to produce flowing concrete.

Three Rules to Consider:

1. Use admixtures only when they solve a specific job need
2. Confirm compatibility with the cement and any other admixtures before use
3. Know the trade-offs since changes in air, water or set time also affect strength durability and finishability

References

1. CSA A23.1 A23.2 2024. Concrete materials and methods of concrete construction Test methods and standard practices for concrete. CSA Group

2. Design and Control of Concrete Mixtures. 9th Edition. Cement Association of Canada