Fly Ash in Hot Weather Concrete

WHEN THE MERCURY GOES ABOVE 80°F and as-placed concrete temperatures rise above 85°, a complex set of problems must be dealt with. The good news is, simple adjustments to the concrete mix or to construction practices may prevent these potential problems.

Hot weather has been defined as any period of high temperature in which special precautions need to be taken to ensure proper handling, placing, finishing and curing of concrete. Environmental factors that contribute to change in concrete properties include high ambient temperature, high concrete temperature, low relative humidity, high wind velocity, and solar radiation.

PROBLEMS

Accelerated slump loss because of the increased rate of hydration and evaporation. Hydration of cement becomes an issue as the temperature rises. Because cement generates 120 BTUs per pound, it is important to reduce the amount of cement-generated heat.

Increased water demand, which leads to the reduction of both short- and long-term concrete strength.

Accelerated set time, which requires more rapid finishing and normally results in a loss of entrained air.

Early plastic shrinkage or drying shrinkage cracking, which increases the potential for rebar corrosion.

Fly ash helps minimize the effects of hot weather on the placing of concrete by reducing heat of hydration and increasing workability.

SOLUTIONS

Adjust Concrete Mix

Reduce heat of hydration. During the critical first 24 hours, replacement of 100 lbs. of cement with the same amount of fly ash can reduce the heat of hydration by 19%, but does not sacrifice any strength or durability features. Replacing large percentages of cement with fly ash, which generates only 15% to 35% as much heat compared to cement at early ages, can reduce the damaging effects of the increased rate of hydration.

To achieve a 1-degree reduction in concrete temperature (C. or F.), the temperature of the concrete ingredients must be reduced by the following amounts:

1. Cement temperature by 8.8 degrees.
2. Water temperature by 3.9 degrees.
3. Aggregate temperature by 1.6 degrees.

Recommended Concrete Temperatures at Placing

Section Thickness	*Min. Temp.*	*Max. Temp.*
<1 ft.	50°F	90°F
1 – 3.3 ft.	50°F	86°F
3.3 – 6.6 ft.	41°F	77°F
>6.6 ft	41°F	64°F

Reduce water requirements. Adding fly ash to the mix reduces water requirements by 2 to 10 percent, while maintaining the same slump. Fly ash also reduces add-water needed to maintain workability, so strengths can be maintained or even increased.

Improve pumpability, placeability and finishability. Fly ash enables the concrete to move more fluidly throughout the placing and finishing processes.

Adjust Construction Practices

Ready Mixed Concrete Producer:

1. Design mixes for strength using a high volume fly ash to replace cement.
2. Substitute fly ash for some of the fine aggregate, thus further capitalizing on the pozzolanic activity between cement and fly ash.
3. Use a chemical retarder in a prescribed dosage to slow initial heat buildup.
4. Spray or shade coarse aggregate pile to reduce aggregate temperature.
5. Substitute chilled water or shaved ice in the mix in place of regular water.
6. Reschedule to night pours.

Contractor:

1. Soak subsurface for a minimum of two hours before placing concrete.
2. Keep spray on rebar until time of pour.
3. Erect a windscreen and/or a shade covering to protect fresh concrete.
4. Keep R/M trucks out of the sun.
5. Refrain from overworking the concrete. Spray on surface evaporation retardant if needed.
6. Immediately after finishing, apply a curing compound (white pigmented) or pond the concrete.

For more information or answers to questions about the use of fly ash in specific applications, contact your nearest Headwaters Resources Technical Sales Representative or call 1-888-236-6236.

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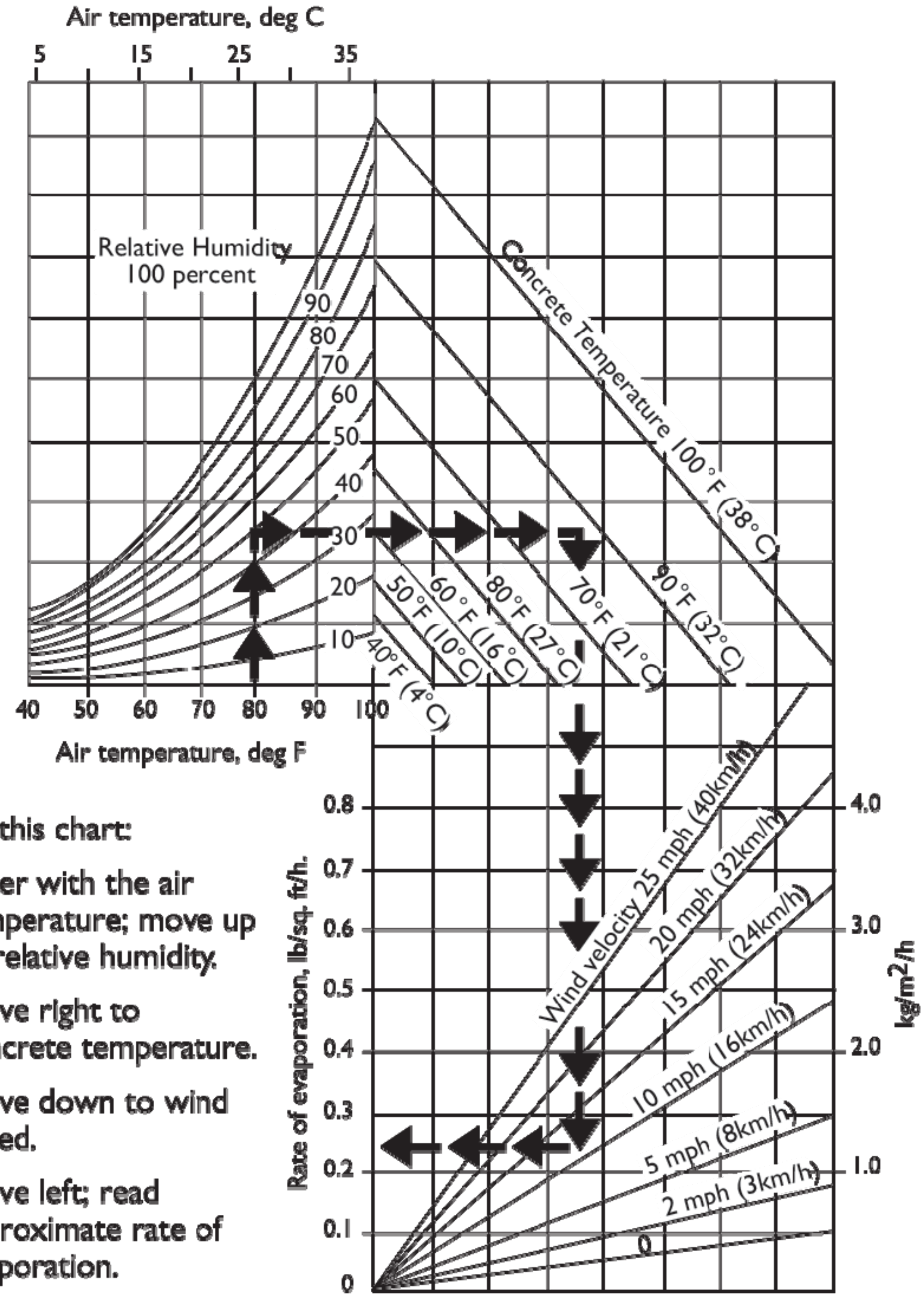

To use this chart:

1. Enter with the air temperature; move up to relative humidity.
2. Move right to concrete temperature.
3. Move down to wind speed.
4. Move left; read approximate rate of evaporation.

Effect of concrete and air temperatures, relative humidity, and wind velocity on the rate of evaporation of surface moisture from concrete. (Lerch, William, 1957, "Plastic Shrinkage", ACI Journal, Proceedings, V.53, No. 8, Feb., 797-802.)

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