

Application note: N° F077

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Humidity Measurement for Precast Concrete Infrastructure Manufacturing

What is Precast Concrete Infrastructure?

Precast concrete is a construction product produced by casting concrete in a reusable mold or "form" which is then cured in a controlled environment, transported to the construction site and lifted into place to be used for bridges, roads, etc. In contrast, standard concrete is poured into site-specific forms and cured on site. Precast stone is distinguished from precast concrete by using a fine aggregate in the mixture, so the final product approaches the appearance of naturally occurring rock or stone.



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By producing precast concrete in a controlled environment (typically referred to as a precast plant), the precast concrete is afforded the opportunity to properly cure and be closely monitored by plant employees. Using a precast concrete system offers many potential advantages over onsite casting. Precast concrete production is performed on ground level, which helps with safety throughout a project. There is greater control over material quality and workmanship in a precast plant compared to a construction site.

For example, precasting concrete in a plant allows concrete manufacturers precise control over the reinforcement and the concrete materials; placing and curing variables that affect durability, strength and appearance of the final product.

Due to the rigours and difficult environment for the curing process, the proper humidity and temperature instruments must be used. The regulations for the Precast Industry is as regimented as the pharmaceutical industry. The CSA concrete design standards, for example are as follows:

Standards

CSA Concrete Design Standards

- CSA A23.3 - Design of concrete structures
- CSA S413 - Design of parking structures
- CSA S6 - Canadian highway bridge design code
- CSA S806 - Design and Construction of Building Components with Fibre-Reinforced Polymers
- CSA S16 - Limit states design of steel structures (precast connections)

CSA Concrete Material and Construction Standards

- CSA 23.4 - Precast concrete – Materials and construction
- CSA A23.1 - Concrete materials and methods of concrete construction
- CSA A23.2 - Methods of test and standard practices for concrete
- CSA A3000-Series - Cementitious materials compendium

Precast/Prestressed Concrete Institute (PCI) Quality Control Standards

- Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products – MNL-116
- Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products – MNL-117

Humidity & Temperature Measurement During Steam Curing

Curing is an important factor for concrete that is used in infrastructure projects. One method to rapidly cure concrete that adheres to the rigorous standards is to Steam Cure after the removal from the form. The process follows these steps.

A typical steam-curing cycle consists of:

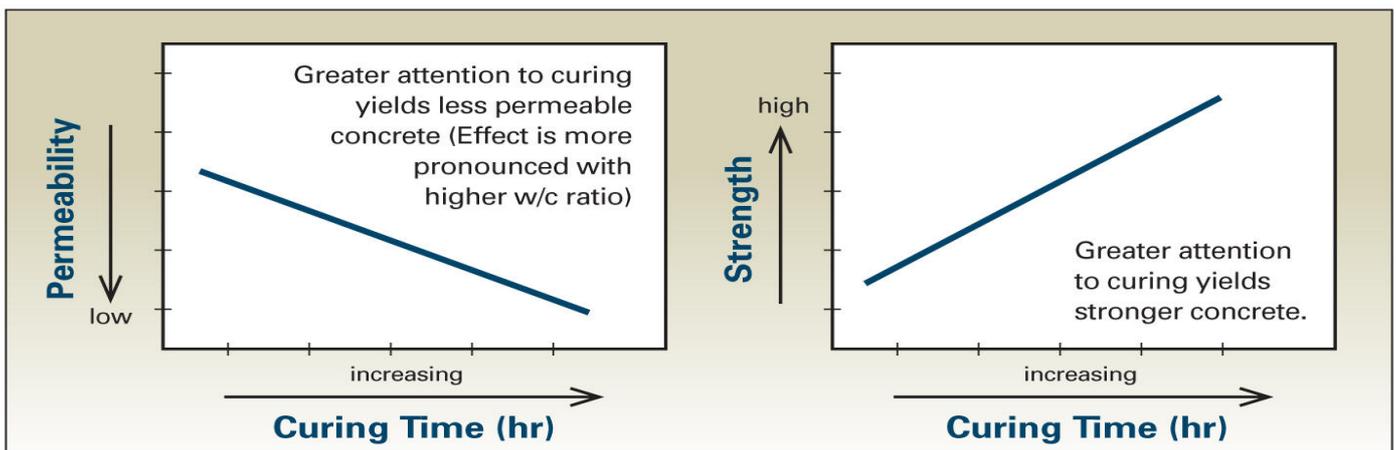
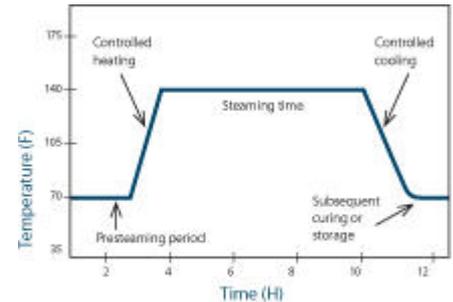
1. An initial delay prior to steaming or a "preset time." Concrete should sit for a predetermined period of time or until initial set.
2. A period for increasing the temperature or "ramp time." Dura-

tion of time required to increase curing-cell temperature from initial temperature to target temperature. The ramping temperature should be limited to a minimum rise of 20 F (11 C)/hour and maximum rise of 40 F (22 C)/hour. Any rise in temperature exceeding 40 F/hour may cause thermal shock, resulting in cracking; anything below 20 F/hour will stunt rapid curing.

3. A period of time holding the maximum temperature constant or "holding time." Duration of time the concrete is maintained at the predetermined target temperature, which should be held until concrete reaches desired strength. Holding time will depend on the concrete mixture and

steam temperature in the enclosure.

4. A period of time for decreasing the temperature or "soak time." Duration of time that concrete is allowed to cool after the steam has been shut off and prior to



What Solution Can Rotronic Offer?

Rotronic offers a broad range of easy-to-use measurement instruments for monitoring and recording humidity and temperature values, including probes, data loggers, handheld hygrometers, and transmitters. Our instruments are designed to maintain accuracy and reliability of measurements in the unique, high-humidity environments of steam curing rooms.

Our products in combination with HW4 software makes it easy to analyse the gathered data or export the data into excel. This information can form the basis for any reporting that must be provided to interested parties including the end user and government regulators.

Rotronic products:

Humidity and temperature probes:

- **HC2-S Heated**
 - Measures relative humidity, temperature and dew point
 - Outstanding accuracy and repeatability
 - Automatic heating function
 - Eliminates of condensation
 - SMD Thermo sensor element

Humidity and Temperature Transmitter:

- **HF5 Digital**
 - Relative humidity and temperature measurement
 - Dew Point and other psychrometric calculations
 - Interchangeable probe for easy maintenance
 - Wide choice of probes to satisfy every application
 - Low voltage and mains versions
 - Freely scalable analogue signals
 - Various digital outputs
 - Available with metal housing



HF5 Digital, E2-05A cable, HC2-S Heated Probe

Customer benefits:

Accuracy:

Choosing Rotronic gives you the best accuracy on the market. So, it doesn't matter what you are monitoring or controlling you can always rely on the measured data.

Long term stability:

Apart of the exceptional long term stability of our IN-1 humidity sensor, that is better then 1%/rh per year, Rotronic also chooses for its other parameters only high quality state of the art sensors. This ensures that we can provide long living reliable products.

Communication:

With all of the different communication methods, from conventional analogue output signals to RS-485, Wireless or Ethernet RJ45, Rotronic can provide the individual solution for each installation.

Easy to handle:

Since our HW4 software is used for almost all of our devices, it is super convenient to do reconfigure or adjust the units. And it does not end there! With the HW4 software it is even possible to build up a professional validated monitoring system that fulfils