PAVE THE WAY:
A RESOURCE FOR THE CONCRETE INDUSTRY

BY POWERBLANKET

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Concrete is a staple of modern society. It supports our homes and offices, paves our roads and runways, and carries water and sewage away. Nearly every building uses concrete as a foundation. It can be seen in every construction site.

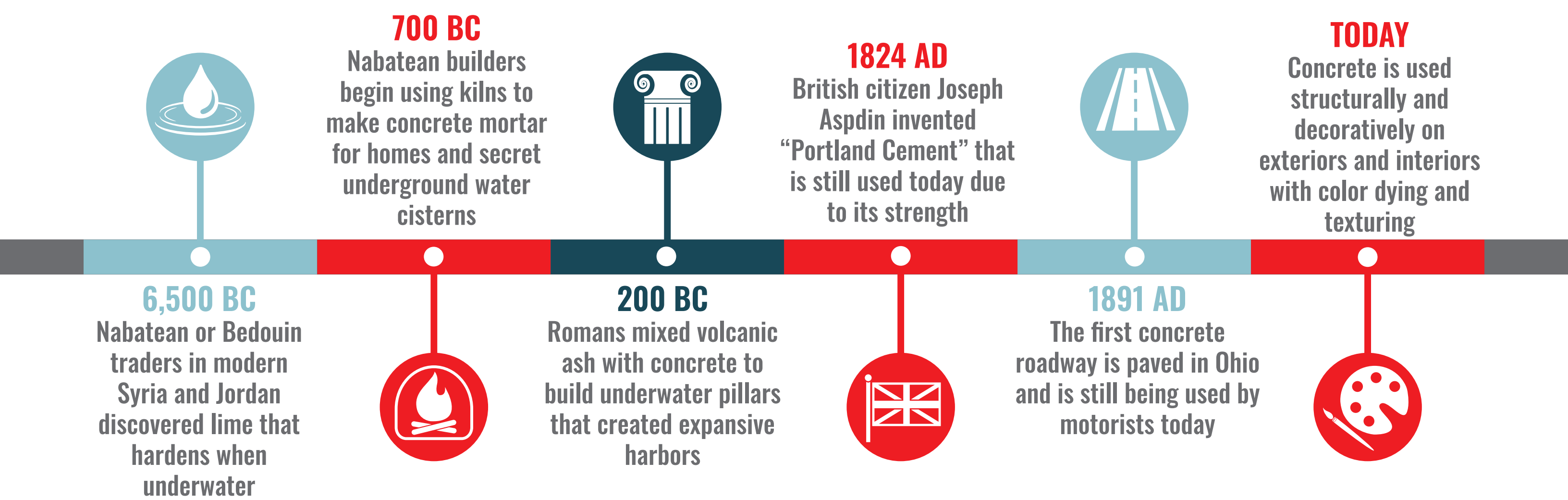
A BRIEF HISTORY OF CONCRETE

Though it's one of the most common building materials in modern society, the origins of concrete began around 8,000 years ago in the Middle East with the Nabataean Kingdom. According to the International Association of Certified Home Inspectors, the Nabataeans were centuries ahead of their time in their understanding of concrete, paving the way for later civilizations.

TIMELINE OF CONCRETE MODIFICATIONS AND USAGE

6,500 BC – The first concrete-like structures were built by Nabataean or Bedouin traders who controlled a series of oases and developed a small empire in the regions of southern Syria and northern Jordan. They understood the need to keep the mix as dry or low-slump as possible, as excess water introduces voids and weaknesses into the concrete. Their building practices included tamping the freshly placed concrete with special tools to produce more gel. This chemical reaction would bond the particulates and aggregate together.

700 BC – Nabataeans later discovered the advantages of hydraulic lime (cement that hardens underwater) and began building kilns to supply mortar for the construction of rubble-wall houses, concrete floors, and underground waterproof cisterns. These cisterns were kept secret and were one of the reasons they thrived in the desert.



200 BC – Engineers of the Roman Empire learned that mixing concrete with volcanic ash made it possible to create pillars of concrete underwater, allowing for expansive harbors to be built on the coasts of Italy.

DARK AGES – Concrete building knowledge and skill sets virtually disappeared during the Dark Ages. In 1414 an ancient manuscript with descriptions of concrete ingredients was found; however, it wasn't until the late 18th Century that concrete returned as a viable building substance.

1824 AD – The most radical development in concrete occurred in 1824, when British citizen Joseph Aspdin invented "Portland" cement, named after stone quarries near Portland, England. The cement is sourced from limestone and other ingredients that help it to maintain its strength. Portland cement today is one of the most common building materials in the world, and is set to only increase in its use.

1891 AD - The first concrete roadway was paved in Ohio, and is still in use by motorists to this day.

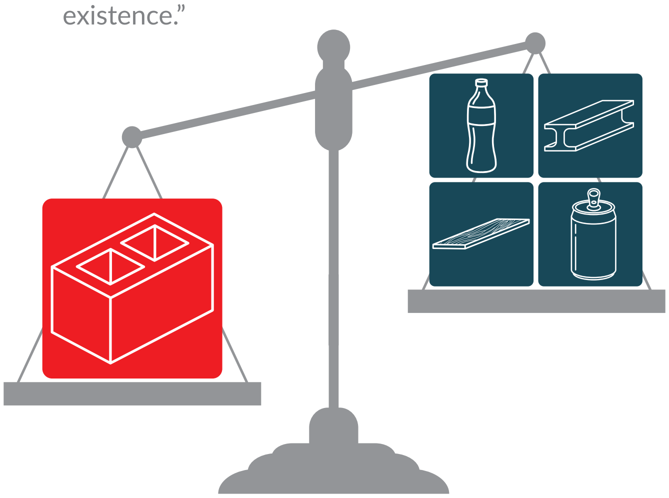
TODAY – Modern concrete is used in more than construction as done by Aspdin in the 1800s. Often seen in building foundations, pillars and walls, it also has a place in interior design, such as the current trend of concrete countertops. Concrete staining, where dye or paint is stained into concrete floors and tabletops, is also a popular modification to concrete.

According to the The Portland Cement Association's website, concrete roadways have an extensive lifespan. It's estimated that most concrete roads last between 30 to 50 years without needing to be replaced. This is due in part to nearly no need for resurfacing or patching. When repairs are needed, road closure times are minimal since concrete is easier to pull up and replace, whereas asphalt can take weeks. In addition, concrete is much safer to drive on than asphalt. The Portland Cement Association says that concrete roadways are "less susceptible to the formation of heavy-vehicle wheel ruts; easier to see at night; ensures shorter vehicle stopping distances in wet weather; (and) due to longevity, there are fewer work zones over the life of the pavement."

BUILDING BLOCK OF HUMANITY

Concrete is the second-most consumed material on Earth, after water. According to concrete know-it-alls Cement Trust:

"There are nearly three tons of concrete produced each year for every human on the planet, making it the most used man-made product in the world. Concrete production and concrete construction have an impact on almost every facet of human existence."



2 X MORE

THAN WOOD, STEEL, PLASTIC, AND ALUMINUM COMBINED

WHAT IS CONCRETE?

Concrete is a mixture of aggregate materials with fluid cement paste. The American Concrete Institute defines aggregate as "granular material, such as sand, gravel, crushed stone, crushed hydraulic cement concrete, or air-cooled iron blast-furnace slag, used with hydraulic cement to produce either concrete or mortar."

CONCRETE CONSTRUCTION STEPS

Following these steps (courtesy of The Constructor) allows concrete to reach its maximum strength, enabling it to hold up dams, steady bridges and help buildings stay standing.

- SELECTING MATERIALS AND MIXING PROPORTIONS
- MIXING
- CHECKING WORKABILITY
- TRANSPORTATION
- POURING IN FORMWORK FOR CASTING
- VIBRATING FOR PROPER COMPACTION
- REMOVING FORMWORK AFTER SUITABLE TIME
- CURING FOR REQUIRED TIME

ALL ABOUT THE AGGREGATES

The Portland Cement Association, one of the most authoritative sources on concrete information, says the process of obtaining aggregate for cement is more complex than most people are aware of.

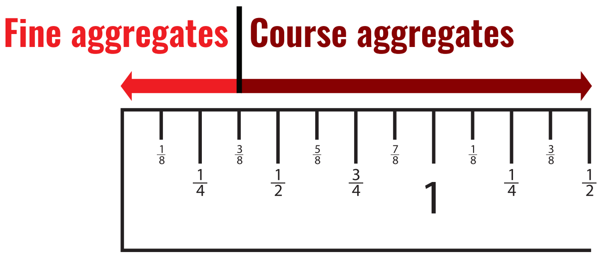
"For a good concrete mix, aggregates need to be clean, hard, strong particles free of absorbed chemicals or coatings of clay and other fine materials that could cause the deterioration of concrete. Aggregates, which account for 60 to 75 percent of the total volume of concrete, are divided into two distinct categories--fine and coarse.

Fine Aggregates

Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 3/8-inch sieve.

Coarse aggregates

Coarse aggregates are any particles greater than 0.19 inch, but generally range between 3/8 and 1.5 inches in diameter. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder.



"Particle shape and surface texture influence the properties of freshly mixed concrete more than the properties of hardened concrete. Rough-textured, angular, and elongated particles require more water to produce workable concrete than smooth, rounded compact aggregate. Consequently, the cement content must also be increased to maintain the water-cement ratio. Generally, flat and elongated particles are avoided or are limited to about 15 percent by weight of the total aggregate."

STRENGTH THROUGH CURING

Concrete is known to have exceptional strength in whatever shape it forms to. Not only for ground covering and building columns, concrete can be used to create tableware bowls, plates, cups and jars. It's strength comes from curing over time. Though concrete becomes usable within a few days, concrete will never stop curing. As long as there is even a minuscule amount of moisture present, the cement will continue reacting and hardening.

FACTORS INFLUENCING CURE TIME

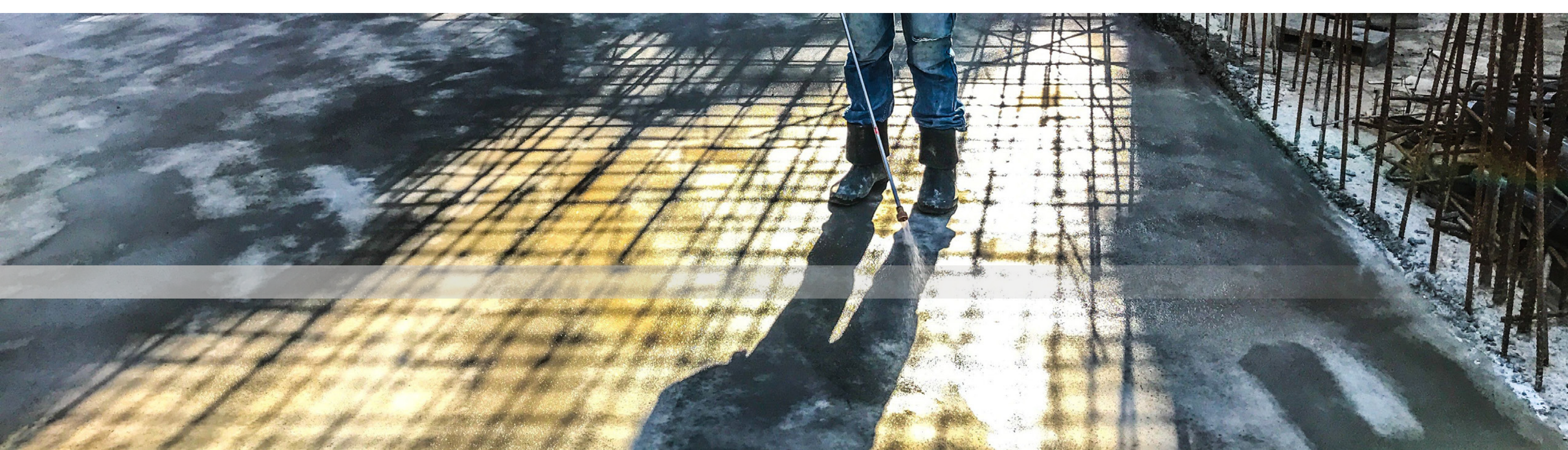
- Mixture proportions- Increasing cement to water ratio will decrease setting time but may compromise long-term strength
- Type of mix used- Some fast curing concrete mixes and add-ins are available
- Specified strength
- Size and shape of slab
- Ambient weather/temperature- Higher temperatures decrease initial concrete setting time, but may decrease long-term strength

Typically, concrete is recognized to have reached full strength 28 days after placement; however, this does not mean you need to wait 28 days to walk on, or even continue construction on newly placed concrete. After placement, concrete increases in strength very quickly for 3-7 days, then gradually for the next 3 weeks. This means that concrete hardening time is typically 24-48 hours, at which point it's safe for normal foot traffic. After one week, concrete is typically cured enough to handle continued construction including heavy machinery.

WHEN IN DOUBT REMEMBER THE RULE

70 in 7 MOST CONCRETE MIXES REACH 70% OF SPECIFIED STRENGTH AFTER 7 DAYS

THEN IT'S READY FOR EXPOSURE TO NORMAL TRAFFIC



> Perhaps more than any other product installed on a job site, concrete requires advance planning
>
> **American Concrete Institute**

WORKING WITH CONCRETE

BIDDING A JOB

Price is an important factor for any construction bid, however it is only a piece of the concrete puzzle. Clients may be tempted to go for the lowest bidder and that can frequently lead to very visible problems in the quality and durability of their concrete.

According to the American Concrete Institute "perhaps more than any other product installed on a job site, concrete requires advance planning... meetings to discuss the project and iron out difficulties ahead of time foster an open channel of communication that will continue throughout the construction process."

While at an American Society of Concrete Contractors conference, a representative from Concrete Decor Magazine facilitated a round-table discussion on job bidding and pricing. "Through the discussions with various concrete contractors, a common theme came up in realizing proposals shouldn't always be only about dollars. It involves so much more. The thought and thoroughness that goes into each bid results in the estimated price to get the job done correctly the first time. Each project is unique and needs to be treated as such. The same holds true for the low-bid battle. It is dangerous for owners or general contractors to base their selection solely on the lowest dollar."

The price offered to clients is only part of the picture. It is critical to advertise and demonstrate these additional factors:

RESPONSE TIME

QUALITY

ATTENTION TO DETAIL

FOLLOW UP AND FOLLOW THROUGH

Response time

The efficiency of communication during the bidding, planning, constructing and post construction processes will put you ahead of the pack in the eyes of the prospective client.

Quality

High quality equipment and materials lead to high quality work that will endure and advertise for years to come.

Attention to Detail

If your bid is detailed and precise then the clients can be assured that the same amount of precision will be applied to the concrete.

Follow through and follow up

After a concrete job is complete, contractors that follow up with the quality of their work build a solid reputation with clients and other contractors. Willingness to fix or re-address faults in concrete will show clients that you stand behind your work and builds trust and respect.

PRECAST CONCRETE

Precast concrete uses molds to form cement into a specific shape. The molds can often be reused to allow formations of the same exact shape to be made over and over again. The business of precast concrete manufacturing is one where you often have to hurry up and wait. Once you pour a precast form, you then have to wait for the time-consuming process of allowing the form to fully cure.

The precast concrete industry, much of which focuses on custom projects and applications, adheres to a strict standard of quality controls for production purposes. These quality controls include paying close attention to the raw materials such as sand, cement, aggregates, chemicals (if needed) and water used in the process and development of the proper mix design. All of the quality control measures taken and all the attention paid to the details and standards set forth by National Precast Concrete Association (NPCA) would be rendered somewhat meaningless if proper curing procedures and techniques were not followed closely.

CURING CHALLENGES

There is a growing pattern and demand for higher compressive strengths and being able to realize those PSI ratings in a shorter curing cycle time. While these issues can challenge production at any time it is particularly challenging during periods of the year when cold weather becomes a factor. Common problems encountered during the cold-climate times of the year can include but are not necessarily limited to:

- Potential freezing in the early stages of placement
- Inability to achieve required compressive strengths within a specified period of time
- Improper curing procedures
- Frequent and /or rapid temperature change

Moisture Retention

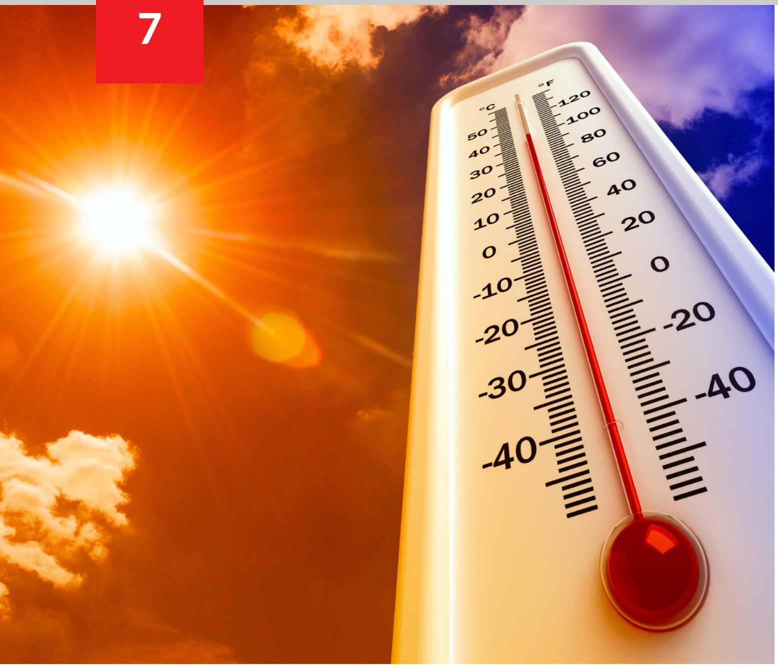
One of the more critical elements in the curing process is moisture retention. The evaporation rate of this moisture needs to be controlled as much as possible and cold weather is an unacceptable excuse for delaying production. Cycle time can obviously take longer during periods of cold weather and time is money. The ambient temperature can slow both the evaporation rate and the curing time. Utilizing heat in conjunction with moisture curing is a proven to be a solution to this problem.

Heat During Curing

Two of the most common and conventional means of providing heat in a precast operation during initial cure are steam and hot air. While effective during the “initial” curing stage, neither method is recommended once the concrete slab has attained its “initial” set.

The use of an electrically powered heating solution can provide several benefits:

- Freeze protection
- Sustainability of acceptable temperatures to enhance cure
- Accelerate the achievement of specified compressive strength levels while preventing rapid temperature fluctuations during the curing cycle



WEATHER AND CONCRETE

Weather can have a significant impact on concrete strength. Concrete cures at a temperature best set above 50° F and below 70° F, meaning if it's too hot or too cold outside, the concrete won't cure properly.

CURING BLANKETS

Curing blankets are very effective at maintaining a regular temperature over concrete, allowing it to set properly and achieve its maximum strength. If conditions are cold, concrete curing blankets provide a manageable way to cure concrete effectively and confidently.

A Cure for What Ails You

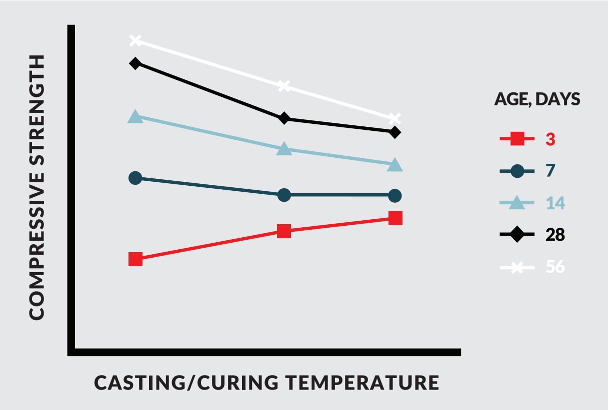
The innovative design of Powerblankets Curing Blankets increases production by rapidly curing with consistent, even heat.

BENEFITS OF USING POWERBLANKET CURING BLANKETS
Cure concrete 2.8 times faster than conventional insulated blankets
Maintain moisture throughout hydrating process
Easily installed and removed
Produce cold weather concreting strength of up to 3,925 psi in 72 hours
Prevent a freeze cycle
Thaw ground and frost from job site before you pour
Reduce downtime and increase profitability
Maintain ACI compliance for cold weather concreting

Powerblanket Curing blanket

> Concrete need not deteriorate
> **American Concrete Institute**

The same goes for hot temperatures and high humidity. High temperatures mean faster curing, but fast curing equates to weaker strength in the end. The following study by Paul Klieger in the Portland Cement Association Research Bulletin 103 illustrates this concept.



At an age of 1 day the 120°F concrete was strongest and the 25°F concrete was weakest. By 7 days the high-temperature cured concretes had no more strength than the 73°F concrete or even less. By the age of 28 days the high-temperature concretes were weaker than the 73°F concrete. From 28 days to 1 year the 55°F concrete was considerably stronger than the 73°F concrete. All of this suggests that, provided there is continuous curing, concrete cured at about 55°F for the first 28 days ultimately reaches the highest strength.

Keeping Your Cool

If you are dealing with hot conditions and your concrete setting too quickly, consider FluxWrap. The FluxWrap from North Slope Chillers is portable cooling equipment that will keep newly poured concrete safe from heat, regulating concrete setting time in both regular and hot conditions.

The FluxWrap is combined with either a cooler or chiller to achieve optimum results. The Circulation Blanket draws heat to the blanket in order to cool the concrete.

- Use Powerblanket's patented heat-spreading technology in reverse–the cooling blanket draws heat away and lowers the temperature of the concrete
- Take it with you on every job: it is easily portable
- Blanket cover and insulation are the same as the robust system used in Powerblanket heating products
- Control the curing speed of newly poured concrete even in hot conditions

Fluxwrap circulation blankets

It's important to note that concrete can cure faster if exposed to higher temperatures during the drying process, but doing so can compromise its strength and lead to cracking. The American Concrete Institute says if concrete has set properly and is not exposed to harmful elements such as wet weather or eroding chemicals, "concrete need not deteriorate."

Climate will always have an effect on concrete no matter how expertly it was laid.

CUSTOM SOLUTIONS FOR COMMON CONCRETE PROBLEMS

COMMON CONCRETE PROBLEMS

TEMPERATURE BASED

SPALLING
Peeling or loss of the top finished layer usually due to freezing before reaching a strength of 500 psi

POP-OUTS
Tiny explosions caused by pieces of aggregate absorbing water and freezing

TEMPERATURE DAMAGED ADMIXTURES
Damage to chemical admixtures caused by improper storage during cold temperatures

OTHER CONCRETE PROBLEMS

WASTE
Concrete is biodegradable, however the process of making it creates significant waste byproducts

CRACKING
Common occurring and easily reduced and repaired

CHIPPING
Concrete can chip when exposed to force and erosive elements such as chemicals and water

SALT DAMAGE
Scaling due to exposure to de-icing salts before concrete has fully carbonized

INNOVATIVE CONCRETE SOLUTIONS

TOTAL TEMPERATURE CONTROL

GROUND THAWING MATS
Quickly remove frost from the ground before pouring to reduce downtime and increase profits

CURING BLANKETS
Reduce concrete cure time and protect slabs from cold and adverse weather conditions

DRUM AND BARREL HEATERS
Protect sensitive materials during storage with custom fit heating wraps to prevent waste and loss

REDUCE WASTE
Properly caring for your concrete's temperature during mixing, pouring, and curing will reduce waste, prevent costly repairs and extend the life of your concrete

Ground Thawing Mat

Concrete Spalling

COMMON CONCRETE PROBLEMS

TEMPERATURE BASED

Spalling

Weather can also have disastrous effects on the surface face of concrete. The most common defect is spalling. Spalling is simply the peeling or loss of the top finished layer of the concrete. It usually happens because the upper surface of the concrete froze before enough crystals grew to give this layer strength of at least 500 psi.

Popouts

Popouts are another common surface defect. A popout is created when a piece of aggregate (rock) in the upper surface of the concrete explodes as a result of freezing. Some pieces of aggregate have a tendency to absorb water. This water freezes, expands and eventually causes a tiny explosion. Gravel companies go to great lengths to try to remove this type of rock from the gravel – but they don't always catch every piece.

Concrete Admixtures

Concreting business thrives during the warm months. And to concrete specialists, it's clear as to why. Concrete takes higher temperatures to cure quickly and properly, but the other side of the equation has to do with the admixtures that are necessary for concrete construction. Chemical admixtures don't do well in cold temperatures either, and if you face the winter months with a surplus of admixtures, you'll need to know how to store them properly. When it comes to storing admixtures for the winter months, keeping the materials at warmer temperatures may or may not be a problem for your business. Perhaps you have a heated warehouse where you can keep them in drums and barrels. However, when and if your admixtures end up outside, you're going to need to safeguard them against the cold. Some admixtures can be applied at the plant before the cement truck leaves, but others are added onsite, immediately before application. In this second scenario, protecting your admixtures becomes increasingly crucial, especially during cold weather concreting operations.

Along with all the cold-weather practices you need to following during and after the pouring of concrete, you also need to keep your admixtures at the proper temperature to ensure they react properly. Such material is best stored in containers kept at an even temperature via drum/barrel heaters.

OTHER CONCRETE PROBLEMS

Waste

While concrete is biodegradable, the process to make it leads to the byproduct of many waste materials, such as carbon dioxide. Civil+Structural Engineer Magazine reports that "acquiring the raw materials to produce concrete, such as cement, aggregates, and water, can also have a significant environmental impact. Many organizations and experts are working on innovations and regulations that make the production and use of this versatile material more efficient, as it becomes a significant contributor to sustainable development and construction."

Cracking

Salt Lake City based company Solid Concrete Walls describes cracking as naturally occurring, and "in some cases, masonry or concrete foundation walls incorporate a nominal amount of steel reinforcement to control cracking."

According to an article titled, "Reducing Cracking in Concrete," Solid Concrete Walls says that just because there is a crack in your concrete doesn't mean danger is imminent.

"Cracks in concrete walls and slabs are a common occurrence. They appear in floors, driveways, walks, structural beams, and walls. Cracking cannot be prevented but it can be significantly reduced or controlled when the causes are taken into account and preventative steps are taken. Most cracks should not be a cause for alarm."

Concrete Construction says that if you've noticed cracking in your concrete, you'll want to follow several steps before taking any repair measures:

"Before repairing your next crack, perform a crack evaluation and establish the repair objectives. Decide what type of repair is needed. Choices include a structural repair using epoxy, a route and seal repair using a flexible sealant to accommodate future crack movements, and a hard or semi-rigid filler repair to support crack edges, with or without routing. Also, establish the cosmetic requirements. After choosing the repair material and procedure, follow the manufacturer's recommendations."

Chipping

Concrete can also chip away after exposure to erosive elements, such as chemicals or water. Chipping can be repaired using simple epoxys such as Sakrete, Quikrete or other products found at your local hardware store.

Salt

De-icing salt damage is another common surface defect. Scaling of your concrete can occur even if everything was done correctly. Here's what happens: As concrete is exposed to air, it gets harder. That process is called carbonation. The carbon dioxide in the air reacts with the concrete and creates limestone (calcium carbonate). This carbonation process, however, usually takes one year to produce any substantial differences in strength. So, if you use de-icing salts or they drip from the underside of your car onto your new slab, you may have a problem with de-icing salt damage.

DECORATIVE USES OF CONCRETE

STAINING

As mentioned before, staining is a great way to turn a slab of gray into luxurious tones of brown, green, even blue. Concrete experts generally use one of two ways to stain concrete: acid and water-based stains. Each one has a specific purpose, but which one should you use?

Acid Stains

Acid stains are made up of metallic salt minerals dissolved into a water-acid mixture. The acids allow for a chemical reaction during the curing process that permanently changes the surface of the concrete in color and texture.

> Every modern home uses concrete in one way or another...and its use has revolutionized America's infrastructure
>
> **Civil + Structural Engineer Magazine**

Non-acid Stains

Non-acid stains treat concrete differently than an acid stain. Instead of altering the structure of the concrete, non-acid stains create a layer over the concrete surface, filling pores and leaving behind a flat, smooth finish.

STAINING STEPS

In order to stain concrete, the concrete must be cured to its proper strength. This can take up to 48 hours (which feels more like forever than it actually is), but with concrete curing products this time can be nearly cut in half. Powerblanket's Concrete Curing Blanket helps keep concrete at stable temperatures above 50°F, making cure time 2.8 times faster than open air curing. This is especially helpful when staining concrete in places where temperatures are variable or close to freezing. Make sure your concrete creation cures correctly. Once the concrete is cured, you can move on to the staining process. According to industry experts, the best way to stain concrete is as follows:

1. THOROUGHLY CLEAN AND PREPARE CONCRETE
2. APPLY CONCRETE STAIN
3. CLEAN UP AND NEUTRALIZE CONCRETE STAIN
4. SEAL CONCRETE FOR LASTING PROTECTION

Thoroughly Clean and Prepare Concrete

- Begin washing down the concrete surface. You won't want any food crumbs or shoe scuff marks to get in the way of the stain, so make sure to give it a good scrub down
- Remove any layers of glue, sealers or curing membranes that might prevent the stain from contacting the concrete
- Apply a concrete acid cleanser to the project surface to ensure the concrete is as porous as possible. Once it has dried, rinse the concrete with water

Apply Concrete Stain

After the concrete is no longer wet from rinsing, use a brush to spread the stain across the project surface. If it's a puddle you can splash in (don't), it's too thick. If it disappears right after applying it (i.e. it absorbed into the concrete), you need more. Once your initial layer is down, allow 24 hours of drying before doing another layer of stain, even if it's the same color of stain.

Most stains have difficulty drying in cold temperatures. If a concrete staining project must happen in the dead of winter, a Concrete Curing Blanket can save the day, allowing the stain to dry within a controlled environment.

THE FUTURE OF CONCRETE

As the need for inexpensive and efficient building material grows, so will the need for concrete. Especially in colder climates, concrete is seen as a work of culture as much as it is a construction tool. “Every modern home uses concrete in one way or another,” says Civil+Structural Engineer Magazine, “and its use has revolutionized America’s infrastructure.”

The magazine also predicts that concrete manufacturers will “go green” as they find less harmful ways to keep the concrete flowing while reducing its impact on the planet. Recycling concrete aggregate and using fuel efficient vehicles to transport concrete are several ways in which concrete is cementing itself into a sustainable future.

Concrete won’t be going anywhere. It’s here to stay, firmly underneath our feet.

Powerblanket is here to help you understand the ins and outs of concrete, as well as bring relief with many of your concrete needs. Curing blankets, drum/barrel heaters, ground thawing mats and more are at your disposal to get the job done. Do it right with Powerblanket.

POWERBLANKET CONCRETE PRODUCTS

CURING BLANKETS

Provide a uniform barrier of heat across entire cylinder, optimizing temperatures and increasing cylinder efficiency

PART NUMBERS
MD1020
MD1010
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MD0510
MD0320
MD0310
MD0304

EXTRA HOT THAWING

When frost, snow, and/or ice is slowing down your job, look to these blankets to improve thawing and frost protection.

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