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information

Concrete Contributions to a Better Environment

Across the United States and around the world, portland cement concrete is the foundation of our environmental infrastructure.

For many reasons, concrete is perfectly suited for construction of water and wastewater treatment facilities. Because it's easily worked, fundamentally maintenance free, and relatively inexpensive, concrete is the building material of choice for engineers and architects planning water facilities, both above and below ground.

And because it's inert, nonreactive, and watertight without special coatings, it's the ideal medium for transport of potable water, wastewater, and sewage—used in desert aqueducts, massive cross-country pipelines, local sanitary and storm sewers, and manholes and inlets in every neighborhood.

Concrete dams provide drinking water for consumers, irrigation for farmers, flood control for property owners, and electric power. Concrete plays a key role in controlling erosion along rivers, estuaries, and coastlines.

But concrete enhances our environmental quality of life in ways beyond water alone. Concrete is the best material with which to control hazardous wastes, and with the right admixtures, cement is without peer in stabilizing landfills and contaminated soils.

It's hard at work ensuring control of potential runoff from roadway deicing salt storage facilities. It's the best choice for sound walls to mitigate noise from urban expressways.

And porous concrete is a new choice for parking lot and driving surfaces, quelling pavement spray, extinguishing noise, and forcing pavement runoff into the proper channels.

Concrete the Natural Choice

Of all building materials, concrete is the natural, overwhelming choice for both drinking and wastewater treatment facilities, and water transmission and distribution systems. Concrete and cement are produced from some of the world's most abundant resources, without toxic byproducts or environmentally compromising processes.

Concrete is readily recyclable, naturally waterproof, and seldom requires coatings or sealers, which would emit volatile organic compounds (VOCs). Because cement and concrete supplies are regionalized, the amount of energy required for handling and transportation is minimized.

The need for concrete water facilities is growing. Wastewater treatment requirements are exacerbated by population growth and aging of existing plants. The Precast / Prestressed Concrete Institute (PCI), citing Environmental Protection Agency estimates, reports necessary investment in U.S. wastewater treatment systems to be roughly $140 billion over the next 20 years.

This total includes $44 billion for wastewater treatment, $10 billion for enhancing existing collection systems, $22 billion for new sewer construction, and $45 billion for controlling combined sewer overflows (CSOs), in which public health is endangered by surges in systems that combine waste and storm water. As many as 2,000 additional plants could be needed by the year 2016 to meet expanded treatment goals. Another $138.4 billion may be required in total infrastructure investment for safe drinking water systems through 2014. Of that amount, water transmission and distribution systems will require the largest capital investment, some $77.2 billion over 20 years for installation and rehabilitation. Concrete will play the largest role in all that construction.

New Designs Utilized

New concrete engineering designs are optimizing water treatment applications. Egg-shaped concrete wastewater sludge and sewage digesters are an energy and space-efficient answer to treatment needs.

Recently, in Bottrop, Germany, four giant "eggs"—149 ft tall and 92 ft in diameter at the midsection—were part of a major wastewater treatment project. Each tank provides an air-free chamber for the digestion of sludge from wastewater treatment plants.

Sight unseen: Nestled into the hilly terrain of a city park, this 6-million-gallon water storage tank in Lowell, MA, replaces an open reservoir.

The prestressed concrete shape provides minimum water surface area for scum buildup and steep cone floors to maximize sludge draw off and eliminate the need for cleaning. The digesters are prestressed both horizontally and vertically to assure a watertight structure.

Separately, research from Pennsylvania State University indicates that use of cement kiln dust instead of hydrated lime offers economic and energy conservation advantages when used in vacuum filter processing of sewage sludge. In Europe, the use of cement kilns has been suggested instead of conventional incinerators to burn sludge as a partial replacement for fossil fuels.

New construction techniques are enhancing use of concrete in sewage treatment plants. In 1997, during construction of an oval oxidation ditch for a large wastewater treatment plant, time and labor were saved by use of a flexible forming system that could accommodate both straight and curved walls.

The structure's four concentric, 14-ft-high, 1-ft-thick concrete channel walls required the forming of 64-ft-long straight sections as well as curves of four different inside radii: 8 ft, 23 ft, 42 ft, and 61 ft, reports *Concrete Construction* magazine.

Concrete lends itself to architectural treatments for tanks associated with water systems. A2-million-gallon tank in Valencia, California—fully buried beneath a park—recently won an award from the Portland Cement Association for distinguished environmental consideration. It not only stores water, but also accommodates tennis courts on its roof. The floors and walls are cast-in-place concrete, with walls 23 ft high and 10 in. thick.

And a precast tank in Lowell, Massachusetts, received honors for its architectural treatment. The new 6-million-gallon storage tank—recessed quietly into a city park amid hilly terrain—replaces an existing open reservoir. It's a reinforced, cast-in-place concrete structure with 4-in.-thick walls.

The new Nazareth (Pennsylvania) Waste Water Treatment Plant is a sophisticated concrete and piping facility. The main complex comprises a treatment unit—a 205-ft by 100-ft rectangular tank divided into several components—and an underground influent structure with 35-ft concrete walls, a blower, storage building, and series of concrete tanks, pipes, and underground units.

Concrete for Aqueducts

Concrete is the building material of choice—both in terms of cost and environmental impact—for modern aqueducts. Concrete was used in the largest water transportation system ever authorized by the U.S. Congress, moving 1.2 million acre feet of water from the Colorado River through Arizona each year.

Part of the 333-mile system required the largest circular precast concrete pipe ever built, according to *Concrete Construction* magazine. From 1976 to 1979, 1,080 two-story-high pipe sections with 21-in.-thick walls were placed under six dry riverbeds in Arizona.

New design equipment is now available to make it easier for contractors to slipform concrete linings for at-grade aqueducts, as well.

Concrete is enhancing our environmental infrastructure because of its long life and low operations and maintenance costs. For example, the U.S. Army Corps of Engineers in its 1998 design manual, *Conduits, Culverts and Pipe*, said concrete pipe will give a product service life approximately two times that of other pipe products, and specifies concrete pipe in public safety applications.

And concrete pressure pipe—designed to withstand high-pressure applications like large-volume pumped water—has operations and maintenance costs of one-half to nearly one-third of the average costs per mile of competitive ductile iron and steel respectively, says the American Concrete Pressure Pipe Association.

Even as cement is manufactured using fuels derived from hazardous wastes—thus removing these materials from our ecosystem—research by cement maker Southdown found not only that residual metals do not leach out of the cement and concrete in any form, but that organic chemicals do not survive the intense sintering heat of the cement manufacturing process in any appreciable quantity. Thus cement remains suitable for water supply use, whether or not it's made with hazardous fuels.

Concrete Confines Wastes

Concrete also enhances our environmental quality of life by capping solid waste landfills, and easing installation of methane collection systems. It can provide secure storage of hazardous wastes. And it's hard at work stabilizing contaminated materials in situ.

In stabilization, portland cement, additives, and even fly ash are mixed with the waste to produce a solid mass for disposal.

The advantages of cementitious materials for stabilization of hazardous waste include safer transport and easier burial, reduced opportunities for leaching and evaporation, easier and safer handling on site, and the added opportunity to recycle some wastes into construction materials.

The Big Cover-Up

Concrete also serves as the best cover or cap for hazardous waste sites. As incineration and on-site detoxification of hazardous wastes under Superfund commission draw local outrage, in-ground storage of these wastes in leach-proof structures, capped by concrete, offers an alternative.

Non-concrete covers are attacked by erosion, vegetation, burrowing animals, exposure to sunlight and the elements, and subsidence. Concrete resists these attacks.

Research in Canada has shown that residual cement kiln dust—when stabilized and consolidated for long-term impermeability—has potential for lining sanitary landfills, thus preventing leaching.

In the meantime, civil engineers from Alabama and Florida have proposed large reinforced concrete buildings for long-term waste storage. Walters, Moffett, Sellers and Lovell, in their paper "Use of Elevated Concrete Buildings for Sanitary Landfills, Monofills, and Cogeneration Facilities," suggest square concrete buildings, measuring 250 ft on a side and 70 ft tall.

Such buildings would produce no water or air pollution. They'd permit exact inventories to be kept of these hazardous wastes, could last a century or longer, and would be ideal for Superfund-type waste storage.

Going with the flow: Concrete canal linings are basic infrastructure for water transportation.

Store Salt with Concrete

One way that government agencies and their contractors are minimizing road salt's impact on the environment is through correct storage techniques. While the outdoor stockpile of salt still is utilized—with its accompanying problems of indiscriminate runoff and groundwater pollution—concrete is used more and more as a base for outdoor stockpiles, and as a foundation for interior storage.

Concrete holds up best to repeated movements of heavy equipment and the weight of the corrosive salt. Ideally, concrete pads would be constructed of air-entrained concrete, observes The Salt Institute. Pads should be sloped to allow surface water to drain away. For good drainage, ditches, pipes, and tiles should be installed where required. In some

Wastewater Irrigates, Thanks to Concrete System

Concrete was key in a major water resources project for the west Texas city of San Angelo.

San Angelo partnered with the Tom Green County Water Control and Improvement District No.1 on a project that will optimize the region's limited water resources by reusing treated effluent water from the wastewater treatment plant, sending it to the district's irrigation canal for distribution to farmers.

The scheme provides a more reliable source of irrigation water for the district, as its draw down from the supply reservoir can be limited in times of drought. And in return, the city and district will exchange water allocations from the source, the Twin Buttes Reservoir, in the amount of effluent water supplied by the city.

A 48-in.-wide, AWWA C303-standard concrete pipeline was built in 1998 to connect the wastewater treatment plant to the irrigation canal, a distance of some 5.7 miles, reports supplier Gifford-Hill-American, Inc.

Similarly, research in Egypt and Qatar shows the use of up to 40% effluent as mix water in concrete in arid climes would not exceed the threshold of dissolved solids, chloride, and sulfates for mix water, but that amounts not exceeding 20% give better compressive strengths than higher amounts.

Quiet zone: Concrete sound walls combat a different kind of urban pollution—highway noise

The Environmental Council of Concrete Organizations is a coalition dedicated to promoting the environmental benefits of concrete and its role in safe and sustainable construction.

ECCO members are companies, organizations, and individuals affiliated with the concrete industry. Together, they are committed to developing and disseminating information on the environmental benefits of concrete and concrete products.

cases, it may be necessary to channel water to a collection point, preferably a specially designed sump area.

While road salt is usually stored in igloo-type wood-frame domes, Kokomo, Indiana, is using a building with tilt-up concrete walls. The 120-ft by 48-ft open-front storage structure includes an 8-in.concrete floor and can accommodate up to 3,000 tons of salt.

Less Noise, Please

Once considered a luxury, sound walls now have become a standard element of expressway construction and capacity improvements in urban areas. And for good reason: highway noise pollutes.

Noise from highways can sabotage the quality of life in residential neighborhoods and drive down property values. It can contribute to sleepless nights, with accompanying loss of productivity and impaired driving.

Concrete—either of precast or tilt-up construction—is the best choice for noise barriers. Precast sound wall systems are environmentally safe and weather extremely well, reports the PCI. They can provide over 100 years of service with minimal maintenance and are readily available.

Concrete sound walls can feature highly textured surface mass to provide optimum sound abatement. They can simulate a variety of textures and a wide choice of other building materials—including stone, brick, or wood—in a variety of colors and textures.

With concrete sound walls, a sound-attenuating surface may be presented to the highway, while an aesthetically pleasing surface is presented to homeowners. And cleanup of graffiti is eased because it can be sprayed over with the same color stain as the original.

Concrete Enhances the Environment

Concrete enhances the environment in many other ways. Below-grade, controlled-environment precast concrete vaults in strategic locations protect the switching and control equipment for cellular telephone systems. Operating within these vaults, cellular telephone systems improve the business environment and boost public safety, while minimizing their intrusion in the built environment.

And above- and below-ground concrete tanks storing petroleum products provide leak-proof and fire-resistant options for state-of-the-art applications. Concrete makes it all possible, and that's why concrete is making a better environment for us all.