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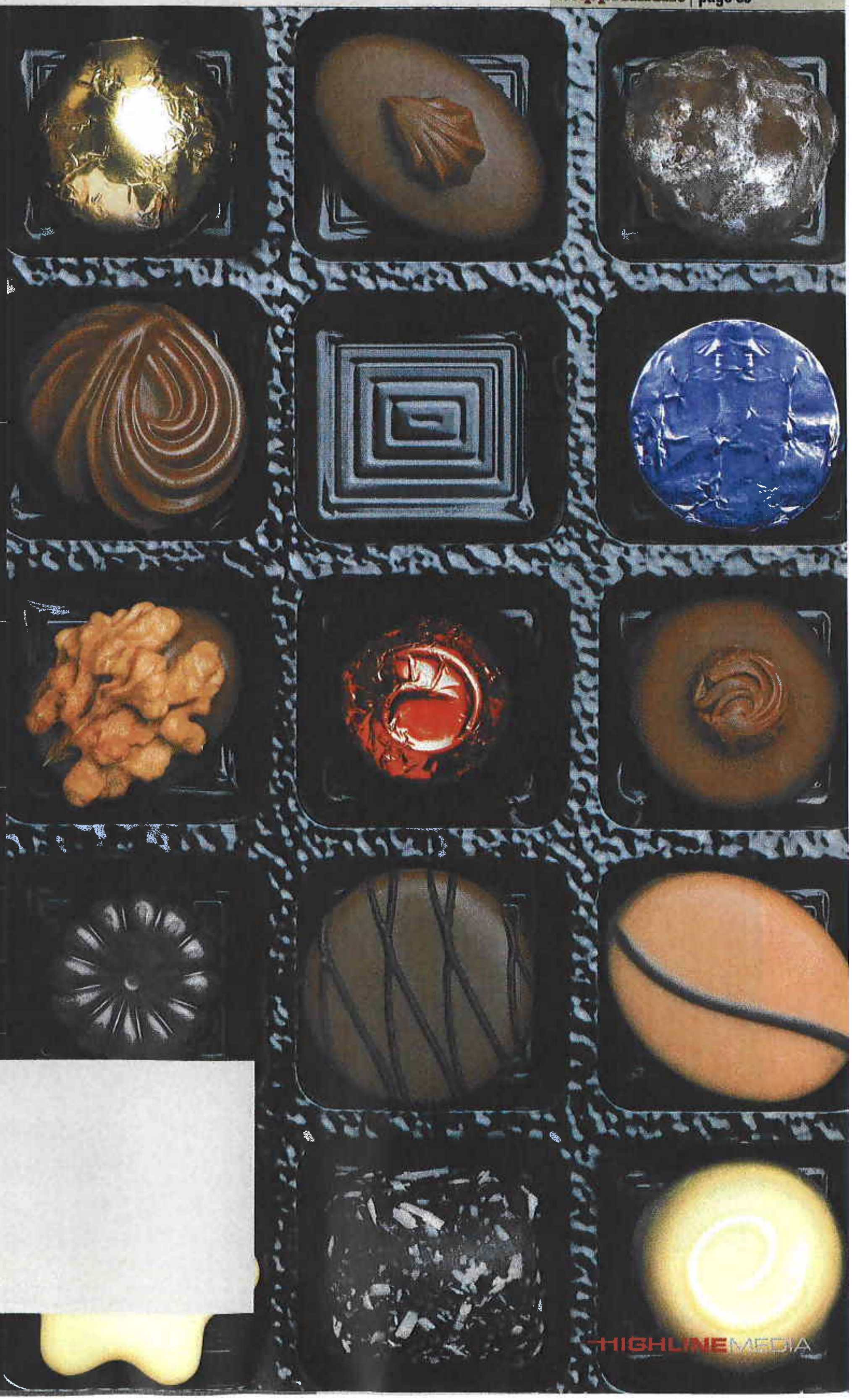

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BY DON HERRMANN, CIEC, CIAQP AND RALPH E. MOON, PH.D., CHMM, CIAQP |

All Backed Up

Tips and Techniques for Cleaning and Restoring Concrete

When comparing sudden and accidental water-loss events, sewage backups pose one of the most serious health concerns, and insurers should understand the potential liabilities associated with these losses, especially when concrete is involved. In particular, current sewage restoration practices, concrete's porosity, and whether current guidance for sewage restoration is sufficient to return the concrete surfaces to a pre-loss condition should be carefully considered.

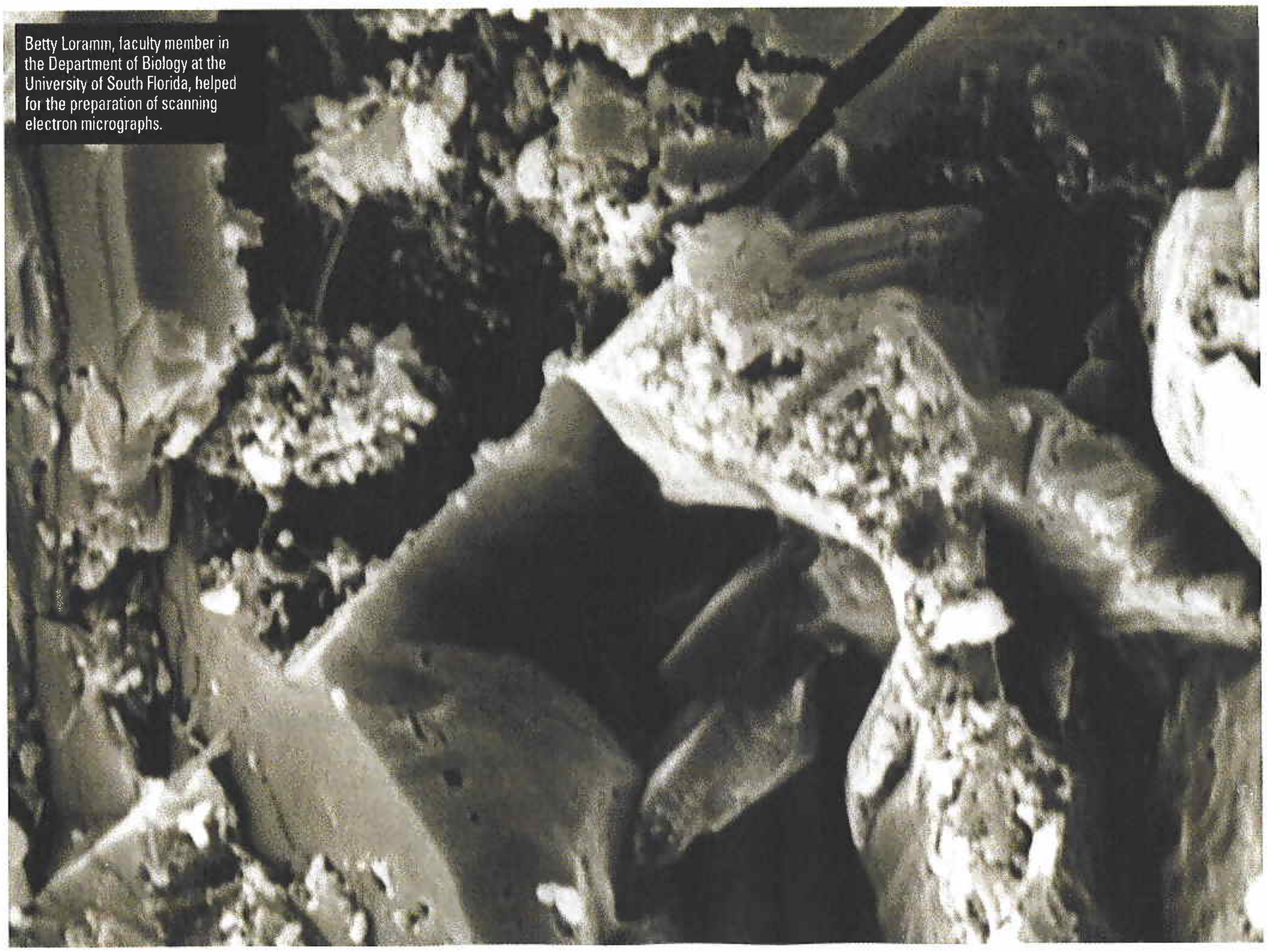
Policy language for water backups covers sudden and accidental losses from backups through sewers or drains or water overflows from devices intended to divert water from the foundation. To be a covered loss, however, the sewers, drains, and sump pumps must be located within the dwelling or on the resident's premises. This is the key question following a sewage loss. Backups that originate from the municipal waste treatment plant, lift stations, and sanitary sewer line maintenance located outside the property boundary typically are not covered events.

According to *U.S. News and World Reports* (June 2000), there are an estimated 400,000 sewer backups and 40,000 sanitary sewer overflows (SSO) that occur in the U.S. each year. Despite notable improvements made by municipalities, the frequency of sewage backups remains a serious problem.

When the different kinds of water-related claims are compared, a raw-sewage loss into a building evokes a visceral response that is unrivaled by water intrusion from flooding, plumbing, or roof leaks. Common sense and scientific fact support concerns that sewage contains a variety of toxic chemicals, human pathogens, pharmaceuticals, chemical pesticides, and organic debris that pose an acute threat to human health and the environment.

State of the Industry

The Institute of Inspection, Cleaning, and Restoration Certification (IICRC) S500 "Standard and Reference Guide for Professional Water Damage Restoration," received approval from the American National Standards Institute (ANSI). The standard was expanded, updated, and rewritten, revising water losses into categories and classes. The class of water was added to designate water damage by its relative degree of saturation



Betty Loramm, faculty member in the Department of Biology at the University of South Florida, helped for the preparation of scanning electron micrographs.

into a material and to help determine if special drying is required. Sewage backups are classified as Category 3, Class 4 water, which equates to water that is grossly contaminated and contains pathogenic, toxigenic, or other harmful agents that can reside in low permeance/porosity materials (concrete, lightweight concrete, and stone). The general restoration tasks described in ANSI/IICRC S500-2006 (S500) are intended to ensure that contents and building materials "do not become a source of biological contamination or add moisture to an already humid environment."

To prevent secondary sources of contamination, it is appropriate to clean first, dry second to prevent the spread of biological contaminants during the drying process. According to an article in the *Journal of Environmental Health* entitled, "Suggested Guidelines for Remediation of Damage from Sewage Backflow into Buildings," other considerations involved in assessing contaminated construction materials are "material porosity, degree of contamination, obvious potential effect on occupant heath and safety, feasibility of cleaning and disinfecting, and local, state, and federal licensing regulations."

Although concrete absorbs moisture, it is not physically damaged by water and is considered "cleanable." Once contaminated contents and sewage sludge are removed, current guidance recommends the decontamination of salvageable components be accomplished by flushing with water, pressure washing and drying, followed by the use of biocides or antimicrobials. IICRC S500 further states that "an independent indoor environmental professional should conduct required post-restoration or post-remediation verification testing."

Clean Up on Aisle Nine

The following task sequence should be considered when cleaning concrete surfaces contaminated with sewage.

- Remove all accumulated sludge and expose all concrete surfaces.
- Pressure wash, rinse, and extract to capture residual particles and free biological matter.
- Clean to remove surface debris from pores and cracks.
- Rinse and extract to remove detergents and capture suspended matter.
- Raise the temperature to approximately 140o F to desiccate biological organisms, conduct uniform drying, and extract excessive moisture to attain 3 lbs per 1000 ft2 or less.
- Once dry, consider the application of a vapor permeable coating to bind residual particulate debris and lessen inhalation risks.
- Test the performance of the cleaning method by obtaining swab samples for E. coli, total coliform, and fecal coliform from test locations that are hard to clean.

Microscopic Examination

One factor in measuring concrete's durability is its ability to transport dissolved chemicals. Porosity determines the rate at which water containing pathogenic organisms penetrates the concrete mass. As a result from past research on concrete porosity, we know that the water-to-cement ratio determines concrete's pore structure.

Concrete porosity includes small and large capillary pores. These capillary pores form networks that influence transport processes and are assumed to have a diameter limit ranging from 10 to 100 nm. The efficiency of capillary transport and size of the capillary diameter demonstrate how viruses and bacterial cells can penetrate the surface features and remain within the concrete.

To visualize concrete's surface appearance, researchers examined samples of varying compressive strengths using a scanning electron microscope and compared them to the size of disease-causing bacteria found in sewage. The micrographs under low magnification revealed the various openings, fractures and crevices.

The micrographs under high magnification show pores and cracks that range in size from five-to-10 microns. These openings provide bacterial niches that can remain hydrated for weeks or months, and illustrate the difficulty of "cleaning" bacteria from a concrete surface.

However, concrete surfaces generally pose a naturally unfavorable environment for bacterial growth. Growth and reproduction are optimal under conditions of modest temperatures (80 to 100°F) and a pH ranging between 6.5 and 7. Extremes of temperature, acidity (low pH), and alkalinity (high pH) effectively stop bacterial growth and serve as a disinfectant. A pH range of 10 to 11 is typical of cured concrete and pose conditions unfavorable for bacterial reproduction.

If the cleaning process does not remove organic debris completely, the organic residue can sustain bacteria and support growth. We believe that concrete surfaces that are not completely dried and are allowed to hydrate after restoration can produce acids that lower the pH and encourage bacterial growth and reproduction.

Get Down to Business

A literature survey conducted by the Hospitality Institute of Technology and Management in 2000 revealed two sanitary evaluations for cleaning concrete countertop surfaces. In the first study, six surfaces (laminate, wood, ceramic tile, concrete, stainless steel, and granite) were contaminated with *Escherichia coli* cultures, cleaned with a detergent solution, rinsed, and tested for the reduction in bacterial population. The surfaces were cleaned again using a solution of white household vinegar and tested for cleaning effectiveness. The study revealed that each material had a different "cleanability."

The second study, entitled "The Effects of Sealing and Cleaning on the Biocontamination of Natural Stone," tested the ability of restorers to clean sealed and unsealed natural stone surfaces. Sealed and unsealed samples of granite and limestone were treated with liquid and blood mixtures from chicken livers, beef tripe, grapefruit juice, expired whole milk, and Roquefort cheese. The samples were incubated in a warm humid environment for two days and samples were tested using a bioluminescence test. The rate of contaminant growth on the unsealed stone and granite was greater than the sealed samples. Further attempts to clean the unsealed stone or granite never achieved the efficacy of cleaning the sealed samples.

How Clean is "Clean?"

If the goal of restoration is to return the concrete surface to a pre-loss condition, how do you determine when the concrete is clean? The objective of cleaning and sanitizing surfaces is to remove the nutrients that bacteria need to grow, and to kill those bacteria that are present. The order of cleaning contacted surfaces is (1) rinse, (2) clean, (3) rinse, and (4) sanitize. According to the Portland Cement Association (PCA), "cleaning" is the removal of food using appropriate detergent chemicals under recommended conditions. "Sanitizing" refers to the reduction of microorganisms to levels considered safe from a public health perspective. The PCA recommends that initial concrete cleaning be done with chemicals, steam, and sometimes, solvents. Cleaning with hot water, trisodium phosphate (or commercial detergents), and steam successfully removes contaminants from the surface. This step is followed by a thorough rinse to remove chemical residues.

Concrete's inherent porosity and dampness makes it difficult to extract and disinfect microbes from impacted surfaces. Restoration efforts must attempt to remove all residual organic debris and implement methods that clean, sanitize, and then dry the concrete to 3lbs per 1000 ft². An independent indoor environmental professional should be retained to conduct post-restoration and post-remediation verification testing. ■

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