Session No. 678

Cleaning Sewage Contaminated Contents

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A Large and Complex Challenge for Safety and Restoration Professionals

As major flooding incidents have increased in the United States and around the world, appropriate safety and health precautions for dealing with flood-damaged materials have become paramount during environmental or safety risk assessments of impacted facilities. A major complicating factor is the fact that flood waters are often contaminated with sewage and animal wastes.

When examined properly, it quickly becomes clear that the problem is bigger than just the major floods that dominate the news. Some of the challenges of properly dealing with damaged building contents are present in just about every loss, as water damage is even part of fire loss situations. The cumulative effect is quite astounding from a monetary standpoint, with the latest available estimate of the annual cost of damaged contents in the U.S. from fire and floods at 2.7 billion dollars.[1] Nor does that represent the total cost. Unfortunately, getting an estimate of the cost of contents damaged from sewage backflows and trauma incidents is difficult because many of those losses are not covered by insurance. As State Farm insurance company bluntly states in their website factsheet entitled *Reduce sewer and drain losses in your basement:*

> Each year, sewer and drain backups cause millions of dollars in damage to the homes owned by State Farm policyholders. State Farm homeowner policies do not cover losses incurred from sewer or drain backup.

Cleaning of hard non-porous contents that are subjected to fire and smoke damage, flooding, sewage backflow, or blood borne pathogens is fairly straightforward. However, considerably more time and effort is expended on the cleaning of soft contents to the point where cash-out of such materials has become the norm for the industry. The difficulty in salvaging soft contents is related to:

- Concerns of the contractors about their ability to properly clean a wide variety of items.
- Hesitancy of safety and health professionals to document that the cleaning was conducted appropriately.
- Perception of the claimant that such items cannot be restored.
- Reluctance of insurance adjusters to undertake cleaning rather than cash-out if the insured is going to resist accepting the items.

Dealing with fire, flood, and sewage- or blood-contaminated contents raises a host of safety and health questions for safety professionals evaluating the situation, the contractors responding to the recommendations made by the investigators, and the occupants who must live with the consequences of decisions made in the field. Because of the wide variation in cleaning effectiveness of standard processes for such losses (such as on-site vacuuming and hot water extraction or off-site cleaning using standard laundry or dry cleaning techniques) it has been difficult for safety and health professionals to determine if such impacted contents have been properly cleaned without destructive testing or massive testing protocols. As such, the response to such losses has generally involved the cash-out of any soft goods or porous materials that are damaged in such cases. While this conservative approach protects the occupants, it is expensive and wasteful if a proven alternative is available.

Know Your Enemy

Sun Tzu, the great Chinese military strategists who wrote *The Art of War*, advised that the individual who "knows his enemy" is more successful in battle. This counsel is certainly applicable to the safety and health professional who manages safe and cost efficient content recovery services to clients following a fire or similar loss. In this case, the enemy is not human, but the odorous and hazardous residues that permeate valuable contents after they have been exposed to contamination.

While there are general similarities between handling contents that are contaminated by fire, flood, sewage, or trauma incidents there are important differences as well. For example, fire and smoke contaminants include soot, carbon particles, polynuclear aromatic hydrocarbons (PNAs), corrosives (such as nitric and hydrochloric acids), sulfur compounds, aldehydes, and vaporized metal residues. Many of these compounds combine to create the universally recognized smoke odors and discoloration that is so typical of fire-damaged materials. In contrast, sewage contaminants are primarily biological in nature. Nearly 100 different types of disease-causing viruses have been identified in sewage, including rotaviruses, the hepatitis A virus, and adenoviruses. Bacteria, the other main class of biological contamination found in sewage, also have a diverse representation in typical household waste water. Bacteria types such as *Escherichia coli* (often referred to as *E. coli*), S*almonella* (as many as 1,700 different types), and a variety of *Shigella* species are typically found in samples collected from sewage sources.

Floodwater contaminants are a veritable witch's brew of widely varying contaminants depending on the location and cause of the flooding. Extensive environmental studies conducted by the Federal Emergency Management Association (FEMA) to assess the impact of hurricane Katrina on New Orleans showed that most flood-damaged contents were contaminated with bacteria, mold, heavy metals, pesticides, and oil.[2] In contrast, trauma scene contaminants are more like the hazardous materials found in sewage since blood borne pathogens are primarily viruses (hepatitis strains, TB, HIV, etc.) and bacteria (coliforms, *Enterococcus*, etc.).

This extreme variety in contaminants, from objectionable but nonhazardous odors to life threatening viruses, is what makes dealing with contaminated contents so challenging. If we build on the idea that these contaminants are the enemy, then Sun Tzu's further advice to never underestimate your opponent can be valuable. Regardless of the type of loss or physical appearance of the materials, safety and health professionals should insist that restoration contractors have standardized procedures in place for properly dealing with contents, which protect the workers handling the objects as well as the valuables themselves. Treating all contents

from loss situations as if they are contaminated also means that the transport vehicles and the facility where the items are cleaned and processed are also protected.

An additional benefit to adopting a comprehensive process for contents that treats them as if they are contaminated is that it protects both the project investigator and the contractor if additional or different contaminants are discovered later. A well thought out content processing system protects all involved parties from hazards related to other types of contamination such as asbestos, bird droppings, illicit drugs like methamphetamines or cocaine, bed bugs or dust mites, lead, mold, and avian flu or Norwalk virus.

Traditional Industry Approaches to Soft Goods

As mentioned previously, cleaning of non-porous items is fairly straightforward. It is the soft goods that pose a greater challenge because contaminants can become infused throughout the entire item. The more layers that make up the porous item, or the bulkier the material, the more difficult cleaning and verification of the cleaning becomes. The ever increasing variety of fabrics and materials that are used for soft goods compounds the problems because certain cleaning techniques are only appropriate or effective for specific materials.

Nevertheless, there are a number of tried and true cleaning technologies and approaches to dealing with contaminated soft goods that have been verified through sampling by safety and health professionals. These approaches are primarily based on the type of loss. For example, in a fire loss a number of cleaning techniques are considered acceptable alternatives. Soft goods that are damaged by soot and smoke odors can often be cleaned by a combination of HEPA vacuuming, detergent washing, commercial laundering, dry cleaning, chemical deodorization, and oxidation through exposure to ozone gas or hydroxyl radicals. The current options for sewage-contaminated items, contents recovered from flooded structures, or those exposed to residue from trauma incidents is much less extensive with disposal and replacement being the current standard.

Fortunately there are some emerging technologies for dealing with contaminated contents. One technique that has been popularized by the mold remediation industry is a cleaning technique known as the HEPA sandwich. This process involves three steps with vacuuming being the first and last activity. In between, some form of wet cleaning such as damp-wiping, washing, or hot water extraction is utilized. While this HEPA sandwich approach has been used extensively for cleaning non-porous or semi-porous building surfaces, it has also been used successfully for a number of porous materials. For example, carpeting that is impacted by deposition of mold spores but is not supporting visible colonies of fungal growth has been efficiently cleaned by HEPA vacuuming before and after a professional hot water extraction of the floor covering. Thousands of pieces of upholstered furniture have also been successfully salvaged using this method.

Cleaning and treatment options from other industries are finding their way into the restoration field. Radiation in the form of ultraviolet light has been used in health care facilities for decades to assist in sterilization of equipment and surfaces. Although there are reports of some individuals trying to use ultraviolet light to decontaminate soft contents, its benefits are restricted to the surface of the objects, limiting its usefulness.

In a similar fashion, many chemical treatments are used to remove smoke odors, biological contamination, and staining. The multitude of formulations available to assist with this process can be bewildering as the chemical cleaning agent must be matched with both the material being cleaned and the contaminant. Dense or multilayered soft goods pose additional problems as the

chemical treatment must penetrate at least as far as the contaminants. This is more difficult than it may seem at first glance as contaminants carried on flood waters or through the heat action of a fire can work their way to the very depths of a pillow, cushion, teddy bear, boot, sleeping bag, or similar bulky item.

Since heat and water movement are two major players in carrying contaminants deep into soft goods many restoration professionals consider the combination of heat and water in the form of steam to be the perfect decontamination media. This has taken on greater interest since the development of specialized steam cleaning systems for hard surfaces such as restroom equipment and tile floors. However, two practical difficulties keep steam from being effective on soft goods. Since much of the heat energy of steam is dissipated on contact it takes considerable temperature or pressure to enable the steam to penetrate thoroughly into multi-layered items. And the consequence of high temperatures or pressure is the potential for damage to the surface of the article.

Power washing is frequently used to decontaminate non-porous contents such as lawn furniture, folding chairs, shelving units, hand tools, and the like, but the pressure and spray pattern of such systems generally produces too much destruction if directed at soft goods.

A New Approach Known as Specialized Laundry

The concept of specialized laundry systems to remove contaminants is only about a decade old. It is a rethinking of the standard agitator or tumble washing processes that characterize most top- or front-load washing machines. The primary innovation that led to the term *specialized laundry* was a washing system intended to clean sports equipment, known as the Esporta Wash System. This machine was designed to use hydraulic water pressure rather than agitation as the primary means of forcing cleaning solution through materials.

Once the inventors were able to get complete penetration of multilayered soft goods they needed to match the physical cleaning action of the water with neutral pH cleaners to preserve washed materials. Since much of the malodor associated with dirty sports equipment comes from bacterial contamination the Esporta system was engineered to force antimicrobial compounds through dense products like foam-padded hockey gear. As it turns out, this process produces an incredible kill rate for microbial contamination in many items, including those that are a mixture of hard and soft materials.

This claim is not simply sales hype from the manufacturer. The Esporta Wash System has been subjected to a number of independent tests to determine the cleaning effectiveness of the process. Multiple studies have demonstrated impressive effectiveness dealing with contaminated soft goods.[3] Matching these test results, which consistently show a near total kill rate of bacteria on washed items, with anecdotal data from the machine operators and their customers provides numerous lines of evidence that support the claim of removal of fire residue, odors, and other contaminants. The deep penetration of water and chemicals allows for the cleaning of otherwise un-washable items.

A review of the Esporta Wash System shows that both laboratory and real world tests have been conducted:

2004 – Laboratory test of antimicrobial properties of wash additive
2005 – Laboratory test of sports equipment
2005 – Laboratory test of firefighter gear

2006 – Field study of cleaning effectiveness on firefighter gear
2007 – Study of sewage-contaminated soft goods
2008 – Unpublished study of blood borne pathogens

Using the Sewage Study as an Example

While a number of rigorous tests have been conducted on the Esporta system and are available for public review, the author was personally involved in one of those efforts. Therefore, the 2007 testing of sewage-contaminated items[4] is used as a case study to demonstrate the potential of specialized laundry systems. The study involved testing a variety of contaminated fabric, leather, and padded soft goods before and after cleaning in the Esporta Wash System.

Carefully measured squares were cut through every layer of representative items before and after wash cycles and evaluated for concentrations of *Enterococcus*, total coliforms, and *E. coli* bacteria to determine the percentage of reduction in bacterial load. Those three specific bacteria types were chosen for analysis because they are the ones most commonly used to assess the presence of sewage contamination. Many industries use this combination of microbial types because they serve as indicators of the presence of pathogenic organisms that are found in human and animal waste.

Due to the expense of laboratory tests and the variation that occurs in the level of contamination from project to project, and even item to item, the study was also designed to determine if a simple quality control test could be completed by cleaning technicians to regularly validate the process. As such, field verification methods were tested on a side-by-side basis using a Hygiena SystemSURE II ATP hygiene monitoring system. This device uses special swabs to measure total biological residue using a non-destructive method that has been used for on-site quality assurance at foodservice and pharmaceutical manufacturing facilities for years.

The results of the study showed that under the machine's *extra heavy* wash settings, the Esporta Wash System is more than 98% effective (100% effective in most cases) at removing *E. coli*, enterococci, and coliform bacteria from a wide range of fabrics and padded items. Just as important, only one padded item showed any evidence of possible cross contamination during the various wash cycles tested for padded items and fabrics.

A strong correlation between laboratory data and the ATP sampling results was observed. Given that the few discrepancies identified between laboratory and field test results for fabric and padded items recorded false positives that would require recleaning, it was further concluded that ATP monitoring is an effective tool in field verification of the effectiveness of sewage contamination removal in items laundered with the Esporta Wash System.

Because the sewage study is just one of many studies produced by a variety of independent authors and labs that all reported consistent outcomes, we are in a position to take the case study and apply it to the big picture. If the proper use of specialized laundry systems results in a near total removal of a wide range of contaminants, then contents now being disposed of can be saved,[5] producing a win–win–win situation (*i.e.*, owner–insurance carrier–contractor).

Practical Implications Point toward a Process Approach

As noted at the beginning of this article, handling contaminated contents is a sizeable and complex challenge. While the extent of the potential market and prospective savings to the

industry make contaminated contents a challenge worth accepting, the complexity of dealing with thousands of disparate items and utilizing multiple cleaning procedures clearly indicates that a detailed process is necessary in order to successfully complete each job. However, implementing a process requires pre-project planning and appropriate training as well as the acquisition and set up of necessary equipment.

Understand and Manage the Process

With the advent of new equipment and processes for cleaning contaminated soft goods the safety and health professional is now in a position to offer fact-based advice following traumatic situations like floods, sewage backflows, and even fires. Still, overcoming obstacles while saving both dollars and valuable memories requires careful planning and adherence to rigorous standards during a post-decontamination evaluation.

From a project management standpoint safety and health professionals must ensure that project setup, equipment, personal protective equipment, and work practices all mesh together into an effective process that protects both workers and the recovered items. No amount of cost savings is worth a worker's short-term injury or long-term illness. Therefore, developing a detailed processing plan before a project begins is crucial.

Developing such a plan allows the safety and health professional to lay out detailed, measurable objectives for the project. Since there are currently no federal, state, or provincial mandates for evaluating the effectiveness of cleaned contents, communication of an objective endpoint to all involved parties is key to a successful outcome. In short, know your endpoint before you begin.

To ensure that all parties understand the goals of the project safety professionals should get written confirmation that the client agrees to the plan. Safety and health professionals should also work with restoration contractors to understand their capabilities so that as a team they can choose decontamination techniques that will achieve the objectives. In this way, the military adage "plan your work, work your plan" can be made a reality.

After using good judgment in a cooperative approach to selecting an appropriate cleaning process it is the responsibility of the safety and health professional to use both laboratory and field methods to verify the effectiveness of the work. Overall management of the project will allow an objective third party to document the entire process as well as the outcomes. With billions of dollars at stake and new technologies like the Esporta Wash System to assist with the cleaning of sewage-contaminated contents, safety and health professionals can take the lead in protecting individuals while helping to return a sense of normalcy to the lives of individuals traumatized by substantial losses. We can ask for no higher calling.

Endnotes

1. Cost estimates were compiled from two sources. Fire/smoke damage figures are from the 2005 NFPA estimate of direct damage from fires. 20% of the total for fire damage was assigned to contents for an estimate of approximately $2.0 billion. Water/flood damage estimates are from the 2003 U.S. National Weather Service report with 30% of the total estimate for loss assigned to contents (*i.e.*, $0.7 billion). Note that different years were used to compile the total since 2005 is the latest year for which NFPA estimates are available, but that was the year of hurricanes Katrina and Rita, which skewed the estimate of flood damaged contents substantially higher. As

such, 2003 figures for flood damage were matched with the 2005 fire damage figures to produce a cost average for a more “normal” year. The proportion of the damage estimates assigned to contents (*i.e.*, 20% for fires and 30% for floods) is based on discussions with a number of industry experts who concur that, in general, costs for structural damage as compared to contents are more extensive in fires than in floods.

2. See *Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report; Building Performance Observations, Recommendations, and Technical Guidance* released in July 2006 as FEMA publication #549 for details regarding the types and levels of contaminants identified in flooded houses.

3. For example, see *Evaluation of the Cleaning Effectiveness and Impact of Esporta and Industrial Cleaning Techniques On Firefighter Protective Clothing - Technical Report* by Jeffrey O. Stull of International Personnel Protection, Inc. published May 10, 2006.

4. *Evaluation of the Esporta Wash System for Cleaning Sewage-Contaminated Soft Goods* by Wonder Makers Environmental, Inc. in September 2007.