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DISASTER RECOVERY TODAY

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Disaster Recovery Consulting

Mold: A Formidable Foe, But FEMA Can Help

By Thomas Aloi and Sandy Heiss

Water can be a devastating force, especially in a natural disaster. Whether it enters a structure due to overland flooding or ocean storm surge, water infiltration can have ravaging effects on the structure, infrastructure and contents of a building. Following catastrophes like major floods and hurricanes, the initial devastation is obvious — from deposits of mud, silt and water-borne debris, to conspicuous waterlines and structural damage.

But often the less-noticeable damage presents a special challenge: mold and mildew (early-stage mold) begin to take hold within 24 to 48 hours.[1] After a disaster, power outages often lead to delays in the pumping and drying activities necessary to eradicate mold and mildew, and prevent regrowth. Humidity and heat become unwitting accomplices, with warmer temperatures — occurring

IN THIS ISSUE

Water. Nothing is more essential. Yet nothing can be more destructive.

We look at *two* of the ways that happens:

Disaster recovery consultants Tom Aloi and Sandy Heiss discuss the unseen danger lurking behind what first meets the eye: mold. They note some of the ways mold carries out its nasty work, but more importantly they review how the Federal Emergency Management Agency (FEMA) can help.

Damages from salt water inundation can be even worse. Since salt reacts chemically with many surfaces, the damages go beyond structural to involve electrical and mechanical systems intrinsic not only to the operations of an organization, but to its safety and security. Chemical engineer Sal DePrisco details specific damages that can take place and presents a strategy for addressing them. (Page 7)

naturally in tropical climates or artificially through HVAC systems — accelerating the growth of these opportunistic fungi in organic materials like wood, carpeting, drywall, ceiling tiles, cardboard, and decaying vegetative material.

The Unseen Can Be Worse

If mold is clearly present on surfaces, like walls and ceilings, more — possibly much more — usually does lurk in other unseen areas. Mold spreads via spores — microscopic seeds transported through the air — infiltrating vents, seams, pores and crevices in a structure. Outward signs of mold are indications that a more thorough assessment is required. Air ducts and filters must be thoroughly investigated, and walls must be opened to inspect interior components like framing and insulation. Mechanical, electrical and plumbing fixtures must also be carefully examined.

Along with compromising the integrity of a building and its contents, mold growth is also well known for presenting potentially serious health risks, especially to those who suffer from asthma or other respiratory ailments.

When and How FEMA Helps

If mold proliferation is the result of a presidentially declared disaster qualifying for FEMA funds, certain costs associated with proper remediation and repair may be eligible for reimbursement under the FEMA Public Assistance (PA) Program. Funding can be provided to support either emergency remediation measures or permanent repairs.

Once excessive mold is observed in a disaster-damaged building, costs associated with mold sampling — before and after remediation — may also be eligible for FEMA funding. If clear evidence of mold exists, sampling may not be necessary to confirm contamination. (However, per FEMA policy, if sampling does not substantiate a mold threat, the costs associated with the testing are not reimbursable.)

If mold contamination is substantiated, the following remediation activities can be funded as an emergency protective measure to reduce the risks associated with mold and mildew exposure:

- Wet vacuuming, damp wiping or HEPA vacuuming of interior spaces;

(Main article continues on page 4)

MOLD REMEDIATION*

DETERMINING ELIGIBILITY OF MOLD REMEDIATION COSTS

- The cost of mold sampling, both pre-and post-remediation, may be eligible for reimbursement, provided there is evidence prior to remediation to indicate the existence of disaster-related mold.

- The cost of mold sampling which reveals no presence of disaster-related mold is not eligible for reimbursement.

- Costs to perform eligible remediation — either through force account or a contractor — may be eligible for reimbursement. Contractor costs are subject to the contract procurement requirements in 44 CFR 13.36.

- The following remediation activities may be eligible under Category B:

  > Wet vacuuming, damp wiping or HEPA vacuuming of the interior space.
  > Removal of contaminated gypsum board, plaster (or similar wall finishes), carpet or floor finishes, and ceilings or permanent light fixtures.
  > Cleaning of contaminated heating and ventilation (including ductwork), plumbing, and air conditioning systems, or other mechanical equipment.

- If an applicant fails to take reasonable measures to prevent the spread of mold contamination to a facility, the rehabilitation and repair of the additional contaminated area will not be eligible for federal assistance.

- If an applicant can document and justify why reasonable measures were not taken to prevent further contamination to a facility from mold, or why reasonable measures taken were insufficient to prevent further damage, remediation activities may be eligible for reimbursement. Examples of extenuating circumstances may include:

  > Disruption of power.
  > Facility remained underwater.
  > Inability to access the facility due to the disaster; i.e., debris blocking access routes and facility.
  > Facility HVAC equipment damaged due to the disaster.
  > Insufficient resources to remediate the entire facility.

IDENTIFICATION

- Mold contamination or associated damages, identified by the applicant, must be a direct result of the disaster. Situations that are not obvious will require a closer examination, usually with the assistance of an Industrial Hygienist.

- It is the responsibility of the applicant to show evidence of mold contamination or damage during the inspection. Sampling may not be necessary; however, applicants may choose to conduct pre- or post-sampling by an experienced professional to ensure proper or adequate remediation.

- The applicant may provide an Industrial Hygienist's report to support its request for assistance.

REMEDIATION

- The method of remediation will depend on the types of material that are damaged and the extent of damage. Accordingly, applicants may employ a variety of mold cleanup methods to remediate mold damage, as appropriate to the characteristics of the situation.

**Taken from FEMA Recovery Division Fact Sheet 9580.100, November 7, 2006*

(Main article continued)

- Removal of contaminated wallboard, plaster or other wall finishes, flooring, ceilings and permanent lighting fixtures;

- Cleaning contaminated HVAC systems, vents and ductwork, plumbing and other mechanical equipment.

Small areas of mold (less than 10 square feet) can be remediated by following universal guidelines. These guidelines are widely available from organizations like FEMA, the Environmental Protection Agency, and the Centers for Disease Control.

Under the FEMA PA Program, if reasonable measures are not taken to prevent the spread of mold, the remediation of newly contaminated areas will not typically be eligible for reimbursement. However, exceptions can be granted if extenuating circumstances interfere with timely remediation measures.

"Along with compromising the integrity of a building and its contents, mold growth is also well known for presenting potentially serious health risks. ..."

FEMA policy notes that extenuating circumstances include situations involving disruption of power, lack of facility access or prolonged flooding. Lack of resources, both financial and human, is another circumstance that might prevent timely remediation activities.

Larger areas, however, require cleanup according to standards set forth by the Occupational Safety and Health Administration (OSHA). Many communities and agencies in the throes of disaster response and recovery opt to contract the work to companies that specialize in remediation. These companies are equipped with the knowledge, proper gear and trained staff to complete the remediation according to OSHA standards. An important note: even in cases of emergency mold remediation, FEMA policy requires that contracts are properly procured.

Removing moldy contents and structural components can also be funded as a permanent repair under the FEMA Public Assistance Program. "Gutting" flooded buildings and properly disposing of wet flooring, walls, ceilings and other interior structures not only removes soaked areas where mold can flourish, but these activities also prepare the building for reconstruction. Even if the tear-out is performed by a remediation contractor, the work can still be funded as a permanent repair because it will ultimately help restore the building to its pre-disaster function.

Friend or Foe: Knowing the Difference

In the disaster recovery industry, mold is often cast in negative light. That's understandable, since much effort and expense is employed to eliminate mold and mildew after a flood event. There are thousands of species of mold — it is literally everywhere — indoors and out. It can never be fully eliminated — nor would that be ideal. While an overabundance inside homes, schools and other buildings is cause for concern, it is important to note that mold plays an important role in our environment. Recalling those early science classes, penicillin, one of the most important discoveries of modern medicine, began as a hapless mold spore that drifted into a petri dish of unsuspecting staphylococcus.

The key is to understand when mold presents a threat. While there are currently no established guidelines to indicate what amounts are considered harmful, it is generally accepted that the presence of excessive mold inside a building presents serious health risks and, if left unchecked, adds significantly to repair costs. By appropriately managing these costs and adhering to well-documented guidelines of the FEMA Public Assistance Program, mold contamination after a declared disaster can be remediated and repaired in eligible facilities with FEMA Public Assistance funding.

MOLD REMEDIATION METHODS*

METHOD	APPLICATION
Wet Vacuum	• Use when materials are wet • Use where water has accumulated, such as on floors, carpets and hard surfaces • Do not use when sufficient liquid is not present
Damp Wipe	• Wipe or scrub non-porous (hard) surfaces with water and detergent • Follow instructions listed on the product label
High Efficiency Particulate (HEPA) Vacuum	• Final clean-up after thoroughly dry, and contaminated materials are removed • Recommended for cleanup of dust outside of the remediation area • Properly seal HEPA filter • Personal protection equipment (PPE) is highly recommended; filter and contents must be disposed of in well-sealed bags
Discard	• Building materials and furnishings that cannot be remediated • Seal contents in two bags using 6-mil polyethylene sheeting • Large items may be covered in polyethylene sheeting and sealed with duct tape • Sealing materials must be within containment area to limit further contamination

Summarized from Indoor Environments Division (IED) of the U.S. Environmental Protection Agency, "Mold Remediation in Schools and Commercial Buildings."

**Taken from FEMA Recovery Division Fact Sheet 9580.100, November 7, 2006*

APPLICATION OF REMEDIATION METHODS*

WATER DAMAGED MATERIAL	ACTION
Books and paper	• Non-valuable items, discard • Valuable/Important, photocopy and discard originals • Invaluable items, freeze in frost-free freezer, meat locker or freeze dry
Carpet and backing	• Wet vacuum • Reduce ambient humidity levels with dehumidifier • Accelerate drying process with fans
Ceiling tiles	• Discard and replace
Cellulose insulation	• Discard and replace
Concrete or cinder block surfaces	• Wet vacuum • Accelerate drying process with dehumidifiers, fans and/or heaters
Fiberglass insulation	• Discard and replace
Hard surfaces, porous floorings (linoleum, ceramic tile, vinyl)	• Vacuum or damp wipe with water and mild detergent • Scrubbing may be necessary • Allow to dry
Upholstered furniture	• Wet vacuum • Accelerate drying process with dehumidifiers, fans and/or heaters
Wallboard (drywall and gypsum board)	• If obvious swelling and seams are not intact — discard • If no obvious swelling and seams are intact, may be dried in place • Ventilate wall cavity
Window drapes	• Launder or clean according to manufacturer's instructions
Wood surfaces	• Remove water with wet vacuum • Accelerate drying process with dehumidifiers, fans and/or heaters • Treated or finished wood, damp wipe • Wet paneling, discard and ventilate wall cavity

Summarized from Indoor Environments Division (IED) of the U.S. Environmental Protection Agency, "Mold Remediation in Schools and Commercial Buildings."

OTHER ITEM OF NOTE: Do not use fans before determining that the water is clean and sanitary. Consult an experienced professional if you and/or your remediators lack expertise in contaminated water situations.

Taken from FEMA Recovery Division Fact Sheet 9580.100, November 7, 2006

"... even in cases of emergency mold remediation, FEMA policy requires that contracts are properly procured."

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[1] *A Brief Guide to Mold, Moisture, and Your Home.* United States Environmental Protection Agency, September 2010. EPA.gov

ABOUT THE AUTHORS

Thomas Aloi

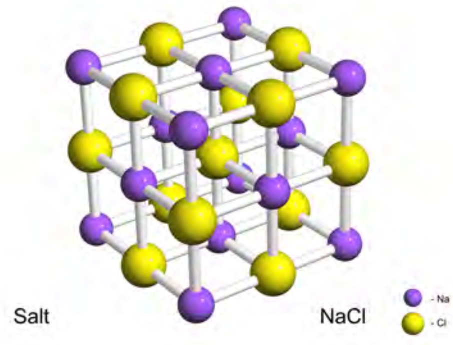
Thomas Aloi has significant Public Assistance and leadership expertise in hazard mitigation, alternative procedures, alternate projects, disaster planning, project worksheet formulation, cost estimating and project management. He supervised FEMA Public Assistance reimbursement processes for long-term recovery of Hurricane Sandy applications in Nassau and Suffolk Counties on Long Island.

Sandy Heiss, PMP

Sandra Heiss, PMP, served as a consultant for Adjusters International, assisting the State of New York with disaster recovery efforts from Hurricane Sandy. A certified Project Management Professional since 2004, she holds bachelor's and master's degrees from the University of Memphis.

Saltwater Inundation: Beware of the Hidden Damage

By Sal DePrisco



The following article is based on the efforts of a nine-month program to inspect, benchmark and provide advisory services in and around the flooded infrastructure of a major city where more than 237,000 inspection points were made and more than 18,000 photos were taken.

When we think of flooding — whether a minor event or a major disaster — most thoughts are directed to the obvious impact of water saturating and immersing the affected areas. Other than dealing with the catastrophic result of washed-away infrastructure, attention is usually focused on the draining, drying and disinfecting of all systems and components, small and large, in attempts to salvage and get things back to normal.

In many cases, the measure of "how long" something has been exposed to flood waters is a main factor in determining the remediation effort needed. In the case of saltwater inundation, however, this factor has little meaning. The most significant effect of saltwater flooding is not saturation, immersion or resulting organic growth, rather, it is the deposition of salt on vulnerable surfaces.

Chloride, sulfide and nitride ions of salt dissolved in sea water create chemical bonds with many surfaces. These bonds happen immediately upon wetting — resulting in a salt residue remaining long after the water is gone. One second of exposure to salt water can have the same effect as an exposure lasting an hour, a day, a week or even a month.

The residue, at a microscopic level, cannot be removed with simple rinsing or routine brushing. It requires extraordinary force or chemical neutralization. If neither is done, and the salt residue remains, the potential for latent damage will exist. Over a period of weeks, months or even years, the salt left behind will continue to corrode any susceptible, affected surface. The corrosion process will continue until the salt residue is exhausted or the corroded surface is consumed.

CHEMICAL COMPATIBILITY RESULTS*

Chemical Selected: Sea Water

MATERIAL	COMPATIBILITY
Brass	D-Severe Effect
Carbon Steel	D-Severe Effect
Cast iron	D-Severe Effect
Polyurethane	D-Severe Effect
Stainless Steel-304	C-Fair
Stainless Steel-316	C-Fair

*Cole Parmer Corporation, *Chemical Compatibility Database* http://www.coleparmer.com/Chemical-Resistance (09-Jan-2013)

Potential Effects on Components

Electrical

The brass-, copper- and iron-based surfaces of typical electrical components are easily attacked by salt water. Corrosion starts almost immediately and continues until all salt ions are removed. The challenge with most affected devices is being able to remove the salt residue from all of the places the salt water has reached.

Termination points, wire ends and contact surfaces are highly susceptible to damage. Draining and drying alone will not suffice, and the cost to properly remediate salt residue down to acceptable levels can be prohibitive. Inadequate techniques leading to unsuccessful attempts to remove the salt can leave the component vulnerable to continued damage. (Fig. 1)

Electronics

Electronic devices have the same susceptibility to saltwater corrosion as electrical devices, but with the added concern for lamination degradation. The coatings on many types of printed circuit boards, motor windings and transformer ballasts are attacked by the residual salt. In the presence of condensing water vapor, the remaining salt residue can provide enough of an electrical pathway to cause a short circuit. In the case of the ballasts, a short circuit can occur without the presence of condensation if the lamination of adjacent, closely wound wires deteriorates from the salt.

Fig. 1 — Circuit breakers corrode after salt water submersion.

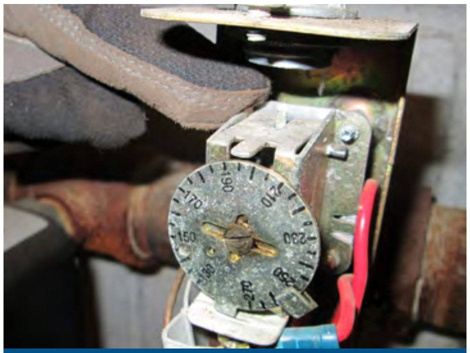


Fig. 2 — This boiler over-temperature safety switch is corroded in place. It will not activate when needed, compromising safety.

Fig. 3 — Salt residue at a conduit coupling indicates that salt water was present within the conduit.

Electro-Mechanical

The effects of salt water on electro-mechanical devices not only include all of the same ill effects as with electrical devices, but also the likely fouling of non-electrical mechanisms. The result is a device that has several possible failure modes, including the loss of mechanical integrity due to corrosion. In Fig. 2, the boiler over-temperature safety switch has been corroded in place. The switch cannot activate — and in turn the safety system it serves is disabled. Small devices like this can easily get overlooked in a post-disaster review of damaged infrastructure.

Conduits and Conductors

Galvanized conduits inundated with salt water will accumulate salt deposits and start to rust as soon as they are affected — resulting in roughened interior surfaces that make replacement of related electrical conductors difficult, if not impossible. Additionally, the nylon slip sheet found on many wires can be very susceptible to salt water at typical elevated operating temperatures. The result is a sheath that peels off, adding to the difficulty of removing the conductor. Unused conduits inundated with salt water may provide such a roughened surface that the slip sheaths and insulation sheaths of any new wires can be damaged during their installation.

"The most significant effect of saltwater flooding is not saturation, immersion or resulting organic growth, rather, it is the deposition of salt on vulnerable surfaces."

With most electrical conductors, the insulation sheath can act as a pipe to channel water down the length of wire strands contained within the sheath. The extent of this channeling is based on the amount of wire under water and the hydrostatic pressure the floodwater exerts on the wire. In most cases, if the terminated end of a conductor was under water, any length of wire associated with it that was also underwater will be affected.

The salt water and salt residue on the wire can be conductive enough to expose flaws and weaknesses in the insulation sheath of the wire. Although most sheath

Fig. 4 — This termination point, cleaned twice, continues to corrode due to salt water wicking from the associated conductor.

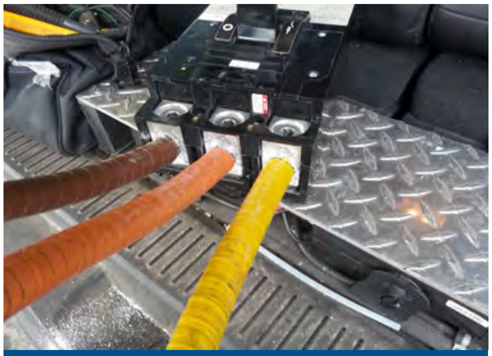


Fig. 5 — The terminals of a newly installed breaker corrode due to saltwater wicking from the existing conductors. The salt water wicked up from the wires terminated at the bottom of the breaker.

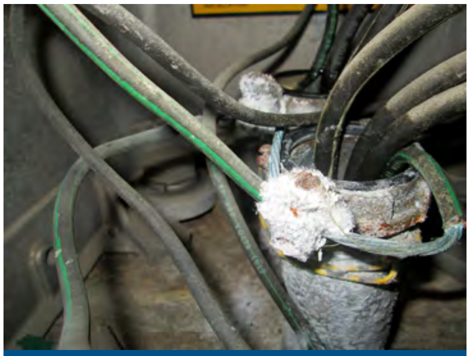


Fig. 6 — Salt residue engulfs a conduit bonding clamp. Corrosion will continue until the salt or clamp is consumed.

materials are completely unaffected by salt water, any cracks, scrapes or other imperfections in a sheath can expose the wire to salt, resulting in a short circuit between conductors or from a conductor to a metallic conduit. Additionally, over a long period of time, the corrosive effects can consume enough of the conductor to affect current capacity and in turn, safety. This is especially prevalent in un-sheathed ground conductors.

Finally, conductors that have been submerged will continually "wick" moisture and salts for months or even years after initial draining. The wicking can occur horizontally or vertically — including upward — and is very insidious. The consequence of this wicking is salt deposition on any component connected to the affected conductor. The resulting salt causes unexpected corrosion on newly replaced components connected to the existing, inundated conductors. (Figs. 4, 5)

Grounding and Bonding Components

Grounding and bonding components can be a forgotten subset of electrical conduits and conductors. These critical National Electric Code (NEC)-required safety system components are frequently overlooked because few expect them to carry current. It is only in the event of a failure that these associated grounding and bonding safety systems are utilized.

Unfortunately, this can also be the time when these components are first discovered to be compromised by the effects of salt water. Physical damage from the flowing waters, and incremental corrosion of critical components, can reduce the capacity or completely defeat the ability of the systems to route dangerous current away from personnel — as well as prevent fire from a short circuit.

Like other conductors, ground and bond wires can be attacked by salt water flowing between wire strands. Grounding busbar, terminal strips and metallic conduit, as well as associate clamps and fasteners, can also be compromised — all affecting system functionality and safety. (Fig. 6)

Fire Suppression and Water Supply Equipment

Components of fire suppression and water systems are as susceptible to the damaging effects of salt water flooding

Fig. 7 — Section of ductwork that had been submerged in sea water during Hurricane Sandy. If the surface is not improved, additional drag from the roughened surface will affect system energy consumption.

Fig. 8 — Corrosion on the fasteners of this heat exchanger head may make removal difficult.

Fig. 9 — Corrosion-induced scaling of this rebar may prevent proper concrete adhesion unless properly cleaned.

Fig. 10 — Rust comes from one of the trunion wheel bearings of this gantry crane above. There was no sign of corrosion prior to the salt water inundation from Hurricane Sandy.

as any other devices. Usually considered "water-proof" due to the prevalent use of brass materials, many of these critical components go uninspected following a salt water event — only found to be compromised when they are activated.

Brass is severely affected by the salt ions dissolved in sea water. Brass affected by salt can lessen the usefulness of devices such as standpipe or fire hose bib valves following its first exposure to salt water. The failure mode usually involves corrosion between the brass valve stem and brass valve stem guides. Also affected, and usually overlooked, are the associated limit switches used to sense when the valves are actuated.

Ductwork

Any ferrous-based ductwork that takes on salt water is susceptible to corrosion and subsequent failure. Prevalent galvanized ductwork easily corrodes in the presence of salt water. When the inside of the ductwork is affected, corrosion may only be noticed after it has advanced to the point of corroding surfaces from the inside out. Whether or not ductwork surfaces are actually breached, the resulting roughened surfaces of the affected interior areas may create additional drag on airflow when in use, seriously affecting the system's energy consumption. (Fig. 7)

Mechanical and Process Equipment

Mobile and stationary mechanical equipment can trap salt water in critical locations without being noticed by maintenance personnel. The consequences can range from rusted fasteners to oxidized process equipment — causing operating inefficiencies — and on through to damaged load-bearing devices, which can halt equipment operation. Salt residue allowed to remain on threaded fittings can result in plumbing leaks as well. (Figs. 8, 10)

Structural

Salt water inundation of structural infrastructure components can create latent issues that manifest themselves years later. Salt ions forced into the cracks of concrete can attack both the reinforcement steel as well as the concrete itself. Both can lead to an incremental decrease in strength, spalling, carbonation of the concrete, and cracking. In addition, the scaling of exposed rebar as a result of contact with salt water, will reduce the grip of newly poured surrounding concrete unless the scale is sufficiently removed. (Fig. 9)

Salt water can also attack polyurethane sealants and mastic adhesives, causing either to lose effectiveness. In the case of urethane sealants, elasticity is reduced. In the case of mastics, adhesion strength is reduced.

Be Vigilant, Specific and Detailed!

Salt water flooding, whether from a minor occurrence or a major disaster, can have significant, long-term effects on virtually everything the flood waters reach. The duration of the flooding has little relevance on the extent of the far-reaching damage to be expected.

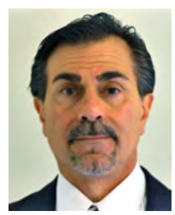
"Salt water flooding, whether from a minor occurrence or a major disaster, can have significant, long-term effects on virtually everything the flood waters reach. The duration of the flooding has little relevance on the extent of the far-reaching damage to be expected."

Because draining, drying and disinfecting will not themselves prevent the insidious damage from the corrosive effects of salt residue left behind, it is imperative that a highly detailed inspection be performed of all affected assets. Many systems and components — which might be ignored with fresh water flooding — need to be inspected and remediated to reduce salt ions down to acceptable levels. If not addressed, serious damage that might be avoidable can result.

More importantly, critical safety systems involving fire suppression, process control or electrical grounding/bonding, may be found compromised at the least opportune time.

Following any salt water inundation, it is essential to conduct a vigilant, specific and detailed inspection and benchmarking program for all affected areas — resulting in a targeted, well-documented salt remediation program.

ABOUT THE AUTHOR



Sal DePrisco

Sal DePrisco has served as a Disaster Recovery Consultant for Adjusters International. He designed and managed a highly successful "Salt Water Inundation, Latent Damage, Inspection, Benchmarking & Advisory Services Program" for the Port Authority of New York & New Jersey following Hurricane Sandy. He holds a bachelor's degree in chemical engineering from Polytechnic Institute of New York. He is presently the Vice President of Sensible Technical Solutions.

Adjusters International

CORPORATE OFFICE
126 Business Park Drive
Utica, New York 13502
800.382.2468
Outside U.S. (315) 797.3035
FAX: (315) 272.2054

Editor@Disaster RecoveryToday.com

WEB ADDRESSES
AdjustersInternational.com
DisasterRecoveryToday.com

PUBLISHER
Ronald A. Cuccaro, SPPA

EDITOR
Sheila E. Salvatore

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