INTEK Decon Solutions: An Aqueous Based Chemical Decontamination Process

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ABSTRACT

The planned construction of new nuclear power plants and fuel storage facilities and the decommissioning of nuclear weapons facilities have created a need for safer, more efficient decontamination processes. Chelant based chemical compounds present an attractive alternate to traditional means of decontamination such as acid cleaning, sandblasting, and other physical methods. There is now available a family of polydentate chelant chemical compounds, designated INTEK Decon Solutions, that is aqueous based and operates at a neutral pH that can be sprayed on and washed off with water. A major advantage of this process is that it minimizes waste volume and makes the waste easier to handle. This process has been demonstrated to produce very effective decontamination in a wide variety of situations. This paper will review the procedures used for three specific applications in projects undertaken for the DOE and industry.

INTRODUCTION

It appears that there may be a resurgence of nuclear power plant construction to meet the growing demand for electricity in both the industrialized and emerging nations of the world. To insure public acceptance of a new generation of nuclear facilities we must first show that we can clean up the decommissioned sites, unused nuclear facilities, and closed weapons plants. The US, UK, Japan, and other countries are now engaged in intensive efforts to decommission these facilities and restore the land to its original condition. This has created a demand for new and better ways of decontaminating material, equipment, and buildings. Traditional means of decon using acids, sandblasting, scraping, high pressure water, and steam often resulted in high volumes of nuclear and toxic waste and rarely achieve 100% free release. An alternate chemical decontamination process, "INTEK Decon Solutions," encompasses a family of chemical compounds based on a proprietary molecular chelant that operates at neutral pH, thereby minimizing corrosion to underlying base metals and other construction materials, in addition to increasing worker safety. Also, the used chelants are destroyed to less than 0.1% by weight through chemical oxidation and are not part of the waste thereby keeping the volume of waste to be disposed of to a minimum. Decon Solutions can be formulated to work effectively on loosely positioned (ND-600) or fixed radioactivity (ND-75). Special formulations for use with radioactive contaminated lead (ND-207) are also available. This process has been successfully applied in a number of demonstration tests in decontaminating hot cells and glove boxes, manipulator arms, tools and miscellaneous equipment, and power plant turbine rotors and steam generators. The procedures used and the results obtained in three selected projects conducted at DOE and industry facilities are described below.

Decontamination of Large Metal Objects

An example of decontaminating a large metal object involved the disposal of 2 turbine rotors from a BWR at the Peach Bottom Station (1), with a fixed contamination activity level of 2 mR/hr and a loose surface contamination level of greater than 400 dpm/100cm3.. A preliminary study was made of all the alternative decontamination methods and compared to radioactive transportation and burial of the cut up pieces. Sand blasting was ruled out since the sand could not penetrate equalizing holes and crevices and rotor divider spacers, and would generate large volumes of radwaste and airborne particles. Also, the sand could drive contaminated particles further into the surface of the rotor.

A chemical chelant was selected to decontaminate the rotor, and a special process was devised for application. Rotors were wrapped in plastic and transported to a special area designated for this process. The rotor was placed on a stand over a catch basin. The chemical solution was added to a collection tank, pumped through four flushing wands (or spraying wands) over the rotor, and then channeled from the catch basin back to the collection tank, where it was reheated, filtered and reused through the flushing wands. During the flushing period the rotor was rotated to insure even distribution of the solution. This process was repeated for about 16 hours until the rotor was determined to be decontaminated, it was then cut into wedges weighing 4-5 tons each, and sold as scrap metal. A radiological survey did not find any areas threat exceeded free release criteria.

The project resulted in significant savings to the utility. Not only was a potentially dangerous radio active waste problem avoided, but the utility, Pennsylvania Power and Light, was able to sell the material as scrap. This was not an insignificant consideration since the rotors were 33 feet long and weighed 130 tons each. A little more than 100 gallons of the chemical was used and the waste solution was treated with a special oxidizing agent that completely destroyed all chelants. Approximately $0.1m^3$ of resulting sludge was solidified with cement resulting in 99% less waste than generated by conventional waste disposal methods. Of equal importance, the entire process was safely carried out with minimal precautions and samplings indicated there was no airborne radioactivity inside or outside the tent. This process resulted in significant savings to the utility and provided recycling of valuable materials.

Decontamination of Large Surface Areas

An additional example of the flexibility of INTEK's decontamination chemicals was the successful decontamination of three hot cells at Oak Ridge National Laboratory. Lockheed Martin Energy Systems (LMES) operators of ORNL at that time contracted with MELE Associates to provide decontamination services for 6 hot cells at the Radioactive Materials Analytical Laboratory (RMAL) Building 2026 at ORNL. MELE carried out this work using one of INTEK's decon solutions (which at the time was marketed under the name Corpex) and achieved significant reductions in dose rates and transferable contaminants as well as person REM exposure without any damage done to the facility or its contents.

The RMAL receives stores, assays, and ships radioactive materials, some of which is highly radioactive and arrives in shielded casks where it is unloaded and examined remotely. As a result of long-term operations, contaminates accumulate on walls, floors, and ceilings presenting a safety exposure problem. It was decided to decon the entire cell block, which consisted of 6 cells, 6 feet x 7 feet x 11 feet, made of standard concrete with walls 4 ½ feet thick painted with epoxy paint. Each cell was equipped with manipulators, normal utility service water, inert gas compressed air, and electric connections. Application of one of INTEK's decon solutions was done remotely using specialized equipment developed by MELE, which was first tested on a mock-up of the hot cell using plain water to develop a spray pattern and confirm the integrity of the system to ensure there was no leakage.

Prior to application, a chemical-resistant sealant was used to seal openings and a plug inserted in the floor drain. The cells were sprayed alternately with the INTEK solution and de-ionized water and collected in a common drain, and returned to the pumping equipment for reuse. All decon solution and rinse water used on the decontamination of the cells and the chain conveyor system was collected and destroyed in accordance with approved destruction methods, and ultimately discharged into the ORNL low level waste drainage system. The liquid waste was then pumped to an onsite evaporator for volume reduction. This resulted in a significant reduction (78%) in post contamination waste volume.

Because the chemical was applied with a low pressure spray, there was very little damage to the cell walls and ceilings, and very little waste was produced from gaskets and seals worn away by corrosion and water spray. There were some problems with the fasteners on the lighting fixtures that required special treatment. The operation of certain working parts, like the airlock doors, was improved after the thorough cleaning. In summary, the process administered by MELE using an INTEK decon solution was very effective and completely removed the radioactive contaminants, safely decontaminating the cells, at minimum cost to the operator.

Decontamination of Lead Products

The third example of the versatility of INTEK's decon solutions has been demonstrated in a project conducted by the Energy Technology Engineering Center of Rockwell Aerospace for the DOE on the decontamination of lead. In this instance lead was identified as a material excluded from regulation as a solid waste and could be decontaminated and recycled provided it met free release criteria. Approximately 230,000 pounds of lead consisting of sheet, shot, brick, and wool, some of which was encapsulated in shielding doors and plugs, was contaminated during various DOE programs. The usual methods of decon were sand blasting, ice blasting, and treatment with acids, all of which were intrusive procedures that not only damaged the lead surfaces but created mixed waste and difficult residues to handle. While ice blasting was effective for steel surfaces of encapsulated lead items, chemical decon using the INTEK solution was considered the best method for exposed lead surfaces. A single vendor, Hake Associates, proposed a combination of ice blast treatment and chemical application. An INTEK decon solution, specially formulated to for lead applications, was used in a two-phase program. Phase one was a pilot program for 1,700 pounds of lead decontaminated by both ice and chemical process and then the remaining 228,300 pounds was decontaminated. It should be noted that the INTEK solution was specially formulated for lead and is different than the ND-75, or the ND-600 which are used for most other

materials. The decontamination chemistry of this patented chemical is a nontoxic, biodegradable, nearly neutral pH, aqueous-based proprietary chemical. It decontaminates lead by neutralizing ionized particles on the surface and removing oxides from the lead without attacking the base material. The chemistry disassociates the inorganic metal compounds entrapping radio nuclides and forms metal complexes with the radioactive ions, thus releasing them.

A conclusion drawn by this project and reported to the DOE states "the decontamination of radioactive lead by a combination of crystalline ice blasting and use of the INTEK decon solution was shown to be viable for large scale decontamination projects. Free release with no detectable activity can be achieved, and DOE sites with similar inventories of contaminated lead may benefit by utilizing the methods specified herein.

CONCLUSION

The preceding three projects described in this paper are samples of the demonstrated successful application of INTEK's decon solutions. This product is now offered for sale in a number of chemical formulations and strengths depending on the desired application. It is a safe, aqueous based, easily handled, and cost effective way to remove radioactive contaminants from a variety of surfaces and materials.

REFERENCES

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