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CO_2 PELLET DECONTAMINATION TECHNOLOGY AT WESTINGHOUSE HANFORD

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INTRODUCTION

Experimentation and testing with CO_2 pellet decontamination technology is being conducted at Westinghouse Hanford Company (WHC), Richland, Washington. There are 1,100 known existing waste sites at Hanford. The sites specified by federal and state agencies are currently being studied to determine the appropriate cleanup methods best for each site. These sites are contaminated and work on them is in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).[1]

There are also 63 treatment, storage, and disposal units, for example: groups of waste tanks or drums. In 1992, there were 100 planned activities scheduled to bring these units into the Resource Conservation and Recovery Act (RCRA) compliance or close them after waste removal. Ninety-six of these were completed. The remaining four were delayed or are being negotiated with regulatory agencies.[1] As a result of past defense program activities at Hanford a tremendous volume of materials and equipment have accumulated and require remediation.

BACKGROUND

To support WHC's mission of environmental remediation and restoration, the WHC ALARA (as low as reasonably achievable) Engineering group began evaluating a patented CO_2 pellet cleaning technology in January 1993. The CO_2 process is a unique dry process that uses dry ice as the exclusive decon medium, and does not use any hazardous chemicals, water, solid grit or aggregate materials. This process does not create costly secondary wastes and is a non-destructive surface cleaner.

A decision was made to test the technology on a variety of items at Hanford to gain first hand information about the efficacy of the CO_2 pellet decontamination methodology. Non-Destructive Cleaning, Inc. (NDC), is the vendor chosen to provide the demonstration of services contract at Hanford (Figure 1). The NDC mobile CO_2 decontamination unit is a stand alone, transportable, steel enclosure. No special mounting requirements are necessary and the unit can be placed on any firm flat surface, such as a paved lot or crushed stone. The unit is designed for cleaning items ranging in size from small hand tools to items up to twenty feet long with no weight limit.

NDC was chosen through a sole-source justification based on the perfection of a patented process including ventilation control and containment. A number of vendors can generate and deliver CO_2 pellets, but the key to an effective and safe CO_2 decontamination practice is proper ventilation and containment during the actual work. NDC, Inc., has demonstrated technical expertise in the diverse applications of the process to a variety of materials within the commercial nuclear industry.

CO_2 PELLET PROCESS

The NDC patented process/facility[2] uses small, solid carbon dioxide particles propelled by dry compressed air. The CO_2 particles shatter upon impact with the surface of the material to be cleaned and flash into dry CO_2 gas. The cleaning is accomplished by the rapidly expanding CO_2 gas lifting and flushing the foreign materials out. Microscopic sized particles are captured on high efficiency particulate air (HEPA) filters and larger materials are retrieved using HEPA-filtered vacuum cleaners. Therefore, the NDC mobile unit requires no drip pans or dikes or double walled leak protection designed to prevent leakage of radioactive liquids. Since no solid grit or aggregate is used, the CO_2 unit requires no bulk radioactive solid waste handling equipment. In addition, since no chemicals are required for the process no radioactive chemical processing or mixed waste handling facilities are needed. CO_2 levels have been demonstrated to remain below OSHA requirements and a CO_2 monitor verifies the levels during operation.

NDC had operated within the commercial nuclear industry for 9 equivalent operating years. Some examples of the items successfully decontaminated include: hand tools, power tools, pumps, tanks, glass, pipes (Figure 2), computer components and circuitry, manipulators, and lead shielding. The CO_2 pellets will clean metal objects, as well as softer objects like wood, plastics and rubbery materials without causing damage.

External Design of the CO_2 Unit

The main features of the CO_2 unit are designed to accommodate easy setup and tear down. Each facility arrives on site in three pieces that are simply joined together in place. The three pieces are two stand-alone, transportable, steel enclosure boxes and a flat bed containing the CO_2 tank and air compressor (Figures 3 and 4). All electrical interconnections are managed by a central power cable which is connected to a power control and distribution panel located within the mobile unit.

Internal Design of the CO_2 Unit

The CO_2 decontamination unit is designed with separate rooms: a machinery and electrical room, a large decontamination room, a decontamination cell room, and a count room where cleaned items are surveyed after cleaning (Figure 5). The unit has been designed with a complete HVAC system for "out of doors" operation in any environment. All floor and wall covering materials in the decontamination unit are specially selected and installed for ease of decontamination.

The decontamination room is completely lined with stainless steel, and includes a large entry door and an internal hoist that can handle up to two tons. The floor loading capacity is unlimited. The decon room ventilation system includes two pre-filters (Figure 6) and a HEPA filter system (Figure 7). The decontamination room is pre-piped for the use of supplied breathing air for worker safety. A special rolling lift table equipped with an air driven vise to hold items for cleaning has also been built in to the unit.

The decontamination cell room houses a unique cleaning cell equipped with CO_2. The design includes high capacity sweep air flow, a pull-out drawer in the decon cell and a foot pedal operated air vise inside the decon cell to hold items being cleaned. The delivery of the CO_2 pellets is also triggered by a foot pedal. The decon cell has been ergonomically engineered for ease of operation. The CO_2 pellets are produced by the pelletizer, which converts CO_2 gas to rice-sized pellets. The pelletizer is located in the machinery and electrical room (Figure 8).

DEMONSTRATION OF SERVICES

NDC has been operating their patented process and facility for the last 5 months. The intent of the WHC demonstration of services contract was to test the effectiveness of the CO_2 process on a variety of items within the Department of Energy complex. The CO_2 pellet decontamination unit has operated at Hanford's B-Plant, the 222S laboratory, the Hanford Central Waste Complex (CWC), and will support the mission to clean up equipment located in the 300 Area Nuclear Fuels Fabrication building.

CO_2 SUCCESSES

The CO_2 pellet decontamination activities being conducted and tested at WHC, have resulted in unprecedented accomplishments. The real success has been attributed to the three phase process used in the CO_2 unit. Phase I is the cleaning, phase II is the ventilation control and containment as described in the process section, and phase III is the exhaust gas filtration. This third phase allows us to stay in compliance with environmental laws regulating the release of hazardous effluents to the environment.

B-Plant Demonstration

Successes at the B-Plant resulting from a three month demonstration of the CO_2 pellet decontamination technology included the free release of ten years accumulated materials and equipment. The efforts resulted in the elimination of thousands of cubic feet of radioactive waste as well as the decon of thousands of pounds of contaminated lead shielding for re-use. Items free released included (Figure 9) assorted hand tools, electric drills, squirrel cages, shafts and bearings, shelving, door stop carriers, fan blades, and metal collars. An example of the decontamination log sheet (Table 1) shows the initial smearable contamination in disintegrations/minute (dpm)/100 cm^2, final smearable, approximate cleaning times and the air pressure (psi).

222S Process and Analytical Laboratories Demonstration

The demonstration activities at the 222S laboratories have resulted, so far, in greater than 2700 cubic feet of material decontaminated. Most of the material was free released. Where free release is not achieved two other approaches are used: (1) reduction of dose rates (ALARA), or (2) reducing burial costs by converting high-level waste to low-level waste.

In addition, a number of chemical sampling hoods were decontaminated for reuse or excess using the CO_2 process (Table 2). Hepa filter housings and a variety of duct work were also cleaned to determine the CO_2 decon efficiency.

FUTURE PLANS

Near-Term Plans

Beginning in May, the Hanford Central Waste Complex and the 300 Area Nuclear Fuels Fabrication Building are scheduled for a 10 week and 6 week demonstration of CO_2 decontamination activities, respectively. Items to be tested for the CWC are materials, tools, and equipment scheduled for burial at Hanford. Expectations are to recycle and excess all the items and save 100% of the burial costs. The Fuels Fabrication Building has some specialized equipment and fuel carts contaminated with low level uranium scheduled for CO_2 decontamination testing.

Long-Term Plans

CO_2 pellet decontamination technology will be used at Hanford in the years to come to assist the U.S. Department of Energy (DOE) contractors in completing their mission of environmental remediation. The long term plans are to, through the governmental competitive bid process, determine the appropriate vendor to continue the work demonstrated by NDC and their CO_2 process. Because of the successes with the demonstration of services with NDC, CO_2 pellet decontamination activities will continue at Hanford.

A workshop was held October 4-5, 1993, in Richland Washington. The workshop was sponsored by WHC Health Physics and supported a DOE Directive to form a CO_2 User's Group, and allowed 5 major DOE sites (7 contractors) who participated to utilize a savings through sharing concept. Eleven of the eighteen invited vendors attended the workshop.

COST SAVINGS

A cost savings of over 5 million dollars has been estimated for the term of the contract. Long term cost savings resulting from the use of CO_2 are estimated at over 50 million dollars.

CONCLUSION

CO_2 pellet decontamination technology will solve many of our decontamination problems. The technology is effective in solving these problems in terms of costs and performance. This state-of-the-art technology is revolutionary in terms of decontamination to ALARA, and in terms of waste management. CO_2 pellet technology will definitely enhance the public's image of Hanford by streamlining the mission of environmental restoration and remediation.

We have definitely learned that CO_2 technology doesn't end at CO_2 pellet delivery. The real technology includes the proper containment technology and the proper ventilation and filtration technologies because, without the entire package, CO_2 technology would be incomplete and unsuccessful.

REFERENCES

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Author Biography

Theresa Aldridge is a Principal Health Physicist at Westinghouse Hanford Company (WHC) in the Radiological Protection and ALARA Department. Ms. Aldridge has twenty-five years experience in Health Physics. She has been involved in ALARA activities for several years, including a stint as the ALARA Program Manager for WHC. She also has many years of experience in internal dosimetry. Her early career years were spent as a Senior Technician in internal dosimetry with the Pacific Northwest Laboratory (PNL) Health Physics Department. She directed the Hanford routine internal dosimetry program for PNL Health Physics Department for eight years. Ms. Aldridge was the driving force in bringing the CO_2 decontamination technology demonstration project to Hanford.

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DISCUSSION

Dionne: Do you have a feel for what type of decontamination factors you are getting with this device?

Aldridge: No, I don't. I did not come well prepared to give you that type of information. I can tell you that most of the items that we are bringing into the unit -- probably 95% -- are free released. We are recycling them. There is a lot of lead that we plan to decontaminate. We have 80 tons, most of which is pre-World War II lead. We are really excited about this decontamination and this process. I can get you that information -- I just don't have it today. It is an absolutely amazing process. I'm the sight cognizant engineer, and I have a lot of people who are very skeptical, and they want to come out and see the facility but they are very reluctant to give us their tools and equipment. They feel that this thing can't do a drill that has an aluminum body and a rubber cord and some plastic parts -- you can't clean it. They go away absolutely turned around.