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CONTAMINATION CONTROL HARDWARE FOR REMOTE HOT CHILL TRANSFERS

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CONTAMINATION CONTROL HARDWARE FOR REMOTE HOT CELL TRANSFERS*

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ABSTRACT

Remotely-operated plastic-bag sealers have been installed in the Livermore Neutron Cells to minimize the spread of contamination during transfers of highly alpha contaminated materials from the confinement boxes to the underfloor transfer system. An in-cell welding system has been added to one of the rear cell areas to seal active waste materials into steel canisters to aid in meeting "special form" specifications. The operation of these devices is controlled remotely in the semi-automatic mode to increase the reliability of the welded seals.

INTRODUCTION

The Livermore Neutron Cells are designed to accommodate a wide variety of experimental chemistry and physics research programs. The cells were constructed so that interchangeable confinement boxes could be placed inside the biological shielding thereby preventing the alpha contamination of equipment other than the experimental hardware contained in the box. A work table is located behind the confinement box so that transfers of contaminated materials to and from the boxes are performed

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inside the cell shielding. An underfloor transfer system services the four experimental cells and also allows insertion and removal of equipment via the work table. This unusual hot cell concept utilizes manipulators at both the front and rear faces of the cell and has been previously described in the literature.^{1,2}

We have developed a remotely operated plastic welder to perform in-cell bag sealing to maintain the confinement levels required by this concept. A seal approaching 100% reliability is necessary. An in-vit welding station has also been fabricated to insure the "special form" containment required for the disposal of highly-active waste-materials designated for burial.

DESCRIPTION OF SEALER

The plastic bag sealer that we have developed makes air-tight seals through as many as six layers of 12-mil-thick vinyl sheeting. This device makes perfect seals through uneven layers of wrinkled, random-width sheeting because the unit is designed to compress the plastic contained between the jaws to a fixed thickness during the sealing cycle. A layer of sheet mica covering the ground plate prevents arcing between the electrodes if no plastic is between the electrodes when the jaw is forced closed. Figure 1 is a line drawing showing the basic features of the sealing press. A cross-section through the press indicates the configuration of the press during a sealing cycle. The upper grounding plate can be swung outward from one of the tie rods holding the press together, and by extending the latch device on one end of the grounding plate, the whole upper mechanism can be lifted off of the tie rod (by use of master-slave manipulators) for inspection or removal from the cell. The grounding plate contains sixteen small air-actuated plungers to firmly hold the plastic sheeting in place during the heating cycle. The tolerance on these air pistons was intentionally left large so that air escaping past the piston would cool the grounding plate. The radio-frequency electrode is shaped to form a thin section through the center of the seal so that the plastic may be easily parted after sealing.

The press is powered from a 6 kilowatt, 40 megahertz RF generator through twin 50 ohm coaxial cables. The impedance of the closed press was designed to be approximately 50 ohms - therefore no special terminations or buffers are required. Power cables 10 to 15 feet are used with no significant change in impedance at the press. Actual RF power fed to the unit is about 1 KW for "KRENE"^a sheeting up to a total thickness of 70 mils. A predetermined pneumatic and electrical sequence is designed into the press controller. This unit automatically controls (1) the supply of compressed air to the gripper pistons, (2) the hydraulic pump to compress and re-open the RF electrode jaw, (3) the initiation and termination of RF power from the power supply, and (4) the cooling time before the press is opened and the sealed bag removed. Automatic operation can be terminated by the operator at any time, and a new sequence initiated by depressing the "start" button.

OPERATION OF SEALER

The bag sealer is located inside the cell on the work table, directly behind the confinement box. Two jack screws, powered by an air-motor, allow vertical positioning of the RF press to align with the confinement-box bag-changing device.² Figure 2 is a photograph of the bag-changing mechanism, the RF sealing press in the open position, and part of the work table inside the cell. The slip-top-can on the movable fork is the can to receive the sealed-off bag. The circular plate with latching mechanism immediately ahead of the fork device is the top of a plug that can be raised to transfer the can to the transfer tunnel six feet below the work table. The lower part of this plug has a cavity of sufficient size to accept the can from the fork and deposit it in proper

^a KRENE is a registered trademark of Bakelite Division of Union Carbide Corp.

alignment with the tunnel below. There a miniature fork-lift will transport the container to another location in the underfloor tunnel system.

To load the sealer the upper grounding plate is swung open with master-slave manipulators and the section of the bag to be sealed-off is placed across the RF electrode. The upper plate is then closed and the automatic sequence is initiated. This causes sixteen small air-actuated plungers to extend downward from the upper grounding plate and grip the plastic sheeting so that the lower air pressure in the containment box will not draw the softened plastic back into the box during the sealing cycle. The RF electrode is then forced upward by a hydraulic cylinder, compressing both the plastic and the small hold-down plungers. (The lower jaw is designed to accept initial non-parallelism with the grounding plate and closes to a predetermined parallel gap as the seal progresses.) When the hydraulic fluid reaches a preset pressure, the RF power is turned on; the hydraulic piston compresses and deforms the plastic as RF heating softens the sheeting. When the predetermined gap is reached, compression ceases and the plastic flows to conform to the electrode shape. The combination of the electrode configuration and the gap width generates an easily parted "rip-seal" at the plastic weld. After completion of the RF heating cycle and a delay period for cooling, the hydraulic pump is reversed to open the sealer and the bag is removed from the press. Separation of the bag sections is made by a simple tug with the M/S manipulators; contamination is confined in the seal which is about 1/8-inch-wide and 20-mils-thick at the center. The desired bag segment is placed in the lightweight can and the cover is taped on. It is then transported by underfloor carrier to another cell, or if the contents are to be disposed of as radioactive waste, to the back cell area equipped for metal welding.

WASTE CANISTER WELDER

One back-cell work table has been modified to include a variable speed turntable and a pre-positioned MIG welding torch. Figure 2 shows the arrangement of the equipment used for welding waste canisters. The turntable is driven by a pneumatic motor and right-angle gear box through spur gears to the central shaft. This shaft also connects the turntable drive plate to a mercury-filled cup which is electrically isolated from the rest of the table. The negative lead of a 350 ampere constant-potential welding power supply is connected to the mercury cup and isolated from all other components. The torch is mounted on top of a steel post by a holding jig that can be firmly held in either of two positions by an over-center spring device. The post is made with a center turnbuckle section and can be extended or retracted up to an inch without rotating axially. The torch is normally preset to position the tip at the correct height and angle to direct welding wire at the lid seam from 45° above the canister cover. The wire arc-gap is held constant by the voltage setting of the welding supply. Wire is fed to the torch through a small L shaped conduit from a variable speed wire-feeder located on top of the cell. The turntable in the back-cell operating area is located one foot from the viewing window and the torch is positioned so that the operator has a clear view both of the advancing seam and the freshly deposited weld metal. Type E-60CS wire and 75% CO₂-25% argon cover gas is used to make the fillet.

Waste canisters are fabricated from schedule 5 10-inch-diameter steel pipe with matching flat covers and lifting clips. Back-up rings are welded inside the pipe so that the flat covers are recessed 3/8-inch inside the pipe ends. The fillet is made in this recess and therefore the weld is subjected only to shear under the 30 foot drop test.

LOADING DISPOSAL CANISTERS

Waste cans arrive at the welding area right-side-up and are left on the fork-type handling device, Figure 1. Burial canisters, with one end welded in place, follow the waste can into the welding area. A canister, open-end-down, is then placed over the waste can with the aid of master slave manipulators. By use of the lifting clips and MSM's, the canister is then laid on its side between the fork and the turntable. The final motion of righting the canister on to the turntable leaves the waste can upside-down inside the burial canister. A canister lid is then placed on top and the welding torch snapped down into welding position. Alignment adjustments are performed with MSM's if required.

Welding is controlled from outside the cell by the operator initiating the weld sequence. After completion of the weld and inspection, the mechanical motions described above are performed in reverse sequence. The canister is then transported to a precast 4-foot concrete cube by the underfloor carrier and discharged into the block for permanent disposal.

Department of Transportation approved overpacks are used to transport the capped concrete blocks to permanent burial sites.

REFERENCES

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FIGURE CAPTIONS

Fig. 1 Drawing of R.F. press and bag-out port.

Fig. 2 Photograph of Bag-Cell work table showing R.F. heater area.

Fig. 3 Drawing of MIG welding in-cell equipment.

Fig. 1

Fig. 2