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IMPROVED CHEMISTRY CAVE

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IMPROVED CHEMISTRY CAVE.

INTRODUCTION

The cave was constructed to meet requirements of the Chemistry Division. The design of the structure incorporates the following features:

1. Gamma radiation protection equivalent to four inches of lead from floor to above head level.
2. Direct visibility throughout working area from operating side of cave.
3. Ready accessibility for setup and repair by the operator.
4. Accessibility to all areas by a manipulator.
5. Partial accessibility by an outside crane.
6. Ample utility sources with connections and controls located outside the cave.
7. Easily decontaminable.
8. Uniform air flow through the cave volume.

CONSTRUCTION DETAILS

The inside working dimensions of the cave are: width, 3 feet; length, 18.5 feet; and height, 7.5 feet. The floor level of the cave is 3 feet above operator floor level, with the shielding extending up to the 6.5-foot level.

The photograph of the cave under construction (Figure 1) shows the materials used. The cave has steel walls on the back and ends, with 6 pairs of double hinged doors giving an opening 30 inches wide at 2-foot intervals. The interlocking doors are made so that the left section opens first and then the right. The doors, each of which weighs about 1000 pounds, are supported on a ring of 1/4 inch-diameter balls which carry the weight, with the upper hinge pin doing the guiding and preventing tipping or sag. An overhead crane can insert a one-ton load into the cave through any of the door openings.

The steel walls are 6 inches thick, made up by intermittent welding of 1 inch-thick boiler plate. The steel is anchored into the concrete piers rising out of the floor. Steel has been added in various places in the concrete to keep the mass equivalent of shielding to approximately 4 inches of lead. Dense concrete (shown in isometric section) was used under the windows to shorten the access holes and provide a recess for utilities. Above the shielding wall are lucite windows for use of auxiliary spot lighting or viewing devices. Aluminum panels act as a frame for the lucite and, being light in weight, can easily be raised to open the top of the cave to clear the overhead crane.

On the operating side, there are four glass windows opposite the four back-wall openings and three lift doors---one between each pair of windows (Figure 4). The windows are 23 inches high x 35 inches wide x 20 inches thick, made by placing 3/4 inch-thick glass plates inside a sealed tank with mineral oil between the glass plates. The first eleven sheets of glass are a special nondarkening type, and the remainder are ordinary white plate glass. The sheets are mounted on strips of koroseal gasket material, Grade #116, and separated with .020 inch-thick brass shim stock to give uniform spacing of the glass. Clamping bars compress 1/4 inch-thick koroseal gaskets against the two outer glass plates to seal the tank. The tank walls are made heavy to maintain equivalent shielding around the windows. Construction details are shown on drawings RCD-73.

The lift doors between the windows are raised by standard 1/2-ton hoists and provide openings 1 x 2 feet for minor manual manipulations or adjustments from the operating side of the cave. A safety device protects the operator against any mechanical failure of the hoists or lifting mechanism.

Access holes, 4 inches in diameter, are located at three levels in the steel wall and also under the door openings just above the cave floor level (Figures 2 and 3). There are three access holes above and below the glass windows. Stainless steel liners seal the pores in the laminated plates of the steel wall against contamination; in the case of the holes under the windows, the liners served as part of the form for the dense concrete. The access holes are plugged with 4 inch-diameter solid steel plugs (Figure 2) or by two-piece zigzag plugs (Figure 6) for running in electrical or other supply lines from the utility stations. All utility connections can be made before the split plugs are installed for the shielded experiment.

Around the cave 24 inches off the floor are 9 stations of the common utilities and electrical outlets used in chemical laboratories. One station is located under each of the four windows, and one station under each section between the door openings on the back wall (Figures 3 and 4). The electrical sources at each station are as follows:

1. Five 110-V AC outlets and switches
2. Four 27.5-V DC outlets
3. One 220-V 3-phase outlet
4. One special outlet---4 pole

The other supply lines with valves to control each line are:

1. Gas
2. Air
3. Steam
4. High vacuum
5. Cold water
6. Blank
7. Low-suction line

Under each window and at two positions on the back wall is a 1 1/2 inch-diameter drain for nonradioactive liquid waste only.

The superstructure is of light construction and consists of movable panels of lucite framed in aluminum and a fixed double-mirror system to give an overhead view (Figure 2) of the cave floor looking over the steel back wall. The movable panels raise to open the back half of the cave so that the overhead room crane can service the cave area.

Large cracks on the inside of the cave are sealed with Mortite caulking, and small cracks with lacquer putty. The entire surface is covered with three base coats of enamel, a layer of industrial tape, and finally with two finish coats of Du-lux refrigerator enamel. In the case of persistent contamination which cannot be removed by washing the painted surface, the tape may be stripped, and the section refinished. The lower outside surface of the cave is finished in a medium gray color, and the superstructure a light gray; the inside is white. The shade of the colors is best shown in Figure 2.

The ventilation system of the cave is shown by the arrows in the cut-away drawing. The inlet air drawn off the floor of the cave room comes through four dust-stop filters (10 inches x 20 inches x 1 inch), one under each window, and enters the plenum chamber under the floor plate of the cave area. From the chamber the air passes over the edges of the floor plate and out through the lower access holes on both sides of the cave, giving a fairly uniform sweep of air along the entire length of the cave. The exhaust ductwork at the cave is an asbestos material (Careyduct) bonded and coated with a material which is resistant to most chemicals. The exhaust take-offs are above each window between the mirrors. Before stack discharge the exhaust air is passed through a combination of Dust-Stop prefilters and CWS filters (24 inches x 24 inches x 11 1/2 inches) to remove particulate radioactive contamination. The amount of air drawn through the cave is approximately 1200 cfm, corresponding to about 3 air changes per minute. The velocity through an open double hinged door is 160 fpm. The maximum velocity of air coming out of any of the inlet access holes is 500 fpm at the edge, dropping rapidly at 6 to 8 inches from the hole to about 20 fpm, which is the average upward velocity throughout the cave volume.

Smoke-bomb tests of the flow pattern indicate a fairly uniform movement of air throughout the cave volume when all doors are closed, with a somewhat more rapid movement along the window wall. With one pair of hinged doors and the superstructure immediately above open and with the bomb inside the cave, there is no escape of smoke through the openings.

The cave is illuminated by 8 continuous rows of slimline fluorescent lamps which are located about 2 feet above the windows along the entire length (Figure 2). These lamps are sealed from the inside of the cave by a curved lucite liner and are serviced by removing the reflectors from the outside

of the cave area. There are five sodium vapor lamps, one mounted over each lift-door opening between the windows (Figure 2) and one on each end of the cave.

Because of the absorption of light in the thick windows about 25 % of the light inside the cave reaches the observer. The intensity is still further reduced by any apparatus mounted in front of the window, so that auxiliary spot lighting is required for adequate illumination of specific areas.

The cave is serviced by an all-electric rectilinear manipulator. Interchangeable tongs of various shapes may be readily attached to the head by a simple cam lock. The tong can be oriented to various positions and actuated with the desired jaw tension from an electrical control box (shown in Figure 4). This control box can be plugged in at any of the utility stations around the cave. The manipulator (as shown in Figure 2) is mounted on a cantilever beam riding on rails just above the windows. Construction details of the manipulator are shown in drawings RCD-72.

FIG.1 UNDER CONSTRUCTION

FIG. 2 HINGED DOOR OPENING

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FIG. 3 GENERAL VIEW HINGED DOOR WALL

FIG. 4

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FIG. 5

FIG. 6