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Project NY 300 010
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interim technical note

DEVELOPMENT OF A PORTABLE DECONTAMINATION SHOWER UNIT

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SUMMARY

A prototype decontamination shower unit incorporating a waste water chlorination and recirculation system has been designed by Laboratory personnel. Construction, operation and water treatment tests have been made to aid in the further development of the unit, which has a capacity of 60 men per hour. Tests with BW simulants showed that a chlorine residual of 10 ppm at a pH of 6.7 resulted in rapid destruction of the BG and SM test organisms in the recirculated water. An objectionable mist from the showers was carried into the clean section of the unit.

The unit will be redesigned to improve the various mechanical features and to incorporate a fan to exhaust the mist from the showers.

INTRODUCTION

Project NY 300 010-4, "Portable Arctic Decontamination Shower Unit", directs the development of a lightweight, collapsible, portable shower assembly for decontamination of personnel exposed to chemical, biological and radiological warfare agents. Because of the probable scarcity of an adequate water supply under CBR warfare conditions, an investigation of the practicability of treating and reusing the shower waste water was included in the basic studies.

Navy personnel constructing, operating and maintaining advanced bases may be contaminated by CBR agents while normal facilities in the area are out of service. To minimize personal injury from these agents, it is desirable to provide emergency decontamination shower facilities for all personnel. Such facilities are an essential part of the passive defense component of any Naval Shore Establishment, and the development of a prototype, portable decontamination shower unit was undertaken by the Laboratory.

This interim report outlines the results of developmental tests and describes improvements to be incorporated in a revised design. The final design of the unit will include space heating provisions, which have been omitted in the first prototype, designed primarily to investigate the collapsible shelter and water recirculation and decontamination problems.

DESIGN CRITERIA

Showering Procedure

The basic showering procedure selected for this unit is based on previous work by Camp Detrick and this Laboratory. Each individual will go through the following compartments (see figure 1), in sequence to perform the indicated operation:

1. Undressing room
2. Rinse shower stall
3. Soaping stall
4. Rinse shower stall
5. Soaping stall
6. Final rinse stall
7. Toweling room

One minute is allowed for each person in each section except the undressing room where space allows each person to spend two minutes.

Shower Water

The three shower heads each deliver approximately 3.5 gpm at 20 psi making a total flow of 10.5 gallons per minute for the unit. Shower water is discharged at 90-100F so that personnel will remain in the showers long enough to do a good job of scrubbing.

Water Treatment for Recirculation

In considering water treatment procedures and the requirements of decontamination or removal of CBR agents in the circulating water, it immediately became apparent that no simple method of removing radiological contaminants is available, and in the case of this contaminant, it will be necessary to procure a continuous supply of fresh water for operation of the unit. Limited information in the requirements for decontamination of war gases indicated that heavy chlorination would be the only simple procedure that might be adaptable for treatment of the shower waste water for reuse. Further information must be obtained on this subject before any recommendation for recirculation of treated waste water contaminated by gas can be made. Since heavy chlorination is also essential for biological decontamination, it was made the basis for treatment of the waste water. Informal experiments conducted by Camp Detrick had indicated that a chlorine residual of 10 ppm maintained at a pH of approximately 6.5 was sufficient to rapidly kill spore-forming organisms as well as the vegetative forms. Since chemical dosage and control is simple for these conditions, the method was believed to be potentially effective for recirculating water treatment.

DESCRIPTION OF UNIT

The unit, as designed, consists of three major components: the shower shelter, the water heating and treatment section mounted on a pallet, and an engine-generator set to supply electrical power. Figure 2 illustrates the three sections on a flat bed trailer for transport.

The Shower Shelter

The shower shelter is based on a rigid center frame with a skid base 2 1/2 feet wide. Canvas is used for the walls and roof. To open the shelter from its collapsed position, the floor panels are folded down and the compartment separators are folded out to support the canvas in the shape shown in Figure 3. Figure 4 shows the towel shelves and the compartment separators in the in-service position. Figure 5 shows one of the shower compartments and a soaping compartment.

Water Supply Section

The water supply section consists of a 150 gallon rectangular water tank, a 3/4 hp pump, and an oil fired instantaneous water heater with a thermostatic control for maintaining the water temperature in the 90 to 100F range.

The water tank is used to allow approximately 10 minutes chlorine contact time for the circulating water before it is passed through the heater to the shower heads. Figure 6 shows the connections to and from the shower shelters. This unit required gravity drainage for return of the waste water.

Engine Generator

An engine generator set was used to supply all power for this unit. More use of direct small engine power is contemplated in the revised unit.

DEVELOPMENTAL TESTS OF SHOWER

Construction and Operation Tests

The completed unit was run through the complete cycle of transport, erection, use, and repacking for transport to test the design, construction and operational features.

The major functional defect encountered was the splashing of the shower water and drifting of potentially contaminated mist from the shower section into the clothing issue section. To correct this, a blower to exhaust the mist from this section and shower splash guards will be included in a second design.

It also became apparent from these tests that considerable improvement could be made in the design of the central section. The unit will be made larger and more rigid.

Deficiencies noted during this procedure included such items as water leaks in the shower room floor, insufficient slack in the canvas walls, poorly designed electrical control system, oversized circulation pump, and oversized water lines.

Erection Requirements

Each of the three sections of the unit can be handled by manual labor for loading and unloading, but with much difficulty because of the weight. Mechanical assistance from a fork lift truck is desirable for the loading and unloading operations.

Once the shelter and equipment pallets are in place, it requires one man only a few minutes to place the unit in operation. As Figure 6 shows, the shelter must be elevated at least 3 ft to allow recirculation of the waste water. If this is not required, the relative elevation of the two units is not important, except the drainage should be away from the equipment pallet.

Since all the equipment except the generator is bolted to the pallet, the pallet weighs several hundred pounds. Manual loading and unloading is desirable, therefore, the various items of equipment should be easily dismountable for individual handling.

A sump and sump pump to collect the waste water from the shower and deliver it to the contact tank will be included in the revised design to allow recirculation operation without elevation of the shower shelter.

Water Recirculation Tests

The effectiveness of the chlorination procedure for biological disinfection of the water for recirculation was tested by Camp Detrick personnel. When untreated water and soapy water were contaminated and circulated, large numbers of the test organisms, Bacillus globigii and Serratia marcescens, were contained in the shower water. However, when a chlorine concentration of greater than 10 ppm at a pH of 6.7 was maintained in circulating soapy water, none of the test organisms survived to reach the pump inlet end of the contact tank. The test organism was added to the system at the shower water gutter. Almost all the organisms were killed before they had reached the contact tank. The remaining few were killed in the tank. No concentration of organisms in the soap scum or the contact tank was noted.

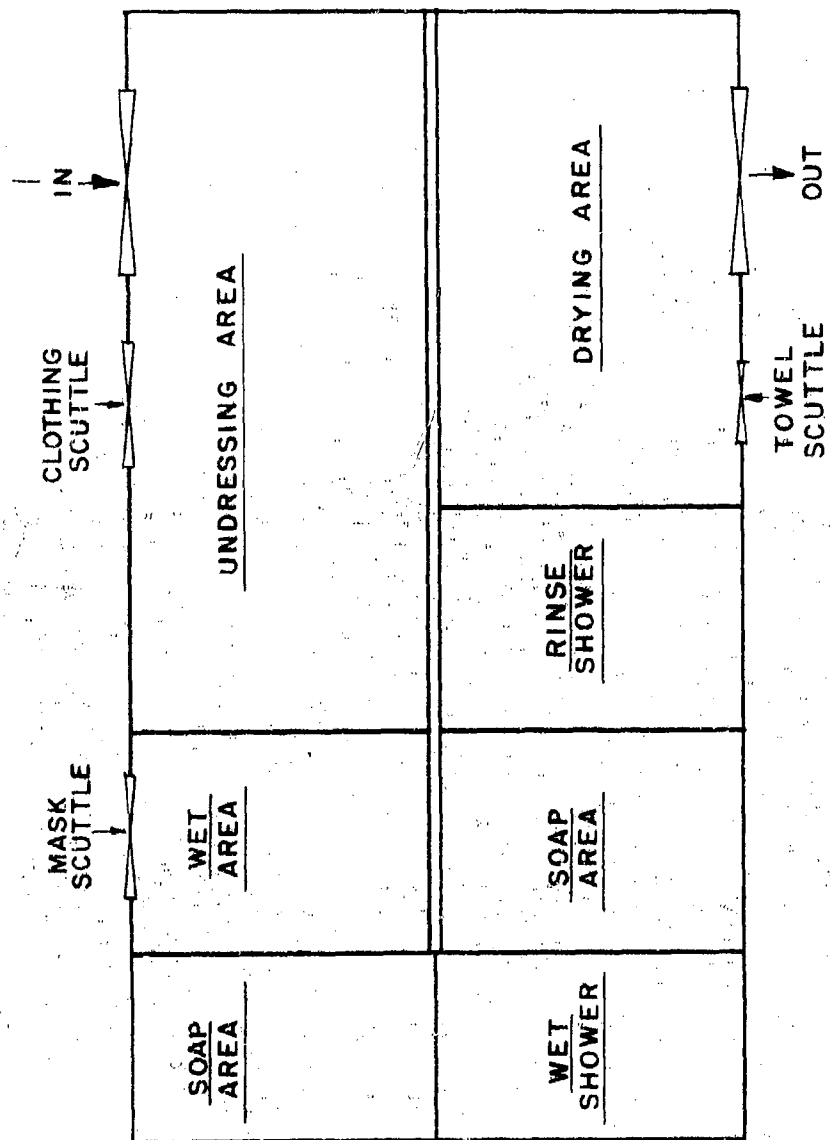
The circulating water has a milky appearance from the soap, which was liquid "Dial". Observation of the water delivered at the shower head indicated that it was impossible to visually detect the soap in the circulating water. A definite, but not strong, soapy taste built up in the water after gradual addition of soap. There was very little difference in taste or appearance of the water regardless of the amount of soap added. Little interference between the soap and chlorine was noted and it was possible to use a colorimetric chlorine tester to determine the chlorine residual. Samples were diluted with distilled water to reduce the milkiness before testing and to bring the concentration within the range of the tester.

A test kit for operation of the unit would require a field chlorine colorimeter, some litmus paper and a few items of glassware.

FUTURE PLANS

The unit will be redesigned to correct the various mechanical defects noted during tests, and a blower will be added to insure correct air movement through the unit. A deeper sump and a small pump will be added to the shower shelter so the recirculation of the waste water can be maintained without having the shelter elevated.

As a result of the tests, the provisions for chlorinating the waste water will be retained to allow the recirculation system to be used under contaminated conditions. Further information will be secured regarding the gas decontaminating potential of the treatment system. No attempt will be made to design a treatment system for radiological contamination for which a continuous fresh water supply is required.



FUNCTIONAL DIAGRAM

FIG. 1.

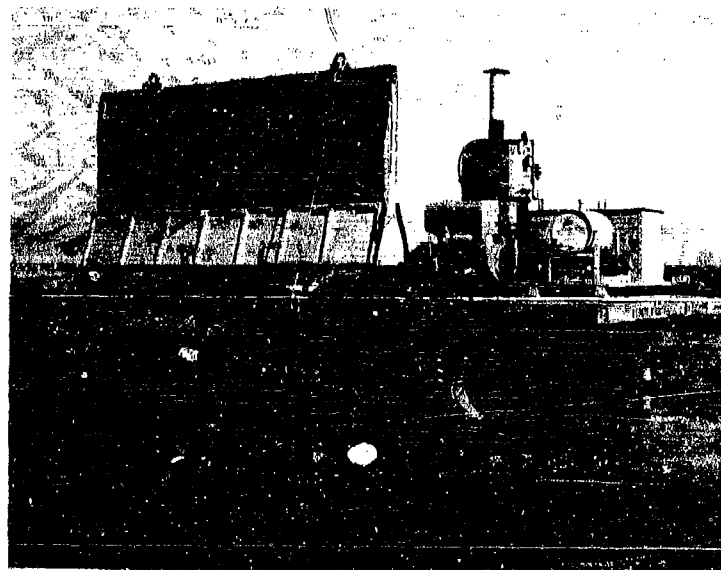


Figure 2. Shower unit loaded for transport.



Figure 3 . Shower shelter after erection.

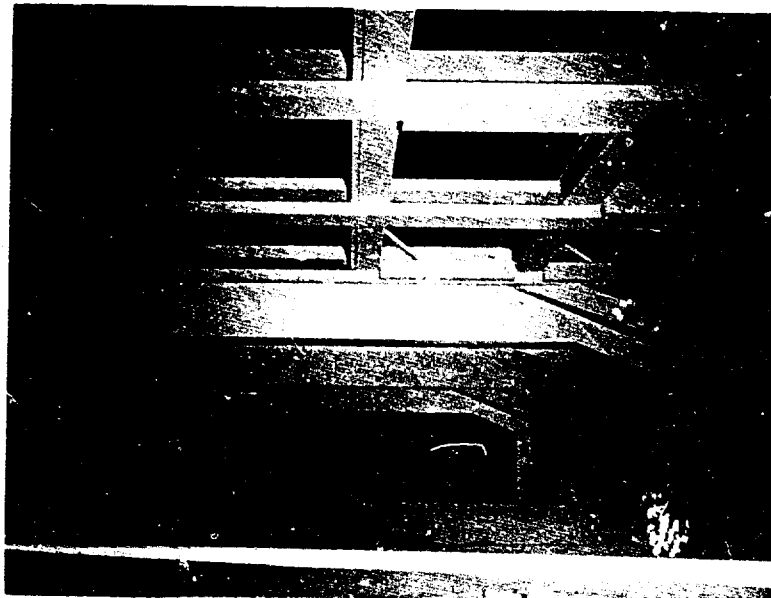


Figure 4. Compartment separators and towel shelves.

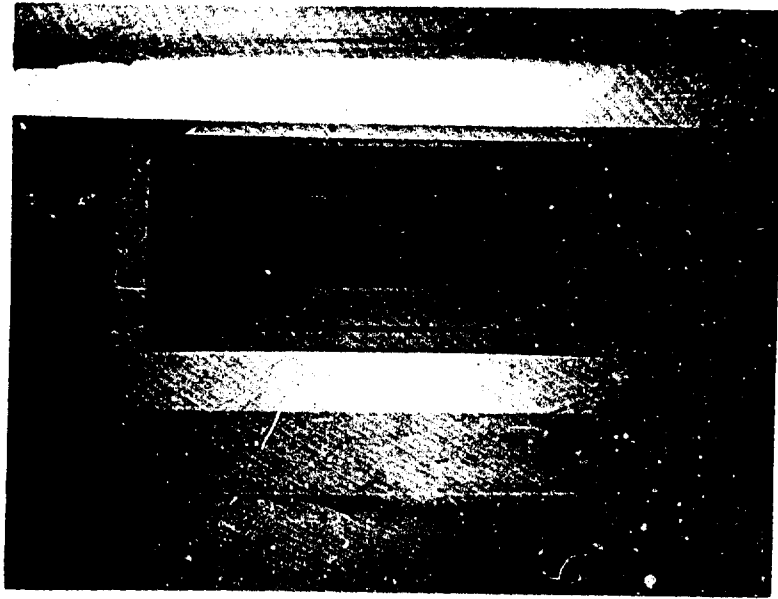


Figure 5. Shower and soaping compartment.

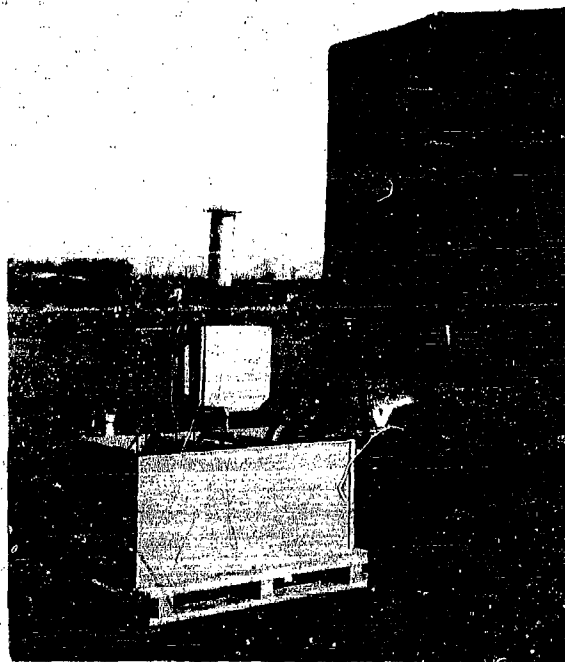


Figure 6. Water connections from equipment
pallet to shower shelter.

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