AD-A115 797   ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMM--ETC   F/G 13/2
EVALUATION OF WATER-SURE (TRADE NAME) 050 CHLORINATION UNIT.(U)
MAR 82   C M SHALL

UNCLASSIFIED   MERADCOM-2349   NL

1 OF 1
AD
A115797

END
DATE
FILMED
7 82
DTIC

AD A115797

(12)

AD

Report 2349

(Trade Name)

EVALUATION OF WATER-SURE® 050 CHLORINATION UNIT

by

Cindy M. Shall

March 1982

Approved for public release; distribution unlimited.

U.S. ARMY MOBILITY EQUIPMENT RESEARCH & DEVELOPMENT COMMAND MERADCOM

U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER 2349	2. GOVT ACCESSION NO. AD-A115797	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EVALUATION OF WATER-SURE® 050 CHLORINATION UNIT		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Cindy M. Shall		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Petroleum & Environmental Technology Division; Energy and Water Resources Laboratory; US Army Mobility Equipment Research & Development Command; Fort Belvoir, VA 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1L162733AH20-EW
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Mobility Equipment Research and Development Command; Fort Belvoir, VA 22060		12. REPORT DATE March 1982
		13. NUMBER OF PAGES 19
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Potable Water Chlorination Unit Residual Chlorine Water Disinfection		

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report covers an investigation conducted to evaluate the operational effectiveness of the Water-Sure® 050 Chlorination Unit. The results of the study indicate that the Water-Sure® 050 Unit is an effective method for chlorinating water and could be used under field conditions.

PREFACE

The investigation covered by this report was an evaluation of the Water-Sure® 050 Chlorination Unit for operational effectiveness for the chlorination of water. Work covered by this report was conducted under Project/Task 1L162733AH20-EW, "Water and Wastewater Management."

The investigation was conducted by Cindy M. Shall. Staff Sergeant Patrick J. Shields provided engineering technical assistance.

CONTENTS

ILLUSTRATIONS

TABLES

EVALUATION OF WATER-SURE® 050 CHLORINATOR

I. INTRODUCTION

1. Background. World Water Resources Incorporated manufactures a chlorination unit which is a flow-through system allowing calcium hypochlorite tablets to dissolve in the water stream to maintain a desired level of residual chlorine. Because of the simplicity of design, this chlorination unit is being used in various areas of the world. For example, it is used in some United States embassies within countries where the water is not potable and in rural areas of the United States where the unit provides safe water to the economically deprived population. This chlorination unit has potential application for use with the 600-gal/h Reverse Osmosis Water Purification Unit (ROWPU). The ROWPU is a mobile water purification system used by the Army to purify fresh, brackish, and salt water by the process of reverse osmosis. The chlorination unit was tested 30 June to 17 July 1981 in Building 325, Mobility Equipment Research and Development Command (MERADCOM), in order to verify the operational capability of the unit and to determine the feasibility of its use with the ROWPU system.

II. INVESTIGATION

2. Equipment The chlorinator manufactured by World Water Resources Incorporated used in this test was a Water-Sure®, Model 050 modified from gravity flow to a flow-through system (Figure 1). The chlorinator is made of National Sanitation Foundation-approved Cycolac ABS plastic with special chlorine-resistant seams. The hopper and lid are made of polyethylene. The hopper holds the calcium hypochlorite tablets. The hopper can be twisted higher or lower into the flow of water to allow more tablets or less tablets to be exposed to the flow. Holes in the bottom of the hopper allow the water to come in contact with the tablets. The lower the hopper, the greater the amount of tablets exposed and, consequently, the higher the chlorine concentration. The hopper level can be checked with the aid of level-markers, ranging from 0-9 A, B, C, and D, inscribed on the hopper. The 0-A level places the hopper highest in the flow of water, and the 9-D level places it lowest. A brass bleeder valve protrudes from the incoming hose, aiding the fine adjustment of the chlorine concentration. If the valve is closed, less water runs over the tablets, so a lesser amount of tablets is dissolved, and vice-versa.

The testing for residual chlorine was done with a Standard Army Color Comparator kit which is a component of the Army Water Quality Analysis Set, Engineer. The standard Army procedure was followed. The indicator used to determine the amount of free available chlorine in the test water was N, N-Diethyl-p-phenylenediamine (DPD) in tablet form. The calcium hypochlorite tablets used for testing were manufactured by Olin Corporation and have 65 percent available chlorine.

Figure 1. The Water-Sure® 050 chlorinator.

3. Procedure. The equipment layout for the testing is shown in Figure 2. The experiment was divided into two phases: potable Fairfax County, Virginia, water was used in the first phase, untreated Potomac River water was used in the second. The source of the potable water for the first phase was a fire hydrant located in front of Building 325, MERADCOM. The flow rate, which varied from day to day between 20 and 22 gal/min, was monitored by a flow meter. The chlorinator was adjusted via the hopper level to maintain an average chlorine residual of 5.0 p/m. This level of free available chlorine is required by the Office of the Surgeon General for field water disinfection (Department of the Army Technical Bulletin, Medical 229; page 7, Table 2). This phase ran for 6 days, 4 hours per day.

The second phase of the experiment, using untreated Potomac River water, had a similar set-up to the first phase, except that the water was pumped from the river to an outlet inside the building. A flow rate of 20 to 22 gal/min was maintained. This phase ran for 4 days, approximately 8 hours per day. On days 3, 5, and 8 of testing, the system was alternately operated for 30 min and shut down for 15 min, simulating the extreme start-stop conditions which could occur with the ROWPU equipment.

As shown in Tables 1 and 2, the schedule for running the system varied daily, but a typical testing series proceeded as follows:

a. Fill hopper one-fourth to one-half full with calcium hypochlorite tablets.

b. Close valve at bottom of contact tank.

c. Open water source gate valve.

d. Adjust flow so that flow meter reads between 20 and 22 gal/min.

e. Take influent water sample from valve preceding the flowmeter. Test for residual chlorine and record results.

f. Open valve at bottom of contact tank.

g. Take effluent water sample from discharge hose of holding tank. Test for residual chlorine and record result.

h. Regulate the hopper level when necessary to maintain a chlorine residual of 5.0 p/m.

i. Repeat procedure as dictated by the testing schedule.

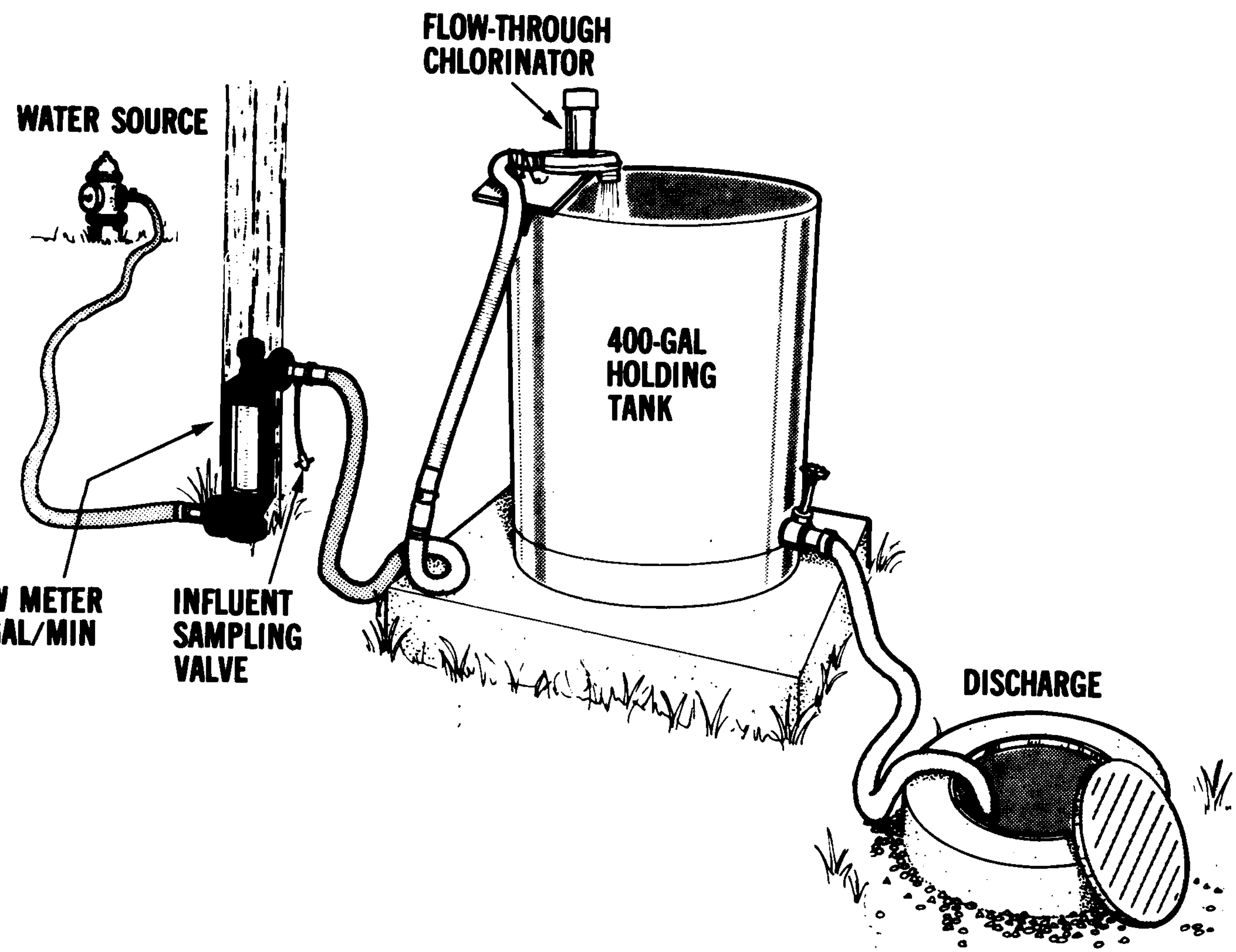

Figure 2. Equipment layout for testing flow-through chlorination unit.

Table 1. Residual Chlorine Levels vs. Time Using Potable Water Source

Day 1 6/30/81			Day 2 7/1/81			Day 3 7/6/81		
Time	Residual Chlorine Effluent (p/m)	Hopper Level	Time	Residual Chlorine Effluent (p/m)	Hopper Level	Time	Residual Chlorine Effluent (p/m)	Hopper Level
0925	6.0-7.0	7-D	0845	5.0-6.0	1-D	0900	1.8	1-D
0935	6.0-7.0	7-D	0915	5.0	1-D	0930	4.0-5.0	1-D
1000	7.0-8.0	5-D	0945	5.0	1-D	0945	4.0-5.0	1-D
1030	3.0-5.0	2-D	1015	5.0	1-D	1015	5.0	1-D
1045	6.0-7.0	3-D	1045	5.0	1-D	1030	5.0	1-D
1100	6.0-7.0	2-D	1230	5.0	1-D	1100	4.0-5.0	1-D
1115	6.0-7.0	1-D	1300	5.0	1-D	1115	5.0-6.0	1-D
1200	5.0-6.0	1-D	1330	5.0	1-D	1145	5.0	1-D
1230	5.0-6.0	1-D	1400	5.0	1-D	1245	5.0	1-D
1300	5.0	1-D	1430	5.0	1-D	1315	5.0	1-D
	Average 6.0			Average 5.0		1330	5.0	1-D
						1400	5.0	1-D
						1415	5.0-6.0	1-D
						1445	5.0-6.0	1-D
						1500	5.0-6.5	1-D
						1530	5.0-6.0	1-D
							Average 5.0	

Table 1. Residual Chlorine Level vs. Time Using Potable Water Source (Continued)

Day 4 7/8/81			Day 5 7/9/81			Day 6 7/10/81		
Time	Residual Chlorine Effluent (p/m)	Hopper Level	Time	Residual Chlorine Effluent (p/m)	Hopper Level	Time	Residual Chlorine Effluent (p/m)	Hopper Level
0900	8.0	1-D	0830	5.0-6.0	1-C	0900	5.0	1-D
0915	6.0-7.0	0	0900	5.0	1-C	0930	3.0	1-D
1015	4.0	0	0915	4.0-5.0	1-C	1000	5.0	2-D
1115	5.0-6.0	1-D	0945	4.5	1-C	1030	5.0	2-D
1230	5.0-6.0	1-D	1000	4.5	1-C	1100	5.0	2-D
1330	5.0-7.0	1-B	1045	4.5-5.0	1-D	1230	6.0-7.0	1-D
1430	3.5-4.0	1-C	1215	5.0-6.0	1-D	1300	5.0	1-D
	Average 5.6		1245	5.0	1-D	1330	4.0	1-D
			1300	4.5	1-D	1400	5.0	1-D
			1330	4.5-5.0	1-D	1430	5.0	1-D
			1345	5.0	1-D		Average 4.9	
			1415	5.0	1-D			
			1430	5.0	1-D			
			1500	4.5-5.0	1-D			
				Average 4.9				

Table 2. Residual Chlorine Levels vs. Time Using Untreated Potomac River Water Source (Continued)

Day 10 7/17/81

Time	Residual Chlorine Effluent (p/m)	Hopper Level
0730	7.0-8.0	1-C
0800	8.0-9.0	1-C
0830	5.0	0-C
0900	4.5	0-C
0930	5.0	0-C
1000	5.0	0-C
1030	5.0	0-C
1100	2.5	0-C
1130	8.0	1-D
1230	3.0	1-A
1300	8.0	1-C
1330	3.5	1-A
1400	5.0-6.0	1-C
1430	5.0	1-C
1500	5.0	1-C
1530	5.0	1-C
	Average 5.4	

III. RESULTS

4. Test Data. The results obtained in the testing of the Water-Sure® 050 chlorinator are given in Tables 1 and 2.

IV. DISCUSSION

5. Observations. The following observations were noted during testing:

a. The chlorinator never required longer than 10 min to reach the 5.0 p/m level or higher of residual chlorine. Once that level was reached, the concentration did not vary more than ± 3.0 p/m residual chlorine. The total average of the residual chlorine readings was calculated to be 5.3 p/m.

b. The residual chlorine level of the water was raised each time the tablets were changed because of the calcium hypochlorite dust washing from the tablets.

c. When the contact tank overflowed, because the gate valve was not opened enough, the chlorinator backed up with water and the tablets became wet. This excessive exposure to water caused the tablets to dissolve more rapidly, thus increasing the chlorine concentration.

d. Immediately following the overflow, the chlorine residual level decreased slightly because the freshly chlorinated water had been flowing off of the top of the contact tank.

e. While untreated Potomac River water was being used, there was a pronounced increase in the frequency with which the tablets had to be replaced in the hopper.

f. A brownish red deposit (probably rust) on the inside surfaces of the chlorinator was observed on the third day of testing with the potable water source. On the ninth day of testing, some of the residue was scraped off the walls. Periodic maintenance to remove this residue should be performed.

6. Discussion. The Water-Sure® 050 chlorinator was tested for its efficiency in chlorinating both potable water and untreated Potomac River water. The test was designed to determine if the chlorinator could reach and maintain a desired chlorine residual level of 5.0 p/m and, if so, the length of time required and the operator interaction involved.

Tables 1 and 2 show that in all but one instance a chlorine residual of 5.0 p/m or higher was reached within 10 min from the time the system was started. The first readings were always taken within 10 min of turning on the system. On the third day of testing, a low reading of 1.8 p/m residual chlorine was the result of taking the reading immediately after the hopper was filled with calcium hypochlorite tablets. The calcium hypochlorite tablets had not had time to dissolve. When the next reading was taken, 30 min later, the system had stabilized and a 5.0 p/m chlorine residual was obtained.

There was a pronounced increase in the frequency with which the calcium hypochlorite tablets had to be replaced in the hopper when untreated river water was used as the water source. The residual chlorine level of the Fairfax County water used as the influent water was 0.0 to 0.1 p/m throughout the testing period. The higher level of organic matter in the untreated river water caused the higher chlorine demand and, consequently, the tablets were depleted more quickly.

Although quantitative data were not collected on the amount of calcium hypochlorite tablets used during testing, it is estimated that for the entire test period 3 pounds of calcium hypochlorite tablets were used. On days 1 and 3, the hopper was filled to one-half capacity. On days 6 and 8, the hopper was filled to one-fourth capacity. On days 9 and 10, the hopper was filled twice during the day to one-fourth capacity. System operation on days 2, 4, 5, and 7 did not require additional calcium hypochlorite tablets.

Throughout the testing, the bleeder valve on the chlorinator was opened completely, allowing a maximum water flow through the hopper area. The residual chlorine level was maintained using only the various hopper levels. These data are presented in Tables 1 and 2.

The hopper level varied from 0-A to 9-D, but the most frequently used level was 1-D. This was the level which placed the hopper low enough in the flow of water to allow the tablets to dissolve at the rate necessary to produce and maintain a 5.0 p/m chlorine residual reading.

V. CONCLUSIONS

7. **Conclusions.** It is concluded that:

a. The Water-Sure® 050 Unit is an effective method for chlorinating water under the test conditions.

b. The Water-Sure® 050 Chloridation Unit could be used for field water chlorination.

DISTRIBUTION FOR MERADCOM REPORT 2349

No. Copies	Addressee
	Department of Defense
1	Director, Technical Information Defense Advanced Research Projects Agency 1400 Wilson Blvd Arlington, VA 22209
12	Defense Technical Information Ctr Cameron Station Alexandria, VA 22314
	Department of the Army
1	Commander, HQ TRADOC ATTN: ATEN-ME Fort Monroe, VA 23651
1	HQDA (DAEN-RDL) Washington, DC 20314
1	Technical Library Chemical Systems Laboratory Aberdeen Proving Ground, MD 21010
1	Director US Army Engineer Waterways Experiment Station ATTN: Chief, Library Branch Technical Information Ctr Vicksburg, MS 39180
1	Commander US Army Armament Research and Development Command ATTN: DRDAR-TSS #59 Dover, NJ 07801
2	Director Petrol & Fld Svc Dept US Army Quartermaster School Fort Lee, VA 23801
1	Commandant US Army Engineer School ATTN: ATZA-CDD Fort Belvoir, VA 22060
1	Commander and Director USA FESA ATTN: FESA-TS Fort Belvoir, VA 22060
1	Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-SL (Tech Lib) White Sands Missile Range, NM 88002
	MERADCOM
1	Commander, DRDME-Z Tech Dir, DRDME-ZT Assoc Tech Dir/R&D, DRDME-ZN Assoc Tech Dir/Engrg & Acq, DRDME-ZE Spec Asst/Matl Asmt, DRDME-ZG Spec Asst/ Scs & Tech, DRDME-ZK CIRCULATE
1	C, Engy & Wtr Res Lab, DRDME-G
10	Petrol & Environ Tech Div, DRDME-GS
3	Tech Reports Ofc, DRDME-WP
2	Tech Library, DRDME-WC
	Department of the Navy
1	Library (Code L08A) Civil Engineering Laboratory Naval Construction Battalion Center Port Hueneme, CA 93043

8 4 - 8,505—AG—Ft Belvoir