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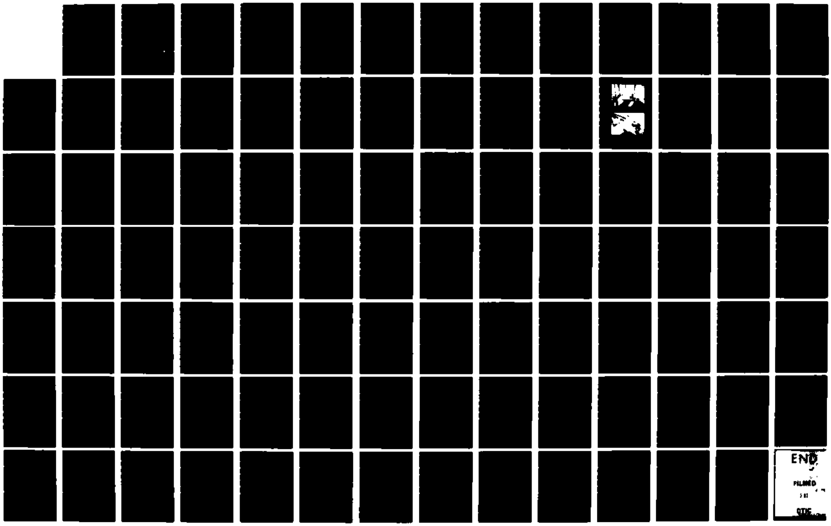

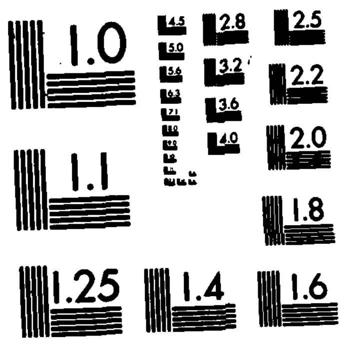

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Report DAAK-70-82-C-0045

A RAPID, SAFE DRINKING WATER SUPPLY PRODUCTION METHOD

Helen F. Gram
Martin E. Muller
Ann M. Pendergrass

Los Alamos Technical Associates, Inc.
Los Alamos, New Mexico 87544

I. J. Wilk
Science Services
Stanford, California 94305

24 October 1982
Final Technical Report

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Ozone and chlorine-hypochlorite were generated electrolytically in weak NaCl solutions using currents of 5-25 volts and 2-8 amps, and ambient temperatures using platinum plated electrodes. The prototype unit electrolyzed 1ℓ/min of water on a continuous basis. One volume of electrolyzed

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solution sterilized and deodorized 40 volumes of sewage-contaminated surface stream water in about 10 minutes at a production rate of (600 gal/hr. (2200 ℓ/hr.). The unit is compact (20" cube) and portable, and can renlace chlorination as a more rapid and thorough disinfection process.

Item 7.

I. J. Wilk
Science Services,
Stanford, CA 94305

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1.0 SUMMARY

The electrolytic generation of ozone and chlorine-hypochlorite (and perhaps free radicals) in weak electrolyte to kill microorganisms has been investigated. A dilute NaCl solution was passed between novel platinum electrode plates which carried a current of 5-25 volts and 2-8 amps. The amount of ozone generated in the anode stream was found to be directly related to the applied voltage and to the electrolyte concentration. The prototype unit developed for these experiments is capable of electrolyzing 1 ℓ/min of water on a continuous basis. One volume of electrolyzed solution (produced at 10 volts, 3.5 amps) sterilized and deodorized 40 volumes of surface stream water contaminated with raw sewage. Conservative estimates are that 18,000 ℓ (4,800 gallons) of water contaminated with microorganisms could be sterilized in an 8-hour day using 0.035 kw. The unit is compact (20" cube) and portable, with a pump as the only moving part. The unit generates ozone directly in water at ambient temperatures rather than by using oxygen, an air supply, or hazardous chemicals such as chlorine gas. *Such a system could replace chlorination as a more rapid and thorough* secondary treatment process.

2.0 PREFACE

2.1 Authorization

This project was authorized under Contract No. DAAK 70-82-C-0045 pursuant to the DESAT program of the Department of Defense.

2.2 Relationship of Work to Overall Project

The electrolysis unit developed and tested under this contract to destroy bacterial and chemical contaminants can be placed downstream of the reverse osmosis elements in the reverse osmosis water purification unit (ROWPU) now being field tested to provide safe drinking water for troops. It can also be developed as a stand-alone unit to provide safe drinking water, free from nuclear, biological, and chemical warfare agents for troops and individual soldiers.

2.3 Contributors

The contributors to this project are:

H. F. Gram
M. E. Muller
A. M. Pendergrass, PhD
I. J. Wilk, PhD

2.4 Copyright Permission

No copyrighted material was used in work performed under this contract.

The novel platinum electrodes, used with the permission of the inventor, Mr. C. D. Themy, are covered by the following patents:

3,443,055 Laminated Metal Electrodes and Method for Producing the Same.

Ross M. Gwynn, 916 Donnajo Way 95825, and
Tim Themy, 7025 Uranus Parkway 95823, both of
Sacramento, Calif.
Filed Jan. 14, 1966, Ser. No. 520,596
Patented May 6, 1969.

3,547,600 Composite Electrode Having a Base of Titanium or Columbium, an Intermediate Layer of Tantalum or Columbium, and an Outer Layer of Platinum Group Metals.
Ross M. Gwynn and Tim Themy, Carmichael, Calif., assignors, by mesne assignments, to KDI Chloro Guard Corporation, a Corporation of Delaware.
Filed May 28, 1968, Ser. No. 732, 510
Patented December 15, 1970

4,236,992 High Voltage Electrolyte Cell
Constantinos D. Themy, 4984 S., 360 West, Murray, Utah, 84106.
Filed August 6, 1979, Appl. No. 64,073
Patented December 2, 1980.

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4.0 REPORT

4.1 Introduction

Ozone has long been used as a potable water treatment method because it is effective in killing bacteria, viruses and other microorganisms; it increases settling; removes tastes, odors, and colors; oxidizes sulfides, cyanides, and algae; and oxidizes organic materials. However, standard ozone generation techniques currently in use are not amenable to field conditions. In contrast the ozone generation unit developed under this contract is small and portable, with low power consumption. Ozone is generated by electrolysis directly in water, which eliminates gas to water transfer problems and minimizes hazards of handling harmful chemicals such as chlorine. The unit can produce large amounts of excellent quality water in the field.

Under this contract, a fast, efficient, and safe process for water purification/decontamination using novel platinum electrodes in a portable unit suitable for field use was to be developed and tested. The concept of *generating ozone directly in water* was to be verified. A prototype electrolysis unit was to be built, capable of producing essentially sterile drinking water at a rate of 1,000 ℓ/day. This has been accomplished.

The tasks specified in the scope of work are

- establish the optimum efficiency of microorganism kills and the corresponding reduction in size, weight, and power consumption of the prototype unit, Task 1;
- develop a base unit capable of producing about 1000 ℓ/day of pure drinking water, Task 2;
- conduct a literature search to identify potential chemical warfare agents and the detoxification effects of oxidation- ozonolysis and hydrolysis on compounds of this type, Task 3;

- conduct preliminary laboratory studies to determine the feasibility of the unit to produce decontaminated as well as sterilized water, Task 4.

This electrolytic ozone generation unit could be incorporated into the ROWPU unit downstream from the reverse osmosis elements. Bacteriological and chemical contaminants would be detoxified by the electrolytic unit. Alternatively, fresh water which did not require desalination could be treated directly with the electrolytic unit to destroy biological and chemical contaminants thereby doubling the output of the ROWPU. The addition of an ion-exchange column would remove radioactive contaminants.

4.2 Investigation

4.2.1 Static System

Preliminary tests were conducted to determine the conditions under which ozone and chlorine-hypochlorite could be generated in water electrolytically. Electrodes of 4 cm × 6 cm dimensions were placed 0.5 cm apart in a cylindrical cell 11 cm high by 6.5 cm in diameter. Tap water solutions of 3 and 30 g NaCl/ℓ were placed in the cell. Direct current at a series of increasing voltages and amperages was applied across the electrodes for 2 minutes. Total chloride and ozone in the electrolyzed solutions were measured by amperometric titration with thiosulfate[1]. Two samples were obtained. The first sample, adjusted to pH 4 with H_2SO_4, was then titrated against standard thiosulfate solution to measure total chloride ($HOCl + OCl^-$). The second sample was adjusted to pH 11.5 and allowed to react for 2 minutes to decompose O_3. This sample was next adjusted to pH 4 with H_2SO_4, and then was titrated in the same manner to measure O_3 + total chloride. The difference in the 2 samples is a measure of O_3 concentration[2].

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1. Greenbure, A. G., J. J. Connors, D. Jenkins, and M. A. H. Franson, eds. "Standard Methods for the Examination of Water and Wastewater," 15th ed. Amer. Pub. Health Assn., 1980.

2. Wilk, I. J., personal communications with H. Gram and unpublished work, 1969 - 1982.

Both ozone and chlorine-hypochlorite concentrations are directly related to the applied voltage (Tables 4-1 and 4-2). At a comparable voltage, the higher concentration of electrolyte allows more current to flow, and more ozone and chlorine-hypochlorite are formed.

TABLE 4-1

OZONE GENERATION IN 3 g/ℓ NaCl SOLUTION
(Tap water, pH adjusted to 7.05, electrolyzed for 2 minutes)

Volts	Amps	$Temp_{in}$ (°C)	$Temp_{out}$ (°C)	pH_{in}	pH_{out}	Cl_2* (mg/ℓ)	O_3* (mg/ℓ)
3	0.2	23	23	7.05	7.05	10.5	0
5	0.9	23	23.5	7.05	7.85	18.0	2
10	3.1	23	24	7.05	8.05	83.0	1

*Cl_2 and O_3 were measured by titration as described in the text.

TABLE 4-2

OZONE GENERATION IN 30 g/ℓ NaCl SOLUTION
(Tap water, pH adjusted to 7.2, electrolyzed for 2 minutes)

Volts	Amps	$Temp_{in}$ (°C)	$Temp_{out}$ (°C)	pH_{in}	pH_{out}	Cl_2* (mg/ℓ)	O_3* (mg/ℓ)
3	0.5	23	24	7.2	8.4	55	4
6.8	10.0	23	25	7.2	10.4	920	0

*Cl_2 and O_3 were measured by titration as described in the text.

Low ozone concentrations measured at high voltages were thought to be due to excess OH^- generated at the cathode which decomposed the ozone.[3] On a thermodynamic basis, chloride ions react with ozone to form chlorine but the reaction is limited by unfavorable kinetics. Even in acidic solutions, the rate of reaction is so slow that it is of no practical significance.[4]

Using the small static cell, sufficient oxide is generated by a 10 volt, 3 amp current per volume of 3 g/ℓ NaCl solution (Table 4-1) to disinfect 8 to 10 volumes of water, with a slight increase in salt concentration. When 30 g NaCl/ℓ (sea water) was electrolyzed using 6.8 volts, 10 amps, approximately 30 volumes of water could be treated based on the quantity of chlorine/hypochlorite formed (Table 4-2).

4.2.2 Laboratory Scale Flow-Through System

In order to disinfect large quantities of water, a continuous system is more efficient than a batch process. Electrolytic experiments were carried out to determine feasible operating parameters of a flow-through system. As in the static system, electrodes of 4 cm × 6 cm, spaced 0.5 cm apart were enclosed in a housing. Tap water containing 3.0 g NaCl/ℓ was adjusted to pH 7.05 and passed through the electrolytic cell at rates of 0.2 and 1 ℓ/min, at increasing voltages and amperages.

Generally, the higher the applied voltage/amperage, the greater the increase in temperature of the treated water (Table 4-3). Increased temperature increases the decomposition rate of ozone[4], which may account for

---

3. Venosa, A. D., Ozone as a Water and Wastewater Disinfectant: a Literature Review in "Ozone in Water and Wastewater Treatment." F. L. Evans III, ed. Ann Arbor Science Publishers, Inc. 1972.

4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

TABLE 4-3

OZONE GENERATION IN FLOW-THROUGH SYSTEM
(Tap water containing 3.0 g/ℓ NaCl)

Flow Rate (ℓ/min)	Volts	Amps	$Temp_{in}$ (°C)	$Temp_{out}$ (°C)	pH_{in}	pH_{out}	Cl_2 (mg/ℓ)	O_3 (mg/ℓ)
0.2	5	0.6	23	24.0	7.05	7.8	16.0	1.5
	10	2.9	23	24.0	7.05	8.0	45.0	2.0
	15	5.9	23	26.0	7.05	8.35	110.0	0.0
1.0	15	5.2	22	22.0	8.4	8.8	25.5	2.7
	25	10.0	22	23.5	8.4	9.23	42.5	5.4

failure to measure residual ozone generated at 15 volts and 0.2 ℓ/min flow. Increased chlorine concentration indicates increased electrolytic activity. If ozone generation per unit time is a function of voltage and electrolyte concentration, a slower flow rate through the cell should produce greater ozone concentration in the outflow stream. However, in an experiment to demonstrate this, the ozone concentration in electrolyzed solution was not positively affected by the slower flow rate (Table 4-3). This may be due again to destruction of ozone within the electrolytic cell by OH^- generated at the cathode. More rapid flow through the cell would decrease the contact time and preserve more ozone in the outflowing stream.

These tests establish that both ozone and chlorine-hypochlorite in measurable quantities can be generated electrolytically in dilute NaCl solutions at a flow rate of 1 ℓ/min, and a current of 5 to 25 volts. As shown in Table 4-3, the ozone and chlorine-hypochlorite produced are related directly to voltage, amperage, and concentration of electrolyte in the flow-through system, as in the static system. These results complete the part of Task 1 relating to experimental ozone generation. The completion of the remainder of Task 1 is discussed in Subsection 4.2.3.

4.2.3 Microbiological Tests

The effectiveness of electrolyzed solutions to kill Escherichia coli was tested. For these determinations, 760 ml of tap water spiked with E. coli to a concentration of 10^6 cells/ml was mixed with 20 ml samples of tap water which had been passed through the electrolytic cell at a range of voltages from 5 to 25 volts, 0.75 to 9.5 amps. This is a 1/38 dilution of treated to untreated water. Samples were collected in sterile bottles containing a small amount of $Na_2S_2O_3$. Coliform counts were carried out by membrane filtration using ENDO broth, 3 dilutions per sample time, following 909A Membrane Filter Procedure.[1]

The original E. coli count of 10^6 cells/ml is considered to be a worst-case contamination of a water source. The dynamics of coliform kill, Figure 4-1, show that destruction of bacteria is largely accomplished during the first 5 minutes following introduction of the electrolyzed solution. Essentially sterile water was produced in a batch process within 10 minutes by treating 38 volumes of heavily contaminated water with one volume of 3 g/ℓ NaCl salt solution electrolyzed at 25 volts, 9.5 amps, produced at a rate of 1 ℓ/min. There was no further significant reduction in bacterial population after 10 minutes. On this basis, 2280 ℓ (600 gal) of water could be sterilized per hour, or 54,720 ℓ/24-hour day (14,400 gal). The increase in NaCl concentration of the treated water would be about 80 mg/ℓ. If less heavily contaminated water were treated, a reduction in E. coli of 10^4/ml could be achieved within 5 minutes using water treated at 15-20 volts, 4-10 amps. The amount of ozone required for sterilization depends upon the bacterial population and quantity of organic material in the water.[4,5]

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1. Greenberg, A. E., J. J. Connors, D. Jenkins, and M.A.H. Franson, eds., "Standard Methods for the Examination of Water and Wastewater." 15th ed. Amer. Pub. Health Assn. 1980.

4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

5. Kinman, R. N. Ozone in Water Disinfection in "Ozone in Water and Wastewater Treatment," F. L. Evans III, ed. Ann Arbor Science Publishers, Inc. 1972.

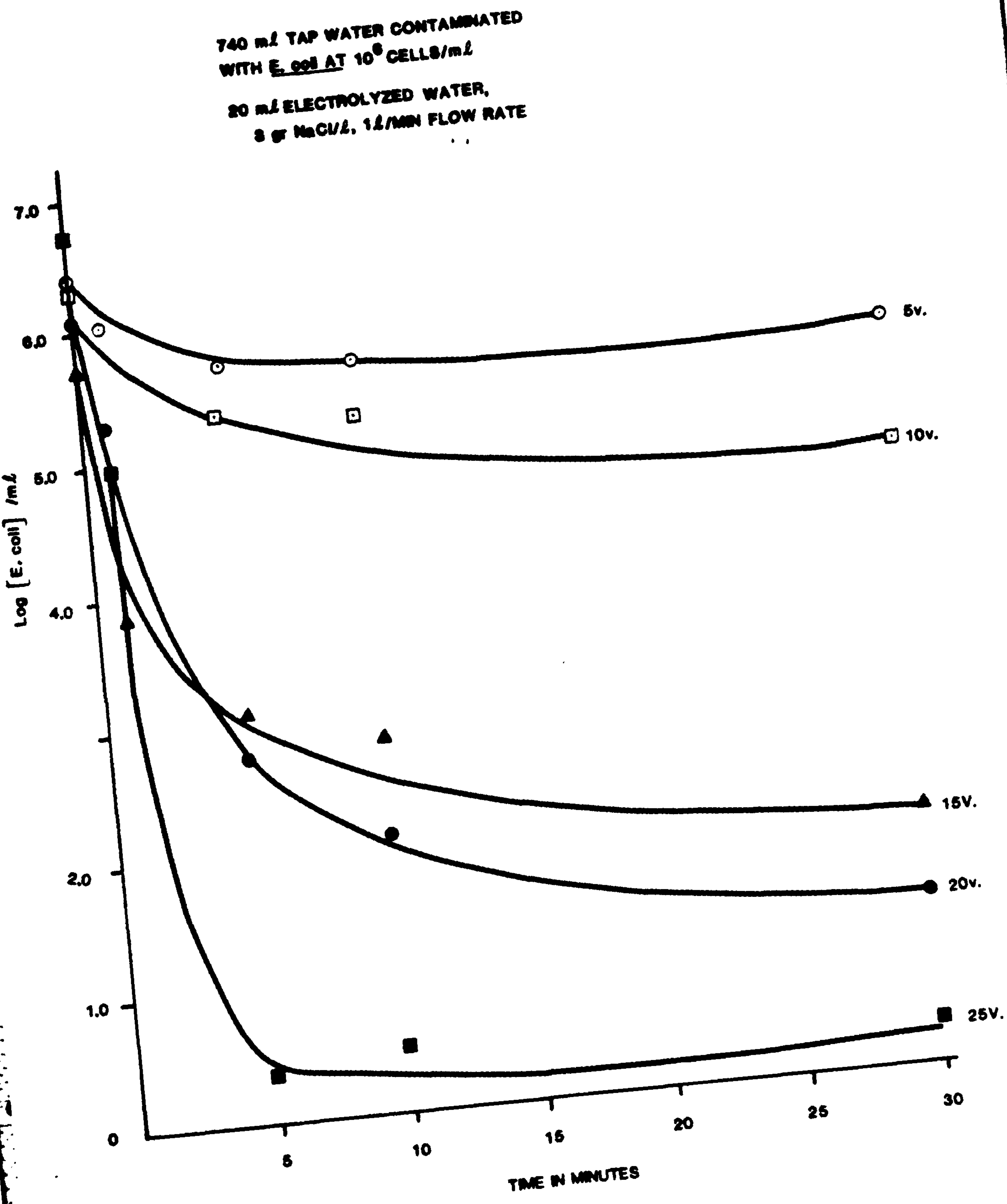

Figure 4-1. Dynamics of E. coli Kill by Ozone Solutions

A test of water sterilization was run using 30 g NaCl/ℓ in tap water as the electrolyte solution because this approximates sea water, a source which could be readily available. Water contaminated with 10^6 E. coli/ml was sterilized to less than 2 bacteria per ml within 30 minutes by treating 38 volumes of contaminated water with 1 volume of 30 g NaCl/ℓ solution electrolyzed at 6.8 volts, 9.5 amps, flowing at 1 ℓ/min. On this basis, about 3 times as much water could be sterilized per day as using 3 g NaCl/ℓ, which is about 150,000 liters. The added salt increased total dissolved solids (TDS) concentration by about 250 mg/ℓ. The New Mexico water quality standard, which is an aesthetic limit for TDS, is 1,000 mg/ℓ. The Army long-term quality standard for TDS is 1500 mg/ℓ.[6]

An experiment was conducted to test the effectiveness of dilute hypochlorite solution compared with the ozone/chlorine-hypochlorite solutions generated electrolytically to kill microorganisms. In these tests, one volume of oxidant solution was mixed with 38 volumes of tap water contaminated with 10^6 E. coli/ml. Concentrations of coliform bacteria were measured over a 30 minute period. Total kill was produced in 10 minutes by the 3 g NaCl/ℓ solution electrolyzed at 25 volts 9.5 amps, the 30 g NaCl/ℓ solution electrolyzed at 6.8 volts 9.5 amps, and the $Ca(OCl)_2$ solution. However, after 1 minute, both of the ozone/chlorine-hypochlorite solutions had killed slightly more bacteria than the $Ca(OCl)_2$ solution (Table 4-4). There may be a synergistic effect using the ozone/chlorine-hypochlorite solution compared to using hypochlorite alone. Ozone is known to act faster than chlorine in killing microorganisms.[4] This is suggested by the slightly faster kill rate obtained from the electrolyzed 30 g NaCl/ℓ solution compared to hypochlorite alone. Both solutions have a comparable total chloride concentration.

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6. Department of the Army Technical Bulletin R B Med 229, "Sanitary Control and Surveillance of Water Supplies at Fixed and Field Installations," U.S. Government Printing Office, 1975.

4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

TABLE 4-4

COMPARISON OF BACTERIAL KILL BY HYPOCHLORITE AND ELECTROLYZED SOLUTIONS (One Volume of Solution Added to 38 Volumes Tap Water Contaminated with E. coli)

Solution	Salt Conc (g/ℓ)	Total Cl_2 (mg/ℓ)	Initial Oxidant (mg/ℓ)	E. coli Concentration (Cells/mℓ) Initial	1 min	5 min	10 min
$Ca(OCl)_2$	9.4×10^{-2}	47	1.2	10^6	1.7×10^5	<1	<1
NaCl 25 v, 9.5 a	3.0	150	1.2	10^6	9.3×10^4	1.6×10^2	<1
NaCl 6.8 v, 9.5 a	30.0	44	3.9	10^6	1.5×10^4	<1	<1

Dilute acid solutions were electrolyzed and the effluent tested for kill of E. coli, in the same manner as the NaCl solutions. Perchloric acid (0.01N) and sulfuric acid (0.01 and 0.1N) were electrolyzed at 11 to 42 volts and 6.8 to 11 amps. One volume of electrolytically-generated oxidant solution was mixed with 38 volumes of tap water contaminated with 10^6 E. coli/ml. Concentrations of coliform bacteria were measured over a 30 minute period. The reduction in bacterial population (Table 4-5) was very small despite higher applied current (Table 4-4), which demonstrates that acid solutions are not nearly as effective as salt solutions in water for electrolytic treatment.

A second type of biological agent, Legionella pneumophila, the Legionnaires' Disease agent, was tested for the efficiency of kill with electrolytically produced oxidant solution. Solutions containing 985 ml of cell suspension were treated with solutions produced from 3 g/ℓ NaCl in tap water electrolyzed at 20 volts, 7 amps. Electrolyzed solution obtained by catheter from the anode area was added to form total oxidant doses of 0.75 mg/ℓ and 0.50 mg/ℓ in the L. pneumophila suspensions. The introduced solution

TABLE 4-5

EFFECTIVENESS OF ELECTROLYZED DILUTE ACID SOLUTIONS IN ACHIEVING BACTERIAL KILL (One Volume of Solution Added to 38 Volumes of Tap Water Contaminated with E. coli)

Solution	Acid Conc (N)	Volts	Amps	Initial Oxidant (mg/L)	pH	E. coli Concentration (Cells/ml) Initial	1 min	5 min	10 min
H_2SO_4	0.01	42	7.5	2.4	0.6	2×10^6	2×10^6	2×10^6	1×10^6
H_2SO_4	0.1	11	11	1.7	0.2	3×10^6	2×10^6	1×10^6	3×10^5
$HClO_4$	0.01	42	6.8	2.3	0.3	2×10^6	2×10^6	7×10^5	4×10^5

contained 1 mg O_3/ℓ and 33 mg Cl_2/ℓ. For comparison, similar tests made using solutions of 0.75 mg/ℓ ClO_2 and 0.67 mg/ℓ HOCl.

Ozone-hypochlorite is effective against L. pneumophila at the doses tested, 0.50 and 0.75 mg/ℓ (Table 4-6). There is less kill at the early sample times than was noted with E. coli, indicating that L. pneumophila may be more resistant. Experience has shown it to be difficult to kill and resistant to chlorine concentrations in drinking water. The 0.75 mg/ℓ ozone-hypochlorite solution was the most effective solution tested, superior to 0.75 mg/ℓ ClO_2 and 0.67 mg/ℓ HOCl. Again, a synergistic effect of ozone-hypochlorite is suggested by the greater kill at similar total oxidant concentrations.

TABLE 4-6

EFFECTIVENESS OF OXIDANT SOLUTIONS IN LEGIONELLA PNEUMOPHILA KILL

Solution	Total Oxidant	L. pneumophila Concentration: Cells/mℓ Initial	2 min	5 min	15 min
O_3/HOCl	0.75 mg/ℓ	10^7	1.9×10^6	1.5×10^4	3.0×10^2
O_3/HOCl	0.50 mg/ℓ	10^7	3.0×10^6	3.1×10^5	2.5×10^4
ClO_2	0.75 mg/ℓ	10^7	2.0×10^6	1.0×10^3	1.0×10^3
HOCl	0.67 mg/ℓ	10^7	8.0×10^6	6.0×10^6	1.0×10^6

These tests show that severely contaminated water can be sterilized within 5 minutes by mixing 38 volumes with one volume of electrolytically treated water. Either 3 g NaCl/ℓ solution treated with 25 volts at 9.5 amps or 30 g NaCl/ℓ solution treated with 6.8 volts, at 9.5 amps, produced at a rate of 1 ℓ/min, will kill virtually all coliform bacteria. At this production rate, 56,000 liters (14,800 gallons) of water per day could be sterilized. Less severely contaminated water could be sterilized at lower power requirements.

The tests establish the voltage/amperage and salt concentration requirements for optimum kill of a worst-case microorganism contaminated water, completing Task 1.

4.2.4 System Design Modifications

The standard electrodes used in these early experiments were platinum foil bonded to a titanium substrate (Patent No. 3,443,055). An improved electrode was subsequently obtained for testing (Patent No. 3,547,600). In the improved electrode, the platinum foil is bonded to the titanium through an intermediate layer of tantalum. Preliminary tests comparing the two (Table 4-7) indicate that the chlorine generating efficiency of the improved electrode is 2.8 times that of the original electrode. The reason for superior performance is not known but may be due to better bonding and increased current flow. The improved type of electrodes formed as flat plates were incorporated into the prototype electrolysis unit built subsequently for Task 2.

TABLE 4-7

COMPARISON OF STANDARD AND IMPROVED ELECTRODES

Electrode	Volts	Amps	T_{in} (°C)	T_{out} (°C)	pH_{in}	pH_{out}	Cl_2 (mg/ℓ)	O_3 (mg/ℓ)	Electrode Area (cm^2)
Original	5	0.5	23	23	7.05	7.6	3.0	0	20
Improved	5	0.6	23	23	7.05	7.9	8.3	0	24

Tests of longevity have been conducted on the standard electrodes. A 1200 hour test in which 100 volts at 10-20 amps was passed between electrodes resulted in a negligible loss of the electrode material. A minimum operating life expectancy of 6 years was estimated from this test. On a commercial scale, a unit installed to purify a municipal water supply in Neo Pendeli, Greece, was operated for 6 hours per day at 20 volts and 35-40 amps. Due to extreme hardness of the water, the electrodes requried cleaning weekly. The electrodes were 10.16 cm long, 5.08 cm wide. This experimental installation was operated for 6 months, or 1100 hours of operation. A similar installation in Zakynthos, Greece, was operated for more than 5 years, 14 hours per day, at 20 volts and 33-40 amperes. The electrodes, 10.16 cm × 5.08 cm, were acid-washed twice a week because of the hardness of the water. This unit was first serviced 3½ years after installation. Assuming that the electrodes were replaced at that time, the electrode operating life would have been 18,000 hours.[2]

The cost of the commercial electrodes, 10.16 cm × 5.08 cm, is not known at this time. The cost of electrodes used in the prototype unit, 4.5 cm × 5.5 cm, is about $250.

All foregoing tests suggested that the ozone (measured by $Na_2S_2O_3$ titration) was being destroyed within the electrolytic cell by OH^- produced at the cathode. This is reported in other work[7], and the small distance (0.5 cm) between electrodes supports this idea. To avoid or reduce mixing of products formed at the separate electrodes, a semipermeable membrane, Dupont Nafion 315, was inserted between the electrodes. Samples of the

---

2. Wilk, I. J., Consultant, personal communications with H. Gram and unpublished work, 1969-1982.

7. Farooq, S., E. S. K. Chian, R. S. Englebrecht, "Basic Concepts in Disinfection with Ozone" Journal WPCF, August 1977, pp. 1818-1831.

were removed from the anode side of the cell with a catheter for analysis. In both flowing and stationary systems, the interposition of a membrane between the electrodes resulted in significantly higher ozone concentration in the electrolyzed water (Table 4-8).

TABLE 4-8

EFFECT OF INTER-ELECTRODE MEMBRANE
ON MEASURABLE OZONE AND CHLORINE CONCENTRATIONS

Solution	Flow Rate	Membrane	Volts	Amps	Cl_2 (mg/ℓ)	O_3 (mg/ℓ)
3 g NaCl/ℓ	1 ℓ/min	+	25.0	9.0	19.3	7.2
		-	25.0	10.0	42.5	5.4
30 g NaCl/ℓ	stationary	+	10.0	11.4	370.0	62.5
		-	6.8	10.0	920.0	0

The membrane concept was incorporated in the prototype electrolysis unit. The substitution of better cell design and electrode components during the design of the working model resulted in a superior piece of equipment. The working model is considered to incorporate the latest information available from the preliminary studies.

4.2.5 Prototype Electrolysis Unit

A prototype electrolysis unit which incorporates the improved electrodes and interposed membrane was constructed.

Process Description

A schematic of the electrolytic water purification system is shown in Figure 4-2. In this system raw water is mixed with an electrolyzed salt solution to destroy impurit by reaction with ozone, hypochlorite, and free radicals. These chemical species are generated in the salt solution as it is passed between the two electrodes of the electrolysis unit. The quantities of ozone and hypochlorite that are thus generated are related to the voltage and amperage applied to the electrodes.

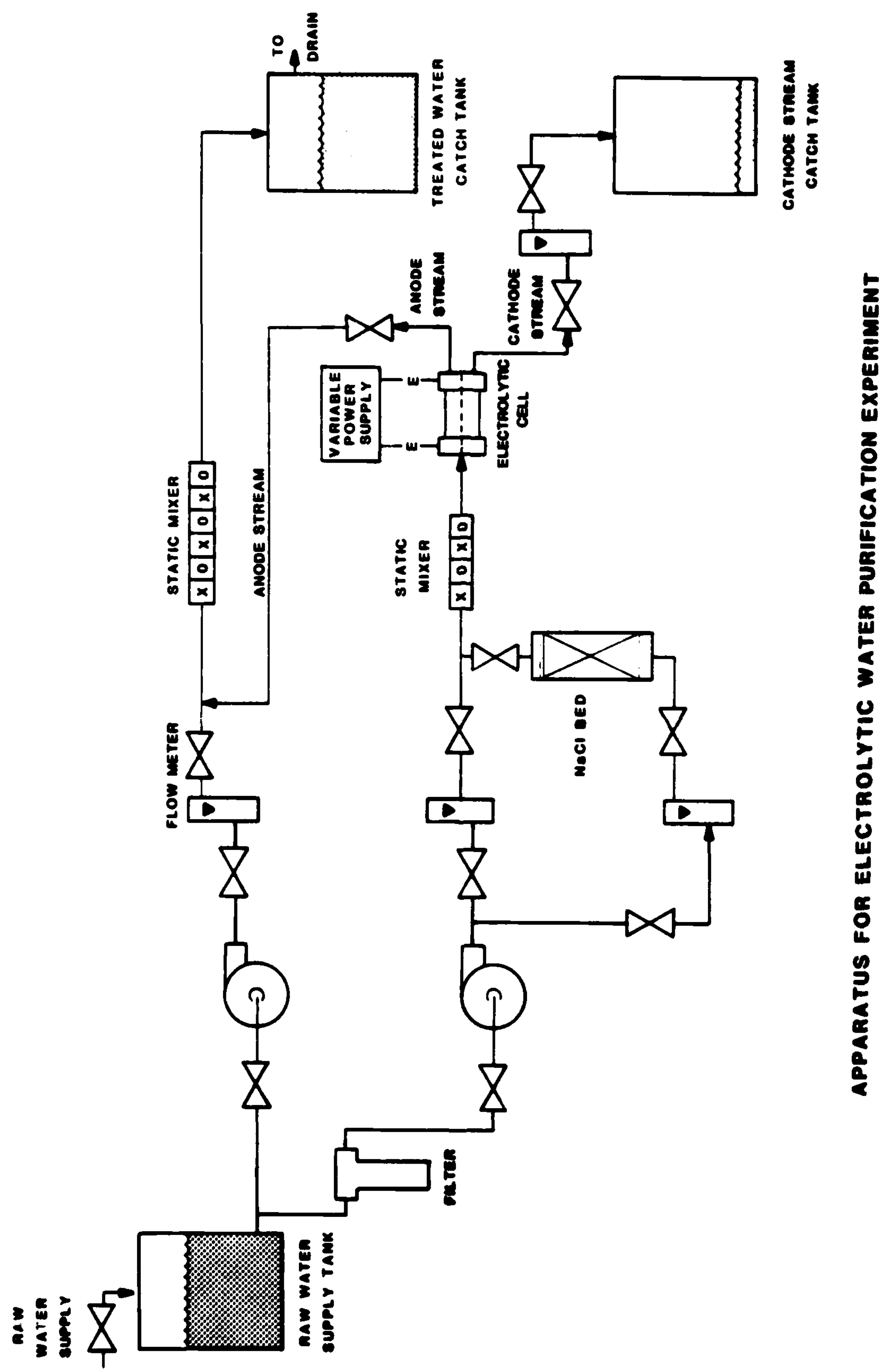

Figure 4-2. The Prototype Electrolysis Unit

The salt solution is produced by contacting NaCl crystals with raw water to produce a saturated solution. The solution is then diluted with raw water to a predetermined concentration. Complete mixing of the saturated salt solution with raw water is assured by the use of a static mixer.

The electrolyte solution is passed between two novel electrodes at a flow rate of 1 liter per minute. Electrolysis produces ozone and chlorine-hypochlorite in situ. The amount of oxidant formed is sufficient to purify up to 60 volumes of raw water per volume of electrolyzed solution. The electrolyzed solution and raw water are mixed in a static mixer to maximize contact of impurities with oxidant. The water is stored in a catch tank after treatment.

The anode and cathode outflow streams are kept separate in order to analyze the anode stream. Early tests showed a decrease in ozone measured when the two streams were allowed to mix, probably due to the decomposition of ozone by OH^-. Under field conditions it may be desirable to reserve the cathode stream until sterilization of the water has taken place, then add it to the treated water to raise the pH and obtain decomposition of chemical agents by alkaline hydrolysis.

The key element of the electrolysis system is the electrolytic cell (Figure 4-3). The overall length of the unit is 17.75 cm (7 in.); the height is 10.8 cm (4.25 in.). Electrodes formed as flat plates are oriented along the sides of the cell. The distance between electrodes is 0.5 cm (0.2 in.). Total volume of the cell is 13.1 ml. The membrane, Dupont Nafion 315, is oriented as nearly as possible down the center of the cell. Both electrodes are the improved titanium-tantalum-platinum type, but only the anode needs to be this type. Based on the size of the electrode cell, this prototype unit is portable, as specified in Task 2.

The volume of the system from the electrode to the static mixer where untreated and electrolyzed solution are mixed is 33 ml. At a flow rate of 1 ℓ/min, residence time of electrolytically treated water from entering the cell to mixing is less than 3 seconds.

Figure 4-3. The Electrode Cell

The volume of the static mixer and piping to the storage (receiving) tank is about 1 ℓ. At an electrolyzed solution/raw water ratio of 1/40 and an electrolyzed water production rate of 1 ℓ/min, the residence time between entering the mixer and collection in the tank is about 1.5 seconds.

The prototype unit utilizes a variable power supply. This can be reduced in size for a field unit which need only produce a single voltage. Specifically, tests were made to determine whether voltage available from an automobile battery, 10-12 volts, would generate sufficient ozone to kill microorganisms, which it did, as discussed in Subsection 4.2.7.

Components, Parts, and Materials

Storage Tanks

Storage for the raw water and the treated water is in plastic containers large enough (150 gal) to allow several minutes of continuous operation of the electrolyzer. Plastic is used to avoid the potential problem of introducing corrosion products into the water. The storage tanks would not be an integral part of a prototype unit.

Pumps

Two pumps are required to move the water and electrolyte solution through the system. Water is pumped to the NaCl bed and peristaltic pump. Peristaltic pumps operate by squeezing a flexible tubing and thus forcing the liquid ahead of the squeeze point. The peristaltic pump has variable speed controls to allow adjustment of the flow rate. Additionally, control valves at the rotometers provide accurate flow control. The raw water is moved with a centrifugal pump. This pump is capable of moving up to 10 gallons per minute of raw water.

NaCl Bed

The NaCl bed is a plastic container filled with NaCl crystals. Raw water enters through the top of the container and is directed to the bottom by an internal pipe. Saturated salt solution exits the top of the container.

Static Mixers

The static mixers are plastic pipes equipped with Ross plastic static mixer elements. These elements provide positive mixing of the solutions but have no moving parts.

Rotometers

The outlet from each pump is connected to plastic, floating-ball-type rotometers to measure flow rates. Control valves are an integral part of the rotometers.

Electrolytic Cell

The electrolytic cell consists of a pair of platinum coated electrodes fitted in an acrylic container. The container holds the electrodes at a 0.5-cm spacing and directs electrolyte flow between them. The ends of the container are fitted with plastic tubing connectors to allow connection to the piping system. A membrane, Dupont Nafion 315 is permanently fixed between the electrodes. Division of flow to the two chambers around the membrane is controlled by a rotometer and control valve in the stream exiting the cathode.

Piping and Valves

All piping and valves throughout the system are plastic, either teflon, PVC or tygon.

Power Supply

The power supply is capable of converting 115 vac, 60 hz power to 0-60 vdc. It has an amperage rating of 20 amps. The lab power supply may be different from that used in a prototype unit, and is much larger than what would be required by a field unit.

4.2.6 Ozone Generation Tests

Ozone was generated by the prototype unit using salt concentration, voltage, and flow rate parameters established in Task 1. Ozone was measured in the anode stream, using the more sensitive method of indigo dye bleaching.[8] This method is detailed in Appendix A. Indigo trisulfonate which has an absorbance maximum at 600 nm, is rapidly and stoichiometrically oxidized by ozone to isatin sulfonic acid, colorless at that wavelength. Ozone was then measured by the disappearance of dye. Chlorine causes a slow decoloration of the dye within 1 hr.[8] Interference by chlorine was minimized by promptly measuring the color disappearance, in solution acidified to pH 2 with H_2SO_4. The ozone measurements are relative in that the method was not standardized against known ozone concentrations. Total chlorides were measured using a HACH colormetric procedure. This method utilizes prepackaged reagents and a visual color comparison against a standard color wheel. It is considered indicative only.

Ozone generated by the prototype unit was related directly to concentration of salt in the solution passing through the cell and to the applied voltage. Tests over the range of 2 to 25 volts, 0.1 to 3.5 amps, were carried out on 3 g NaCl/ℓ solution (Figure 4-4) and 5 to 20 volts, 0.75 to 7.5 amps, on 30 g NaCl/ℓ solution (Figure 4-5). The ozone generation in 30 g NaCl/ℓ is about 12 times that in 3 g NaCl/ℓ at the same voltage. Increasing the voltage beyond 25 volts was shown not to be necessary.

Another determination of the effect of salt concentration on ozone generation was made over the range 0.625 to 30 g NaCl/ℓ (Figure 4-6). Again, there is a strong linear relationship, and a great deal of ozone can be produced at high salt concentrations, as much as 163 mg/ℓ in 30 g NaCl/ℓ solutions, electrolyzed at 10 volts, 3.5 amps.

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8. Bader, H. and J. Hoigne, "Determination of Ozone in Water by the Indigo Method," <u>Water Research</u>, Vol. 15, pp. 449-456, 1981.

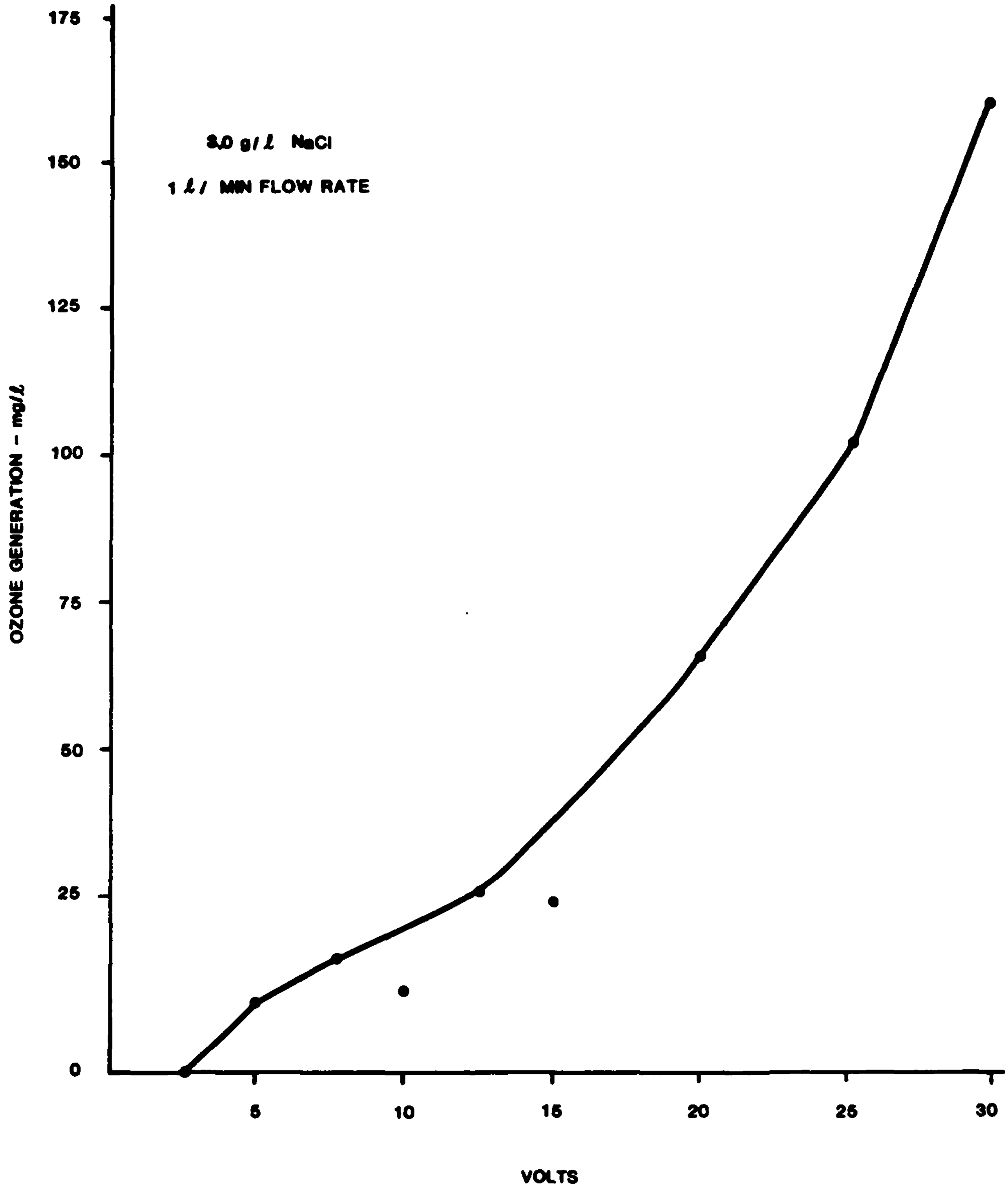

Figure 4-4. Ozone Generation - Voltage Relationship in 3 g NaCl/ℓ Solution

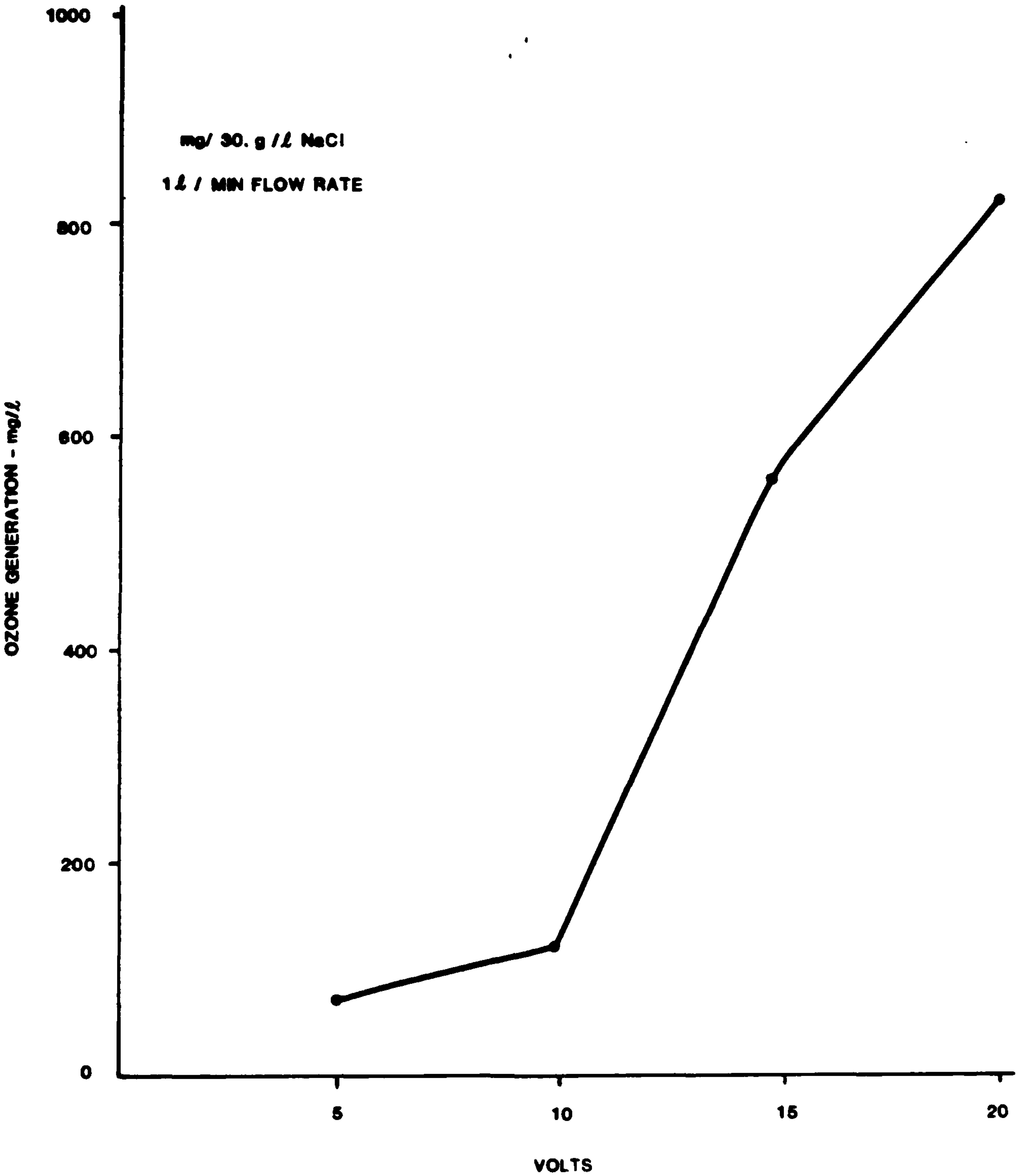

Figure 4-5. Ozone Generation - Voltage Relationship in 30 g NaCl/ℓ Solution

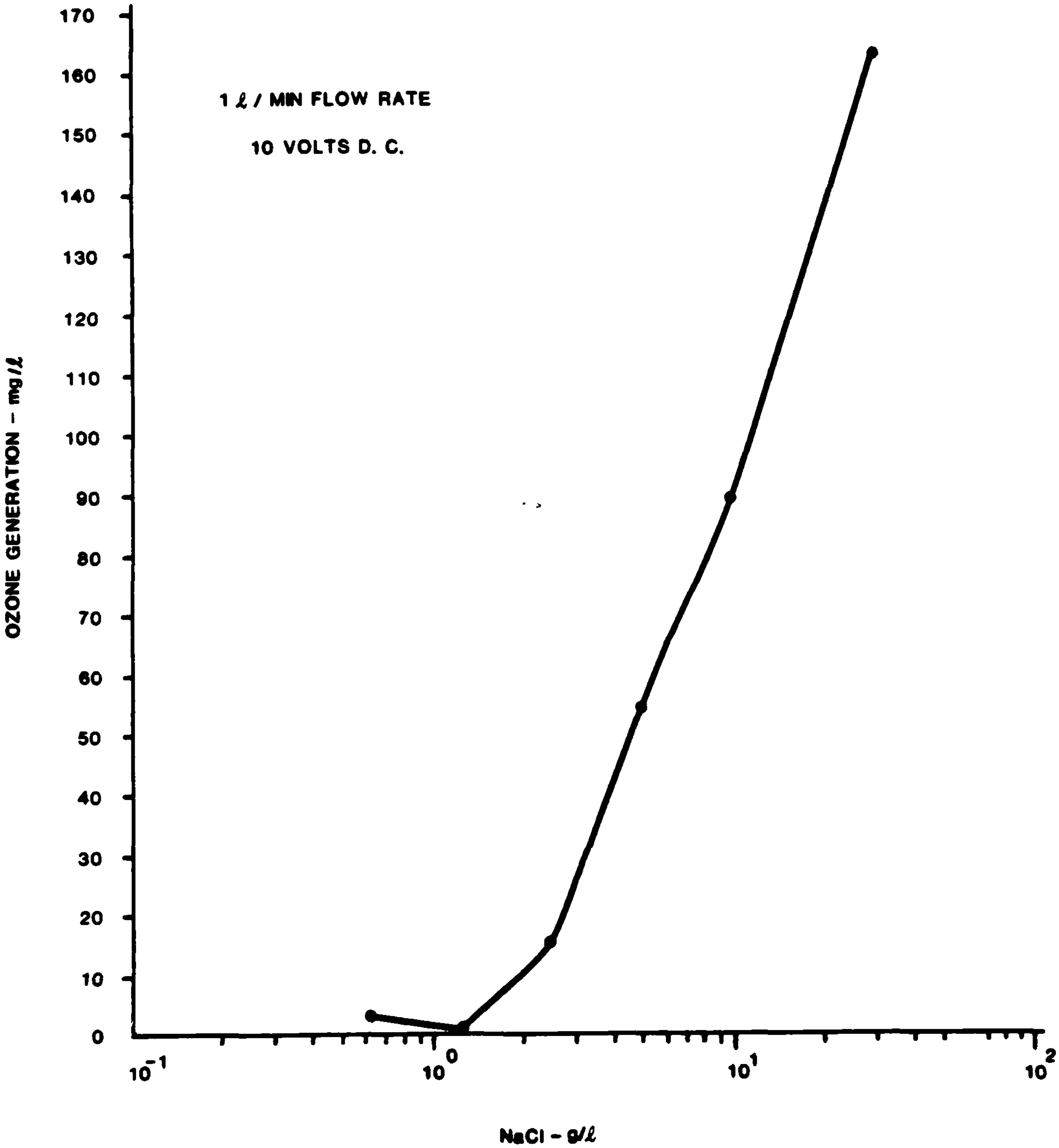

Figure 4-6. Ozone Generation Relationship to Salt Concentration

An attempt was made to measure ozone generated at flow rates less than 1 ℓ/min. The range sampled was 0.2 to 1.2 ℓ/min. As in earlier tests, the ozone concentration in the anode stream was nearly independent of flow rate. The reason for this is not known, but it may be an electrode surface saturation phenomenon, although the low power level (10 volts) was selected in an effort to avoid this phenomenon.

These ozone generation tests performed using the prototype unit complete Task 2.

4.2.7 Microbiological Tests

Sterilization tests were run on surface stream water contaminated with E. coli as a demonstration of electrolytic water purification. For this series of tests, water was collected from Frijoles Creek in Bandelier National Monument. A worst-case situation was established by spiking the water with raw sewage inflow to the Bayo Canyon treatment plant in Los Alamos County, N.M. to provide an E. coli population of 10^5 - 10^6/100 ml. Ozone/chlorine-hypochlorite solution was generated by passing water of 3 and 30 g NaCl/ℓ through the prototype electrolysis unit at 1 ℓ/min. Volumes of the anode stream which correspond to 1/20, 1/40, and 1/60 ratio of electrolyzed (anode + cathode stream) to untreated water were added to the contaminated water. This was stirred intermittantly and samples were removed to determine the microorganism population at 5-minute, 10-minute, 2-hour, (30 g NaCl/ℓ solution only), and 24-hour intervals. The cathode stream was added to the treated water after 2 hours and the solution was allowed to stand covered for 24 hours to determine whether the treated water was sufficiently sterile to prevent the regrowth of coliform bacteria. The membrane filter technique[1] was used to determine bacterial population. Filters were incubated with m FC medium at 44°C to make the test specific for fecal coliform.

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1. Greenburg, A. E., J. J. Conners, D. Jenkins, and M. A. H. Franson, eds., "Standard Methods for the Examination of Water and Wastewater," 15th ed., Amer. Pub. Health Ass'n., 1980.

The 30 g NaCl/ℓ solution electrolyzed at 10 volts, 3.5 amps contained 163 mg/ℓ O_3 and about 200 mg/ℓ Cl_2. At 1/20 dilution, water was sterilized within 10 minutes. At 1/40 dilution, 2 hours were required for sterilization. At 1/60 dilution, after 2 hours the water did not meet federal drinking water standards for coliform bacteria. The Federal standard for drinking water is one coliform/100 ml. After 24 hours, the 1/20 and 1/40 dilutions were still essentially sterile and the 1/60 dilution nearly so (Table 4-9). The 1/20 dilution met the federal standard; the 1/40 dilution contained 2 coliform cells/100 ml; and the 1/60 dilution contained 9 coliform cells/100 ml.

The 3 gr NaCl/ℓ solution electrolyzed at 25 volts, 2.5 amps, contained 100 mg/ℓ O_3 and about 22 mg/ℓ Cl_2. At 1/20, 1/40, and 1/60 dilutions water contained about 10^5 coliform cells/100 ml after 10 minutes, and did not approach the drinking water standard. After standing 24 hours, the odor was gone, the turbidity had decreased, but water still contained too many coliform cells to be safe for drinking. The large quantity of dissolved and suspended organic material present probably depleted the ozone concentration too far for effective bacterial kill. A prefilter would alleviate this problem if suspended material is the substantial contributor to ozone demand.

The treatment of raw water with electrolyzed solution appeared to improve other parameters of water quality. The untreated water was slightly turbid, slightly tinted, and had a strong sewage odor. After standing for 24 hours in closed containers, the water no longer appeared turbid although the tint remained. The sewage smell was no longer detectable in even the water that had been treated with the most dilute electrolyzed solution. Thus, water treated electroytically would be aesthetically acceptable for consumption, which could be important under field conditions. No residual ozone was measured in samples which had stood covered for 24 hours. The pH was 7.72-7.75 compared with 8.05 for tap water.

The final experiment was a flow-through test of the entire prototype electrolysis unit. The tank which corresponds to raw water intake (Figure 4-1) was filled with 110 gallons of turbid Frijoles Creek water spiked

TABLE 4-9

DYNAMICS OF E. COLI KILL:
30 g NaCl/ℓ ELECTROLYZED SOLUTION

Dilution Factor (Volume Electrolyzed/Untreated)	Time	E. coli Concentration (cells/100 ml)
1/20	0	2×10^5
	5 min	1×10^2
	10 min	3
	120 min	~1
	24 hr	1
1/40	0	2×10^5
	5 min	1×10^3
	10 min	2×10^2
	120 min	~1
	24 hr	2
1/60	0	2×10^5
	5 min	5×10^4
	10 min	TNTC*
	120 min	8
	24 hr	9
Unspiked water		3×10^1
Federal standard for drinking water		1

* Too numerous to count at dilutions prepared.

with Bayo Canyon raw sewage inflow to provide an E. coli population of 4×10^5/100 mℓ. A portion of this water was combined with supernatant from the salt bed to form a solution containing 30 g/ℓ NaCl. This was pumped through the electrolysis cell at a rate of 1 ℓ/min. The cell was operated at a current flow of 20 volts, 7.5 amps and 10 volts, 3.5 and 4 amps. The anode stream was mixed with raw water at a production rate of 300 and 600 gallons (1135 and 2270 ℓ) per hour. About 30 gallons of water was produced. The treated water was collected and samples were removed to determine the microorganism population at 5-, 10-, and 30-minute intervals after treatment. The membrane filter technique[1] was used. Filters were incubated with m FC medium at 44°C to make the test specific for fecal coliform. Because of equipment malfunction, ozone and chloride measurements were not made.

At a production rate of 600 gal/hr (2270 ℓ/hr) and 10 volts, 3.5 amps current, the dilution factor of electrolytically treated water to raw water was 1/40. As shown in Table 4-9, the bacterial kill was substantial within 5 minutes and the water was sterile within 30 minutes.

At the same 600 gal/hr (2270 ℓ/hr) production rate but 20 volts, 7.5 amps current, water was nearly sterile within 5 minutes and sterile within 30 minutes, as shown in Table 4-9. The higher current applied was shown in previous experiments to generate more ozone and chlorine-hypochlorite. This increased ozone satisfied the ozone demand due to organic material in the Frijoles Creek water more rapidly, which may account for the more rapid rate of bacterial kill.

At a production rate of 300 gal/hr (1135 ℓ/hr) and 10 volts, 4 amps, the dilution factor of electrolytically treated water to raw water was 1/20. As shown in Figure 4-9, the water was sterilized within 10 minutes. The smaller dilution factor, or higher concentration of oxidant contacting organic material and bacterial population, should account for the more rapid rate of bacterial kill.

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1. Greenberg, A. E., J. J. Connors, D. Jenkins, and M. A. H. Franson, eds., "Standard Methods for the Examination of Water and Wastewater," 15th ed., Amer. Pub. Health Assn., 1980.

After 30 minutes, the odor of the sewage-spiked water had dissipated. After 24 hours, the water appeared less turbid. However, the extent of settling was not determined.

The single-cell electrolysis unit operating at 20 volts, 7.5 amps, produced sterile water from turbid surface water heavily contaminated with coliform bacteria. Water was produced at a rate of 600 gal/hr (2270 ℓ/hr) which corresponds to 18,000 ℓ/8 hr (4,800 gal/8 hr) or 54,500 ℓ/24 hr (14,400 gal/24 hr).

These experiments complete Task 4.

TABLE 4-9

PROTOTYPE UNIT TEST OF *E. COLI* KILL

Operating Parameters*	Time	*E. coli* Concentration (cells/100 ml)
600 gal/hr	0	4×10^5
10 volts, 3.5 amps	5 min	2×10^2
1/40 dilution factor	10 min	3×10^1
	30 min	<1
600 gal/hr	0	4×10^5
20 volts, 7.5 amps	5 min	3×10^1
1/40 dilution factor	10 min	8×10^1
	30 min	1
300 gal/hr	0	4×10^5
10 volts, 4 amps	5 min	5×10^1
1/20 dilution factor	10 min	<1
	30 min	<1
Federal standard for drinking water		1

*Electrode cell flow rate = 1 ℓ/min (constant)

4.2.8 Potential for Detoxification of Chemical Warfare Agents

A literature survey was conducted to determine the types of compounds used as chemical warfare agents that are susceptible to decomposition by oxidation-ozonolysis and/or hydrolysis in acidic or basic solutions. If such agents contaminate drinking water, they could be detoxified by treating the water with ozone or by substantially changing the pH of the water. Ozone is known to readily oxidize a range of phenolic compounds, detergents, pesticides, chemical manufacturing wastes, aromatic compounds, and proteins. Some chlorinated hydrocarbons are not readily oxidized, however.[4]

A computerized literature search of chemical warfare agents was conducted. The printout is attached as Appendix B.

The following compounds[9,10] should be subject to alkaline hydrolysis and/or oxidation-ozonolysis .

Phosgene	PD(Phenyldichloroarsine)
Tabun	ED (Ethylenedichloroarsine)
Sarin	CNL
Soman	MD (Methydichloroarsine)
VX (Nerve agent)	BZ (Incapacitating agent)
CN (Cyanogen)	DA (Diphenylchloroarsine)
HCN (Hydrogen cyanide)	DM (Adamsite)
Mustards	DC (Diphenylcyanoarsine)
Lewisite	

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4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

9. Department of the Army, "Military Chemistry and Chemical Compounds," Field Manual, FM 3-9, October, 1975.

10. Hoskin, F. G. G. and A. H. Roush, "Hydrolysis of Nerve Gas by Squid-Type Diisopropyl Phosphorofluoridate Hydrolyzing Enzyme on Agarose Resin," Science, Vol. 215 (5), pp. 1255-1257, 1982.

The prototype electrolytic unit is capable of generating water which contains about 800 mg O_3/ℓ at a rate of 30 ℓ/hour effluent from the anode. The anode stream is about pH 4 and the cathode stream is about pH 10, depending upon applied voltage. Thus, this unit produces conditions under which many chemical warfare agents could be decomposed.

Detoxification studies of selected chemical agents can be undertaken in Phase II.

The literature search completes Task 3.

4.3 Discussion

4.3.1 Historical Perspective

Ozone has long been used in treatment of potable water because it kills bacteria and viruses, removes tastes, odors and colors by oxidizing dissolved and suspended organic materials, and oxidizes a range of sulfides and cyanides.[3,7,11]

As a bactericidal agent, ozone acts rapidly to lyse or rupture the cell walls. In contrast, chlorine kills by diffusing through the cell walls and inactivating the enzyme systems. Disinfection of E. coli with ozone is

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3. Venosa, A. D., Ozone as a Water and Wastewater Disinfectant: a Literature Review in "Ozone in Water and Wastewater Treatment," F. L. Evans III, ed., Ann Arbor Science Publishers, Inc., 1971.

7. Farooq, S., E. S. K. Chian, R. S. Englebrecht, "Basic Concepts in Disinfiction with Ozone," Journal WPCF, August 1977, pp. 1818-1831.

11. Hill, A. G. and R. G. Rice, Historical Background, Properties and Applications in "Handbook of Ozone Technology and Applications," Vol. 1, Ann Arbor Science, 1982.

3,125 times faster than with chlorine.[4] Ozone is known to be effective against a range of microorganisms at very low concentrations (Table 4-10) once the ozone demand due to dissolved organic material has been satisfied.

The prototype unit is capable of generating water containing a tremendous excess of dissolved ozone over that required to kill any microorganism listed in Table 4-10. The particular advantage of this

TABLE 4-10

LETHALITY OF OZONE ON MICROORGANISMS

Organism	Ozone Concentration in mg/ℓ for 99% Destruction in 10 min
Escherichia coli	0.001
Streptococcus fecalis	0.0015
Microbacterium tuberculosum	0.005
Polio virus	0.01
Bacillus megatherium (spores)	0.1
Endamoeba histolytica	0.03

(Source: Reference 4)

system is that ozone is generated directly in water, eliminating the slow gas-to-liquid transport step which is a part of silent discharge ozonolysis. Approximately 600-800 mg/ℓ of dissolved ozone has been produced at 15-20 volts. At 10 volts, the equivalent of an automobile battery, water containing 160 mg O_3/ℓ was produced (Figure 4-7). At the pH of the anode effluent stream (pH 4), ozone decomposition is very slow. Surface waters can contain considerable concentrations of dissolved organic material, which exert ozone demand that will reduce the amount of ozone available to kill microorganisms. However, the large amount of ozone which can be produced indicates that sufficient ozone will be available to sterilize water even under severe conditions.

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4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

Ozone is a more satisfactory disinfection agent than several chlorine species (Table 4-11). In this study, hypochlorite performed better only on virus. To chlorinate water directly under field conditions, chlorine agents which are hazardous must be transported. By contrast, the electrolytic unit produces ozone and hypochlorite in water on demand with very low power requirements. Thus the biohazards of gaseous ozone and chlorine are avoided. Ozone in water of normal pH at ambient temperatures has a half-life of 20-40 minutes, and decomposes to oxygen.

TABLE 4-11

COMPARATIVE DISINFECTION EFFICIENCY AT 5°C

Disinfectant	Enteril Bacteria	Organism Virus	Spores	Amoebic Cysts
O_3	500	0.5	2	0.5
Cl_2 (as HOCl)	20	1.0	0.05	0.05
Cl_2 (as OCl^-)	0.2	≤0.02	≤0.0005	0.0005
Cl_2 (as HN_2Cl)	0.1	0.005	0.002	0.02

(Source: Reference 4)

4.3.2 Unit Development and Testing

Experiments conducted under Task 1 showed that chlorine-hypochlorite concentration increased as voltage and salt concentration increased but that ozone levels were low. The apparatus was modified by enclosing the electrodes in a flow-through chamber and by placing a membrane between the electrodes to test whether more ozone could be recovered by isolating the anode from the cathode stream. This proved to be the case. Much higher concentrations of ozone were then measured in the anode effluent from the electrolytic cell.

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4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

A prototype electrolysis unit was constructed using PVC or CPVC materials to avoid material degradation by ozone. The unit incorporated the improved platinum-titanium-tantalum electrodes and a Dupont Nafion 315 semipermiable membrane placed between the electrodes. The flow-through system is capable of treating water at 1 ℓ/min flow rate over a 0-30 volt range. The unit was tested over a NaCl concentration range of 0.6 to 30 g/ℓ as described in Subsection 4.2.6. The unit performed extremely well; virtually the only problem encountered was the destruction of the bonding material used in making the cell by ozone. Improved cell design is a goal of Phase II of this project. Basically, the unit is extremely sturdy. There are no moving parts, except for the pump, which could be replaced by gravity flow under many conditions.

Ozone-hypochlorite solutions were produced over a range of 5-25 volts, 0.1 to 9.5 amps, at 1 ℓ/min flow rate. The progress and extent of E. coli kill was studied as described in Subsection 4.2.2. Sterilization of contaminated water took place during the first 5-10 minutes of treatment. One volume of tap water containing 3 g NaCl/ℓ electrolyzed at 25 volts, 9.5 amps sterilized 38 volumes of contaiminated water. Tap water containing 30 g NaCl/ℓ, electrolyzed at 6.8 volts, 9.5 amps produced similar results. Comparable bacterial kills were found for 47 mg/ℓ $Ca(OCl)_2$ solution. Ozone-hypochlorite solution of 0.75 mg/ℓ was very effective in killing L. pneumophila, the causative agent of Legionnaires' Disease, as discussed in Subsection 4.2.2.

To investigate bacterial kill under simulated severe field conditions, surface water from Frijoles Creek collected in Bandelier National Monument was spiked with raw sewage inflow to the Bayo Canyon treatment plant in Los Alamos County, N.M. to a fecal coliform count of 4×10^5/100 ml. This water contained considerable organic material. Based on the rate of bacterial kill, sterile water was produced in 30 minutes using a solution containing 30 g NaCl/ℓ electrolyzed at 20 volts, 7.5 amps, produced at l ℓ/min and diluted 1/40 with raw water. Production rate was 2,270 ℓ/hr (600 gal/hr). The sewage odor had disappeared, although some tint remained.

The design goal, specified in the Phase I proposal, was a unit capable of producing 1,000 ℓ of drinkable water per day. The working model exceeds this specification by 18-fold using very realistic operating conditions. The electric current required to meet this 2,270 ℓ/hr sterile water production rate, 20 volts at 7.5 amps or 0.15 kwh, could be provided by a small, self-contained gasoline powered generator.

The electrolytic unit constructed provides ozone-hypochlorite solution capable of killing microorganisms. Dissolved and suspended organics in the raw water are also destroyed. The anode stream is pH 4 and the cathode stream pH 10. These conditions can be used to detoxify many chemical agents by hydrolysis under alkaline or acid conditions.

The microorganism kill documented in these experiments cannot be assigned either to ozone or to chlorine-hypochlorite, since both are generated electrolytically in the NaCl solution. Ozone is known to be a more efficient agent against microorganisms than chlorine.[4] The electrolytically generated oxidant solution was more effective than hypochlorite alone against E. coli (Table 4-4). The extreme effectiveness of the electrolyzed solution in treating contaminated water indicates a synergistic effect. The electrolytically generated oxidizing solution kills faster than more conventional methods of water treatment, and uses only water and NaCl, which eliminates the need for handling chlorine, a hazardous material. The method achieves complete microorganism kill and is safer for personnel engaged in water treatment.

The electrolytic unit represents a significant advance in ozonolysis because the ozone is generated directly in dilute electrolyte solution at ambient temperatures. Ozone generators generally in use for water treatment rely upon ozone generated as a gas which is then mixed with water. The

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4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

ozone must diffuse from the gaseous state into the water before effective treatment can take place.[7,11] The diffusion step is rate-limiting, and the process is inefficient. The anode temperature must be very low (-20° to -60°C) in order to achieve improved current efficiency.[12] Another method of enhancing current efficiency is to use tetrafluoboric acid (HBF_4) as an electrolyte[12], but this cannot be used in processing water for human consumption.

By contrast, the electrolytic unit operates at ambient temperatures. The only process which is temperature-sensitive is the saturation of NaCl in water, but this varies only about 10% over the temperature range 0° to 100°C, and should not pose an operational problem. After dilution, the TDS content of treated water will be increased by about 750 mg/ℓ (750 ppm), which is within DOA treated water quality standards.[6] Gaseous ozone is hazardous and toxic,[13] however, dissolved ozone breaks down to oxygen, apparently without forming toxic compounds.[4]

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7. Farooq, S., E. S. K. Chian, R. S. Englebrecht, "Basic Concepts in Disinfection with Ozone," Journal WPCF, August 1977, pp. 1818-1831.

11. Hill, A. G. and R. G. Rice, Historical Background, Properties, and Applications in "Handbook of Ozone Technology and Applications," Vol 1, Ann Arbor Science, 1982.

12. Foller, P. C., Status of Research on Ozone Generation by Electrolysis, In "Handbook of Ozone Technology and Applications," Vol. 1, R. G. Rice and A. Netzer, eds., Ann Arbor Science, 1982.

6. Department of the Army Technical Bulletin RB MED 229, "Sanitary Control and Surveillance of Water Supplies at Fixed and Field Installations," U.S. Government Printing Office, 1975.

13. Nieto, J. A., R. P. C. Salvi, and A. Gutierrez, "Ozone Hazards in γ-Plant Operation," Health Physics (42:6) pp. 865-868, 1982.

4. Grayson, M., ed., In: "Kirk-Othmer Encyclopedia of Chemical Technology," Ozone, Vol. 16, 3rd ed., John Wiley & Sons, NY, 1981.

This unit generates both O_3 and Cl_2 at the anode. As noted earlier by Szabo,[14] Cl_2 causes O_3 to decompose to a variety of products including ClO and ClO_2, which are bactericidal agents. Measurements of the concentrations of all individual species have not yet been made, but preliminary work indicates an initial large excess of O_3 over total chloride (Subsection 4.2.7). The bacterial kills noted may be due to a synergistic effect of the several species present, but cannot be ascribed at this time to any specific one.

As far as we are aware, no portable unit is presently marketed which generates ozone in situ, at ambient temperatures, for treating potable water. The electrode inventor, C. Themy, manufactures units for specific water treatment problems. Units such as Chloropac®, marketed by Englehard Industries of Union, New Jersey, generate NaOCl in water.

4.4 Conclusions

Contaminated water can be sterilized by treating it with an electrolytic process which generates ozone and chlorine-hypochlorite in dilute NaCl solution. Novel platinum electrodes are used to form the oxidants in water as the salt solution flows between them. In a pilot plant scale demonstration, electrolyzed solution mixed with 40 volumes of contaminated water produced sterile, deodorized water containing an increase of 0.75 g NaCl/ℓ at a minimum rate of 18,000 ℓ (4,800 gal)/8 hr. Water was sterile within 30 min. The power requirement was 0.15 kw. The only moving part in the appartus is the pump, which could be replaced by gravity flow if necessary. The electrolytic cell is 17.75 cm × 10.8 cm (7 in × 4.25 in). Power requirements for the unit could be supplied by a gasoline-powered generator.

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14. Szabo, Z. G., "Some Remarks on the Decomposition of Ozone Catalyzed by Chorine," C.A. 45:3 (8386), 1951.

4.5 Recommendations

This study indicates that it would be feasible to develop a portable electrolytic unit to sterilize and detoxify water under field conditions. The next phase of developmental work should focus on:

- Improving the electrolytic cell design,
- Continuing tests to define the range of field operating conditions,
- Testing destruction of chemical agents,
- Testing destruction of other biological warfare agents,
- Incorporating an ion exchange unit to remove nuclear warfare agents,
- Proving the unit by 2,000 hours of continuous operation, and
- Building a prototype multicell electrolysis unit capable of generating 55,000 gallons of sterile, decontaminated water per day.

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APPENDIX A

OZONE DETERMINATION METHOD

Introduction

At a pH below 3.0, indigo trisulfonate is bleached rapidly and stoichiometrically by ozone. The loss of color due to the ozonolysis of indigo then is determined photometrically and related to the concentration of ozone present. The maximum absorbance of the dye is at 600 mm with a molar absorptivity of 2.0×10^4 ℓ/mol-cm. The precision of the measurement is affected by the initial concentration of indigo dye present, since it is a bleaching method. Detection at the 3-μg/ℓ concentration level is possible, however. The method is subject to fewer interferences than most colorimetric and all iodometric procedures. At pH 2, chlorite, chlorate, hydrogen peroxide, and manganese(II) do not interfere. Some other interferences can be corrected for by adding malonic acid.[8]

Experimental Proceedure

The indigo reagent, potassium indigo trisulfonate (FW 616.74), was prepared by dissolving 0.66 gr $ℓ^{-1}$ (1.1 mμ) in distilled HOH. This standard dye reagent was stored at 0°C.

The analytical method is based upon decrease in absorbance due to ozone, and represents a relative measure of ozone concentration because the method was not standardized against a known concentration of ozone.

An aliquot (0.1 to 2.5 ml) of solution to be tested for ozone concentration was placed in a 1-cm path spectrophotometer tube. The volume was adjusted to 2.5 ml with distilled water. Concentrated sulfuric acid (0.1 ml) was added to bring the solution below pH 3. The indigo dye solution (0.1 ml) was added. The tubes were inverted several times. A blank was prepared using glass distilled water.

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8. Bader, H. and J. Hoigne, "Determination of Ozone in Water by the Indigo Method," Water Research, Vol. 15, pp. 449-456, 1981.

The absorbance of solutions was read within 10 minutes at 600 nm on a Bausch and Lomb Spectronic 21 spectrophotometer. Ozone was considered to be equal in moles to the amount of dye destroyed, or blank minus test solution.

APPENDIX B

Computerized Literature Survey

24 off-line printouts (the first two were printed on-line)

REVIEW CLASSIFICATION 19

141195 •80-001264
DEVELOPMENT OF TWO SEWAGE AND SOLID WASTE TREATMENT SYSTEMS WITH POTENTIAL FOR WATER REUSE AND ENERGY RECOVERY.
SMITH, DUNCAN K ; LAUGHTON RICHARD V
ONTARIO RESEARCH FOUNDATION.
PRESENTED AT AWWA RESEARCH FOUNDATION/ET AL WATER REUSE SYM, WASH DC, MAR 25-30, 79, V2, P837 (49)
TECHNICAL REPORT THE ONTARIO RESEARCH FOUNDATION HAS BEEN ACTIVELY INVOLVED IN THE DEVELOPMENT OF TWO DIFFERENT WASTEWATER TREATMENT SYSTEMS DESIGNED TO RENOVATE WASTEWATER TO A QUALITY SUITABLE FOR REUSE. ONE SYSTEM IS DESIGNED FOR MILITARY USE AS AN ENVIRONMENTAL SERVICE MODULE (ESM) AND THE OTHER FOR DOMESTIC APPLICATION AS PART OF AN INTEGRATED WASTE MANAGEMENT SYSTEM CALLED CANWEL (CANADIA WATER ENERGY LOOP). THE MILITARY ESM IS AN AIR-TRANSPORTABLE, COMBINED WASTEWATER PURIFICATION, SOLID WASTE DISPOSAL SYSTEM EMPLOYING WET AIR OXIDATION, REVERSE OSMOSIS, AND OZONE-ULTRA VIOLET OXIDATION. EXTENSIVE WATER RECYCLING FOR NONPOTABLE USES IS PROVIDED. THE CANWEL SYSTEM UTILIZES BIOLOGICAL NITRIFICATION-DENITRIFICATI-ON, PHOSPHORUS REMOVAL, OZONE DISINFECTION, AND REVERSE OSMOSIS. THE DEGREE OF PURIFICATION ACHIEVED WILL PERMIT REUSE OF WATER FOR UTILITY PURPOSES. (11 DIAGRAMS, 16 GRAPHS, 3 PHOTOS, 15 REFERENCES, 15 TABLES)
DESCRIPTORS: •SEWAGE REUSE ; •WASTEWATER REUSE ; •SEWAGE MANAGEMENT ; •PHYSICOCHEMICAL TREATMENT ; •INCINERATION ; •SOLID WASTE MANAGEMENT ; •LIME ; •REVERSE OSMOSIS ; CANADA ; CLARIFICATION ; SUSPENDED SOLIDS ; ENERGY CONSERVATION ; WATER QUALITY CRITERIA ; AWWA CONF PAPER
REVIEW CLASSIFICATION 19

141192 •80-001261
STUDIES ON WATER REUSE IN THE NETHERLANDS.
HRUBEC, J ; SCHIPPERS J. C.; ZOETEMAN B. C. J.
NATL INST FOR WATER SUPPLY, NETHERLANDS.
PRESENTED AT AWWA RESEARCH FOUNDATION/ET AL WATER REUSE SYM, WASH DC, MAR 25-30, 79, V2, P785 (23).
TECHNICAL REPORT REUSE AND TREATMENT OF MUNICIPAL WASTEWATERS IN THE NETHERLANDS ARE SURVEYED. TREATMENT SYSTEMS INCLUDE LIME ADDITION, RECARBONATION, DOUBLE-LAYER FILTRATION, OZONATION, ION EXCHANGE, ACTIVATED CARBON FILTRATION, AND DISINFECTION. A PILOT PLANT SCHEME FOR A REVERSE OSMOSIS SYSTEM IS DESCRIBED. MEMBRANE FOULING, AMMONIA REMOVAL, AND ORGANIC COMPOUND REMOVAL CAPABILITIES OF THE SYSTEM ARE REVIEWED. OPERATING RESULTS SHOW THAT THE REVERSE OSMOSIS SCHEME CAN PRODUCE WATER AT HIGH AND CONSTANT QUALITY WITH AN ECONOMICALLY ACCEPTABLE DECLINE IN MEMBRANE FLUX AT A CONSTANT RATIO OF SALT REJECTION. EFFLUENT WATER ANALYSIS INDICATES THAT PRACTICALLY ALL DETERMINED CHEMICAL PARAMETERS MEET THE CURRENT QUALITY STANDARDS SET FOR DRINKING WATER. (2 DIAGRAMS, 8 GRAPHS, 2 MAPS, 5 REFERENCES, 9 TABLES)
DESCRIPTORS: •AWWA CONF PAPER ; •NETHERLANDS ; •WASTEWATER REUSE ; •PHYSICOCHEMICAL TREATMENT ; •LIME ; •FILTRATION ; •REVERSE OSMOSIS ; AMMONIA ; ION EXCHANGE ; OZONIZATION

141148 •80-001217
DEMONSTRATION OF POTABLE WATER REUSE TECHNOLOGY: THE DENVER PROJECT.
ROTHBERG, MICHAEL R. ; WORK STEPHEN W.; LINSTEDT K. DANIEL ; BENNETT EDWIN R.
DENVER WATER DEPT.
PRESENTED AT AWWA RESEARCH FOUNDATION/ET AL WATER REUSE SYM, WASH DC, MAR 25-30, 79, V1, P105 (35)
TECHNICAL REPORT: WATER REUSE PROJECTS AUGMENTING FRESHWATER SUPPLIES IN DENVER ARE DESCRIBED. A PRELIMINARY DESIGN FOR A POTABLE REUSE DEMONSTRATION PLANT IS SURVEYED. THE UNIT PROCESSES PROPOSED FOR INCLUSION ARE GROUPED INTO SIX CONTROL OPERATIONS: PHOSPHORUS REMOVAL; SUSPENDED SOLIDS REMOVAL; NITROGEN REMOVAL; SOLUBLE ORGANIC REMOVAL; DISSOLVED SALTS REMOVAL; AND DISINFECTION. REVIEWED IS THE USE OF BIOLOGICAL TREATMENTS, CHEMICAL METHODS, ION EXCHANGE, GRANULAR MEDIA FILTRATION, AMMONIA STRIPPING, GRANULAR ACTIVATED CARBON, CATALYTIC OXIDATION, DISTILLATION, REVERSE OSMOSIS, AND POLYMERIC ADSORPTION PROCESSES TO REMOVE THESE POLLUTANTS FROM WASTE STREAMS. THE VARIOUS METHODS OF DISINFECTION INVOLVE THE USE OF CHLORINE, CHLORINE DIOXIDE, OZONE, AND ULTRAVIOLET LIGHT. THE EFFICACY OF THESE TREATMENT PROCESSES IS SUMMARIZED. (2 DIAGRAMS, 2 GRAPHS, 33 REFERENCES, 9 TABLES)
DESCRIPTORS: •DENVER ; •WASTEWATER REUSE ; •WATER, DRINKING ; •WATER SUPPLY ; •WASTEWATER MANAGEMENT ; •BIOLOGICAL TREATMENT ; •CHEMICAL TREATMENT ; •PHOSPHORUS ; •FILTRATION ; •CHLORINATION ; •ION EXCHANGE ; •ACTIVATED CARBON ADSORPTION ; REVERSE OSMOSIS ; AWWA CONF PAPER
REVIEW CLASSIFICATION 19

(con.)

141133 *80-001202
ADVANCES IN THE TREATMENT OF SURFACE WATERS USED FOR DRINKING PURPOSES.
MIGNOT JEAN
DEGREMONT-INTL DIV
PRESENTED AT INTL WATER SUPPLY ASSN CONF, SINGAPORE, FEB 13-15, 79, P3C1 (31)
TECHNICAL REPORT: MAJOR RECENT ADVANCES CONCERNING TREATMENT METHODS OF SURFACE WATERS TO BE USED AS DRINKING WATERS ARE EXAMINED. NEW DEVELOPMENTS IN THE UTILIZATION OF CHLORINE, CHLORINE DIOXIDE, AND OZONE AS DISINFECTANTS ARE SURVEYED. THE USE OF THE AUTOMATIC ANALYSIS UNIT IS REVIEWED. THIS UNIT MONITORS THE QUALITY OF A RAW SURFACE WATER PRIOR TO ITS ADMISSION TO A TREATMENT PLANT BY MEASURING AT LEAST FIVE FACTORS: RESISTIVITY, PH, TEMPERATURE, DO, AND TURBIDITY. THE USE OF SUPERPULSATORS FOR SLUDGE TREATMENT IS DISCUSSED. (11 DIAGRAMS, 7 GRAPHS, 7 PHOTOS, 4 TABLES)
DESCRIPTORS: *WATER, DRINKING ; *WATER PURIFICATION ; *CHLORINE DIOXIDE ; *CHLORINATION ; *OZONIZATION ; *BIODEGRADATION-MICROORGANISM ; *CLARIFICATION ; *FILTRATION ; COAGULATION ; SLUDGE TREATMENT ; COST BENEF ANALYSIS-WATER ; CONF PAPER
REVIEW CLASSIFICATION: 19

141105 80-001174
SYNERGISTIC EFFECTS FOR IRRADIATION OF FECAL COLIFORMS.
WOODBRIDGE DAVID D. ; COOPER PRISCILLA C.
(HITTMAN ASSOC, MD) AND; (WATSON & ASSOC, FLA).
WPCF J, NOV 79, V51, N11, P2717 (7)
RESEARCH REPORT: GAMMA RADIATION OF COLIFORM BACTERIA AS A MEANS OF WASTEWATER DISINFECTION IS DISCUSSED. THE SYNERGISTIC EFFECTS OF IRRADIATION IN CONJUNCTION WITH CHLORINATION, OZONATION, OR IODINE DISINFECTION IS INVESTIGATED. THESE ADDITIVES, WHEN UTILIZED WITH GAMMA RADIATION, PRODUCE SYNERGISTIC EFFECTS AND INCREASE THE EFFECTIVENESS OF THE DISINFECTION PROCESS. THE SYNERGISTIC EFFECT CAN BE MAXIMIZED WHEN THE AGENT IS RETAINED IN THE WATER 5-10 MIN BEFORE THE WASTE ENTERS THE IRRADIATION CHAMBER. (6 GRAPHS, 15 REFERENCES, 2 TABLES)
DESCRIPTORS: *SYNERGISTIC EFFECTS ; *COLIFORM BACTERIA ; *IRRADIATION ; *WATER CHEMISTRY ; *OZONIZATION ; *CHLORINATION ; *DISINFECTION ; IODINE
REVIEW CLASSIFICATION: 19

139733 *79-006856
FIELD-SCALE EVALUATION FOR OZONE WASTEWATER DISINFECTION: PART 2.
RAKNESS, KERWIN L. ; HEGG BOB A.
MBI CONSULTING ENGINEERS, COLO.
WATER & SEWAGE WORKS, SEP 79, V126, N9, P82 (3)
TECHNICAL REPORT: THE USE OF OZONE DISINFECTION AT A WASTEWATER TREATMENT FACILITY IS DESCRIBED. EQUIPMENT USED IN OZONE GENERATION IS REVIEWED. PERFORMANCE OF AN OZONE GENERATION SYSTEM DEPENDS ON THE PRODUCTION OF HIGH QUALITY DRY AIR. FACTORS THAT INFLUENCE THE RATE OF OZONE PRODUCTION INCLUDE POWER SUPPLY, AIR DEW POINT, OZONATED AIR TEMPERATURE, AND OZONATED-AIR HEAT REMOVAL CAPABILITY OF THE COOLING WATER JACKET. (3 GRAPHS, 2 TABLES)
DESCRIPTORS: *OZONIZATION ; *ATMOSPHERIC TEMPERATURE ; *DISINFECTION
REVIEW CLASSIFICATION: 19

138967 *79-006119
FROM SCREENING TO FILTRATION: TREATING THE WATER SUPPLY.
HUNDAL, H. S. ; TRATTNER R. B.; CHEREMISINOFF PAUL N.
NEW JERSEY INST OF TECHNOLOGY.
WATER & SEWAGE WORKS, AUG 79, V126, N8, P48 (4)
TECHNICAL REPORT: PROCESSES AVAILABLE FOR WATER SOFTENING, DEMINERALIZATION, AND DISINFECTION ARE SURVEYED. WATER HARDNESS CAN BE MITIGATED THROUGH APPLICATION OF EITHER THE LIME SODA ASH PROCESS OR ION EXCHANGE. AVAILABLE DEMINERALIZATION METHODS INCLUDE ION EXCHANGE, AERATION, OXIDATION, AND ACTIVATED CARBON TREATMENT. CHLORINATION AND CARBON ADSORPTION ARE METHODS AVAILABLE FOR WATER DISINFECTION. COSTS OF DISINFECTION ALTERNATIVES ARE ASSESSED. (2 GRAPHS, 2 TABLES)
DESCRIPTORS: *WATER PURIFICATION ; *WATER CHEMISTRY ; *WATER SOFTENING ; *AERATION ; *CHLORINATION ; *ACTIVATED CARBON ADSORPTION ; OZONIZATION ; CHLORINE DIOXIDE ; ECONOMICS, ENV-WATER ; WATER TASTE ; ODORS ; DEMINERALIZATION
REVIEW CLASSIFICATION: 16

(con.)

137485 79-004723
TREATING RUNOFF FROM AGRICULTURAL OPERATIONS FOR USE AS A WATER SUPPLY.
SIMMONS, JOHN D. ; STONE RUSSELL B.; SEWELL JOHN I.
USDA.
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS TRANS. NOV-DEC 78, V21, N6, P1136 (6)
TECHNICAL REPORT: OPERATION AND INPUT REQUIREMENTS OF SEVERAL RURAL RUNOFF WATER TREATMENT METHODS, INCLUDING CHLORINATION, OZONATION, AND ULTRAVIOLET RADIATION, WERE STUDIED. RUNOFF WAS PRETREATED USING SAND FILTRATION. CHLORINATION WAS AN EFFECTIVE AND DEPENDABLE TREATMENT METHOD; WHEN CHLORINE ALONE IS ADEQUATE FOR TREATMENT, IT IS MORE PRACTICAL THAN OTHER TREATMENTS. OZONATION WAS INSUFFICIENT FOR RURAL DISINFECTION BECAUSE ITS ABILITY TO KILL BACTERIA OR OXIDIZE ORGANIC MATTER DEPENDS ON THE DEGREE OF INCORPORATION INTO THE RUNOFF SOLUTION. INVESTMENT AND OPERATING COSTS, AND COMPLICATED TECHNOLOGY RENDER OZONATION IMPRACTICAL. ULTRAVIOLET RADIATION KILLS BACTERIA BUT DOES NOT AFFECT CHEMICAL CONCENTRATION OR ORGANIC MATTER IN RUNOFF. FOR TREATMENT SITUATIONS HAVING ONLY GERMICIDAL REQUIREMENTS, ULTRAVIOLET RADIATION WOULD BE PRACTICAL AND SIMPLER, BUT ITS EFFECTIVENESS COULD BE REDUCED BY HIGH TURBIDITY. (2 DIAGRAMS, 11 REFERENCES, 7 TABLES)
DESCRIPTORS: *AGRICULTURAL RUNOFF ; *WATER SUPPLY ; *ULTRAVIOLET RADIATION ; *FILTRATION ; *CHLORINATION ; *NUTRIENTS ; *WASTEWATER REUSE ; RURAL AREAS ; OZONIZATION ; BIOCHEMICAL OXYGEN DEMAND ; COLIFORM BACTERIA ; NITROGEN ; PHOSPHATES ; TURBIDITY
REVIEW CLASSIFICATION: 19

136704 79-003959
MEETING THE DRINKING WATER STANDARDS: THE PRICE OF REGULATION.
CLARK, ROBERT M. ; STEVIE RICHARD G.; SINNOTT WALTER B.
EPA, CINCINNATI.
PRESENTED AT RESOURCES FOR THE FUTURE SAFE DRINKING WATER: CURRENT & FUTURE PROBLEMS CONF. WASH DC. MAR 6-8, 78, P271 (54)
SURVEY REPORT: THE SAFE DRINKING WATER ACT OF 1974 MAY BE ONE OF THE MOST IMPORTANT LAWS EVER PASSED, AND THE ACT STRONGLY EMPHASIZES THE NEED TO CONSIDER ALL ASPECTS OF THE ECONOMICS OF WATER DELIVERY. TODAY'S WATER SUPPLY INDUSTRY IS DESCRIBED, AND THE ECONOMIC CONSEQUENCES AND ISSUES SURROUNDING ITS IMPLEMENTATION ARE DISCUSSED. PROPOSED ORGANIC STANDARDS MAY INCREASE THE COST OF WATER SUPPLY BY 20% OR MORE AS THE ACT IS WRITTEN. THE PRICE OF CONTROL TECHNOLOGY IS PLACED ON INDIVIDUAL CONSUMERS AND IS NOT SPREAD ACROSS THE POPULATION. COSTS ASSOCIATED WITH RESEARCH AND REGULATION, SUPPLY, INTERIM PRIMARY STANDARDS, PROPOSED ORGANIC STANDARDS, AND REGIONAL SOLUTIONS ARE EXAMINED. THE COSTS OF MEETING INTERIM DRINKING WATER STANDARDS FOR LARGE MUNICIPALITIES IN THE NORTHEAST ARE ALSO ESTIMATED. (11 GRAPHS, 23 REFERENCES, 17 TABLES)
DESCRIPTORS: *ECON IMPACT-WATER POLL CONT ; *SAFE DRINKING WATER ACT 74 ; *WATER SUPPLY ; *WATER QUALITY STANDARDS ; *ORGANIC COMPOUNDS ; *MONITORING, ENV WATER ; *DISINFECTION ; *WATER PURIFICATION ; *CHLORINATION ; *CHLORINE DIOXIDE ; OZONE ; ACTIVATED CARBON ADSORPTION ; UNITED STATES EAST ; CONF PAPER
REVIEW CLASSIFICATION: 16

132372 *78-006946
UNIT OPERATIONS FOR TREATMENT OF HAZARDOUS INDUSTRIAL WASTES-OZONATION.
HARRIS JUDITH C.
NOYES DATA CORP POLLUTION TECHNOLOGY REVIEW 47, 1978, P767 (31)
TECHNICAL REPORT: OZONATION PROVIDES HIGH CHEMICAL REACTIVITY IN THE FORM OF OXIDATION AND DISINFECTION. LARGE-SCALE APPLICATIONS OF OZONATION HAVE PROVED FEASIBLE FOR CYANIDES AND PHENOLS IN WASTE STREAMS. PILOT STUDIES HAVE DEMONSTRATED POTENTIAL FOR TREATMENT OF CHLORINATED HYDROCARBONS, POLYNUCLEAR AROMATICS, AND PESTICIDES. OZONATION IS EXPENSIVE BUT CAN BE ECONOMICALLY COMPETITIVE WITH OTHER TREATMENT METHODS. OZONE GENERATION REQUIRES LARGE AMOUNTS OF CAPITAL AND POWER. LABOR REQUIREMENTS FOR OPERATION AND MAINTENANCE ARE LOW. OZONATION IS MOST USEFUL FOR TREATING AQUEOUS OR GASEOUS WASTE STREAMS THAT CONTAIN LESS THAN 1% OF OXIDIZABLE HAZARDOUS COMPONENTS; THE PROCESS SHOULD BE USED AS PRELIMINARY TREATMENT OF CONCENTRATED OXIDIZABLE WASTES THAT ARE NOT AMENABLE TO OTHER TYPES OF TREATMENT. THE BACKGROUND, BASIC PRINCIPLES, OPERATING CHARACTERISTICS, EQUIPMENT, APPLICATIONS, ENERGY REQUIREMENTS, AND ECONOMICS ARE DISCUSSED. THE PROCESS DOES NOT CREATE ANY INHERENTLY HARMFUL RESIDUE. (5 DIAGRAMS, 1 GRAPH, 26 REFERENCES, 6 TABLES)
DESCRIPTORS: *OZONIZATION ; *HAZARDOUS WASTE TREATMENT ; *REDOX ; *CHEMICAL OXYGEN DEMAND ; *PHENOL ; *CATALYSIS ; *PHOTODEGRADATION ; *CYANIDE ; *ECONOMICS, ENV-WATER ; PESTICIDE DISPOSAL ; AROMATIC HYDROCARBONS ; DETERGENTS & SOAPS ; CAPITAL COSTS ; OPERATING-MAINTENANCE COSTS
REVIEW CLASSIFICATION: 19

con)

129262 *78-004156
UNNECESSARY AND HARMFUL LEVELS OF DOMESTIC SEWAGE CHLORINATION SHOULD BE STOPPED.
GAO REPORT CED-77-108, AUG 30, 77 (48)
SPECIAL REPORT: USE OF CHLORINE TO DISINFECT DOMESTIC SEWAGE AT MUNICIPAL WASTE TREATMENT PLANTS UNDER GRANTS BY EPA IS DISCUSSED. THOUGH CHLORINE HAS BEEN SHOWN TO BE HARMFUL TO AQUATIC LIFE, IT IS STILL USED AND LARGELY UNCONTROLLED. WITH THE POSSIBLE EXCEPTION OF USING CHLORINE TO PROTECT AREAS OF SHELLFISH HARVESTING OF UNRESTRICTED IRRIGATION WITH SEWAGE, THE PUBLIC HEALTH BENEFITS FROM CHLORINATING SEWAGE ARE MINIMAL. MANY SEWAGE TREATMENT PLANTS USE TOO MUCH CHLORINE AND HAVE HIGH CHLORINE RESIDUALS BECAUSE OF INEFFICIENT CHLORINATION SYSTEMS. REVISIONS OF EPA'S WATER QUALITY CRITERIA, CHLORINE RESIDUAL LIMITATIONS, LOWER LIMITATIONS ON CHLORINE RESIDUALS IN POWERPLANT EFFLUENTS, AND THE INCORPORATION OF FACTORS FOR EFFICIENT CHLORINATION ARE RECOMMENDATIONS PRESENTED. (6 PHOTOS, 70 REFERENCES, 3 TABLES)
DESCRIPTORS: *HEALTH, ENV ; *CHLORINATION ; *SEWAGE TREATMENT ; *EPA, FEDERAL ; *WATER QUALITY CRITERIA ; *WATER, DRINKING ; *SHELLFISH ; *DISEASES ; U S GEN ACCOUNTING OFFICE ; NATL POLL DISCHARGE ELIM SYS ; OZONIZATION ; ULTRAVIOLET RADIATION ; POWER PLANT EMISSIONS ; AREA COMPARISONS
REVIEW CLASSIFICATION: 19

125494 *78-000642
VIRUSES IN WASTE, RENOVATED, AND OTHER WATERS.
EPA REPORT EPA-600/9-76-019, 1976 (32)
BIBLIOGRAPHY: ABSTRACTS ARE PRESENTED FOR VARIOUS REPORTS RELEASED DURING 1976 CONCERNING THE PROBLEMS PRESENTED BY VIRUSES IN WASTE, RENOVATED, AND OTHER WATER; METHODS OF DETECTING VIRUSES; AND TECHNIQUES FOR ELIMINATING THEM. TOPICS COVERED INCLUDE: MORTALITY OF ENTERIC VIRUSES IN MARINE AND OTHER WATER; REGIONAL PROBLEMS WITH SEA OUTFALL DISPOSAL OF SEWAGE ON THE COASTS OF THE U.S.; ADSORPTION OF VIRUSES ONTO SURFACES IN SOIL AND WATER; INACTIVATION OF VIRUSES AND BACTERIA BY OZONE, WITH AND WITHOUT SONICATION; A METHOD FOR ISOLATING ENTEROVIRUSES FROM MEAT; THE EFFECT OF PH ON THE EFFICIENCY OF CHLORINE DISINFECTION AND VIRUS ENUMERATION; RECOVERY OF VIRUS BY CHEMICAL PRECIPITATION FOLLOWED BY ELUATION; ENTERIC VIRUS BEHAVIOR IN SAND DUNES; PROCESSES FOR REMOVAL AND INACTIVATION OF VIRUSES IN WATER; PRACTICAL APPLICATION OF THE GERMICIDAL POWER OF ULTRAVIOLET IRRADIATION TO DRINKING WATER; DETECTION OF MINIMAL CONCENTRATIONS OF VIRUSES IN LARGE VOLUMES; AND REMOVAL OF VIRUSES FROM WATER BY SORPTION ON COAL.
DESCRIPTORS: *VIRUSES ; *WASTEWATER REUSE ; WASTEWATER ; ADSORPTION ; DISEASES ; BACTERIA ; DISINFECTION . WATER, DRINKING
REVIEW CLASSIFICATION: 19

120395 77-002754
OZONE APPLICATIONS IN MANITOBA, CANADA.
THOMPSON G. F.
W. L. WARDROP & ASSOC, CANADA.
PRESENTED AT INTL OZONE INST 2ND SYM ON OZONE TECHNOLOGY, MONTREAL, MAY 11-14, 75, PG82 (12)
TECHNICAL REPORT: OZONE TREATMENT INSTALLATIONS IN MANITOBA, CANADA, ARE DESCRIBED. THE FIRST TWO 125 LB/DAY UNITS FOR THE PORTAGE LA PRAIRIE POTABLE WATER SUPPLY WILL TREAT ASSINIBOINE RIVER WATER FOR COLOR, TURBIDITY, HARDNESS, TOTAL DISSOLVED SOLIDS, TASTE, AND ODOR. THE SECOND TWO 22 LB/DAY UNITS AT THE FRESHWATER INST. OF ENVIRONMENT CANADA WILL TREAT EFFLUENT FROM THE FISH-HOLDING TANKS, AND DISEASE AND QUARANTINE LABORATORIES. PILOT PLANT STUDIES INDICATE THAT OZONE EFFECTIVELY AND ECONOMICALLY TREATS WATER AND WASTEWATER FOR DISINFECTION, TASTE, AND ODOR CONTROL. (6 DIAGRAMS, 3 GRAPHS)
DESCRIPTORS: *MANITOBA ; *OZONIZATION ; *WATER PURIFICATION ; *COLOR REMOVAL ; *WASTEWATER TREATMENT ; CONF PAPER ; WATER TASTE ; DISSOLVED SOLIDS ; TURBIDITY ; WATER SOFTENING ; WATER ODORS
REVIEW CLASSIFICATION: 19

120182 *77-002541
VIRAL DISINFECTION BY OZONATION AT NEW HAMPSHIRE PILOT PLANT.
SCHAFFERNOTH, T. J. ; KELLER J. W.; MORIN R. A.
RIST-FROST ASSOC, NY.
PRESENTED AT INTL OZONE INST 2ND SYM ON OZONE TECHNOLOGY, MONTREAL, MAY 11-14, 75, P472 (14)
RESEARCH REPORT: OZONE DOSAGE AND CONTACT PARAMETERS REQUIRED TO INACTIVATE EFFECTIVELY ENTERIC VIRUS IN THE LAKE WINNIPESAUKEE WATER SUPPLY FOR LACONIA, N.H., ARE DETERMINED. AN OZONE DOSAGE OF 1.0-1.25/PPM WILL COMPLETELY INACTIVATE ENTERIC VIRUS IN THIS EXTREMELY CLEAN WATER SUPPLY. A TREATMENT SYSTEM UTILIZING ACTIVATED CARBON ADSORPTION AND OZONATION IS RECOMMENDED FOR TREATING RELATIVELY CLEAN SURFACE WATERS. (1 DIAGRAM, 7 TABLES)
DESCRIPTORS: *VIRUSES ; *OZONIZATION ; *NEW HAMPSHIRE ; *WATER, DRINKING ; ACTIVATED CARBON ADSORPTION ; CONF PAPER
REVIEW CLASSIFICATION: 16

(con)

117868 *77-000416
OZONE PROVIDES POWERFUL DISINFECTANT FOR WATER.
BOLLYKY JOSEPH
PCL CO, NJ.
WATER & SEWAGE WORKS, OCT 76, V123, N10, P66 (2)
SURVEY REPORT. OZONE IS THE MOST POWERFUL CHEMICAL OXIDIZING AGENT, AND ITS INHERENT INSTABILITY CAUSES IT TO LEAVE NO TOXIC RESIDUE AFTER WATER TREATMENT IS COMPLETED. OZONE IS ESPECIALLY EFFECTIVE IN COMBATING VIRUSES IN THE WATER SUPPLY. POROUS DIFFUSERS, VENTURIES, AND MECHANICAL MIXERS ARE A FEW OF THE METHODS COMMONLY USED FOR OZONE TRANSFER INTO WATER. THE POROUS DIFFUSION METHOD, THE MOST EFFECTIVE MEANS OF TREATMENT, IS BRIEFLY REVIEWED. (2 DIAGRAMS, 1 GRAPH, 3 TABLES)
DESCRIPTORS: *OZONIZATION ; WATER PURIFICATION
REVIEW CLASSIFICATION: 16

115703 *76-006801
WASTEWATER OZONATION: A PROCESS WHOSE TIME HAS COME.
ROSEN HARVEY M
UNION CARBIDE CORP, NY.
CIVIL ENGINEERING-ASCE, MAR 76, V46, N3, P65 (5)
TECHNICAL FEATURE. OZONATION HAS BEEN A TECHNICALLY VIABLE SOLUTION TO DIFFICULT WASTE TREATMENT PROBLEMS, BUT ONLY RECENTLY HAS IT FOUND GROWING ACCEPTANCE AS A COST EFFECTIVE WAY TO MEET HIGH EFFLUENT QUALITY STANDARDS. STRICTER POLLUTION CONTROL LAWS, THE CHLORINE SHORTAGE OF 1974, AND INCREASING RECOGNITION OF CHLORINE TOXICITY ARE AMONG THE REASONS FOR EXPANDING INTEREST IN OZONATION. OZONE IS DISCUSSED AS AN ALTERNATIVE TO CHLORINE. SOME OZONE PILOT PLANT STUDIES AND SOME FULL-SCALE PLANTS USING OZONE DISINFECTION ARE DESCRIBED. THREE OZONATION PROCESSES ARE EXPLAINED. PLANTS USING AZONE FOR TERTIARY TREATMENT ARE EXAMINED. (4 DIAGRAMS, 1 TABLE)
DESCRIPTORS: *OZONIZATION ; *WASTEWATER TREATMENT ; *CHLORINATION ; PATHOLOGY, FISH ; WASTEWATER REUSE, INDUSTRIAL ; TURBIDITY ; ECONOMICS, ENV WATER ; EPA, FEDERAL ; ACTIVATED SLUDGE ; TERTIARY TREATMENT ; BIOCHEMICAL OXYGEN DEMAND ; CHEMICAL OXYGEN DEMAND ; DISSOLVED OXYGEN
REVIEW CLASSIFICATION: 19

105681 75-005580
OZONE DISINFECTION PILOT-PLANT STUDIES AT LACONIA, N.H.,
KELLER, JAMES W ; MORIN ROBERT A ; SCHAFFERNOTH TIMOTHY J.
RIST-FROST ASSOC, NH.
AWWA J, DEC 74, V66, N12, P730 (4)
RESEARCH REPORT. NEW HAMPSHIRE HAS MANDATED THAT ALL WATER INTENDED FOR POTABLE PURPOSES BE THOROUGHLY TREATED BECAUSE THE WATER FOR THE CITY OF LACONIA FROM LAKE WINNIPESAUKEE IS NEAR POTABLE WITHOUT TREATMENT, CARBON ADSORPTION FOR COAGULATION SEDIMENTATION, AND FILTRATION IN COMBINATION WITH OZONE DISINFECTION IS EXAMINED. THE TREATMENT SCHEME HAS WIDE APPLICATION FOR RELATIVELY CLEAN SURFACE WATERS. (1 DIAGRAM, 17 REFERENCES, 8 TABLES)
DESCRIPTORS: *NEW HAMPSHIRE ; *SURFACE WATERS ; *OZONIZATION ; *WATER SUPPLY ; *WATER PURIFICATION ; *DISINFECTION ; *ACTIVATED CARBON ADSORPTION ; OZONE ; FILTRATION
REVIEW CLASSIFICATION: 16

105016 75-004932
OZONATION OF AMMONIA IN WASTEWATER.
SINGER PHILIP C ; ZILLI WILLIAM B. (WATER DEPT, DAYTON, OHIO),
(UNIV OF NORTH CAROLINA) AND
WATER RESEARCH, FEB 75, V9, N2, P127 (8)
RESEARCH REPORT. THE EFFECTS OF OZONE ON AMMONIA IN MUNICIPAL WASTEWATERS ARE INVESTIGATED CONCERNING OZONE APPLICATION FOR ADVANCED WASTE TREATMENT. AMMONIA IS COMPLETELY OXIDIZED IN THE TREATMENTS TO NITRATE, THUS ELIMINATING THE WASTE'S NITROGENOUS OXYGEN DEMAND. IN WASTEWATER, THE REACTION IS ESPECIALLY SENSITIVE TO PH, WITH EFFECTIVE REMOVAL OF AMMONIA POSSIBLE ONLY IF THE WASTEWATER'S PH REMAINS ALKALINE. OZONATION IS PARTICULARLY USEFUL WITH LIME CLARIFICATION AND PHOSPHATE PRECIPITATION. THE OZONE DEMAND EXERTED BY AMMONIA MUST BE RECOGNIZED IF OZONE IS TO BE USED FOR DISINFECTION. (4 DIAGRAMS, 5 GRAPHS, 10 REFERENCES, 1 TABLE)
DESCRIPTORS: *OZONIZATION ; *AMMONIA ; *WASTEWATER TREATMENT ; *OXIDATION ; *NITRATES ; *PH HYDROGEN ION CONCENTRATN ; *LIME ; CLARIFICATION ; CHEMICAL PRECIPITATION ; PHOSPHATES ; MUNICIPAL WASTES ; CHEMICAL OXYGEN DEMAND
REVIEW CLASSIFICATION: 19

032560 *74-005934
OZONE IN WATER & WASTE WATER TREATMENT-USDI OFF WATER RES RSCH REPORT WRSIC 74-204 APR 74 (131)
OZONE IN WATER & WASTE WATER TREATMENT-USDI OFF WATER RES RSCH REPORT WRSIC 74-204 APR 74 (131)
DESCRIPTORS: *WATER ODORS; *WATER COLOR; *WASTEWATER REUSE; *WASTEWATER TREATMENT; *OZONE; *DISINFECTION; *AERATION; CHLORINATION; LAW, ENV NON U S
REVIEW CLASSIFICATION: 19

028722 74-001938
CAN TREATMENT PLANTS MANAGE WITH LESS CHLORINE.
CHEMICAL WEEK NOV 28, 73 V113N22 P45 (1)
DESCRIPTORS: *DISINFECTION; *HYDROGEN PEROXIDE; *CHEMICAL SHORTAGE; *CHLORINE; *WATER PURIFICATION; *SEWAGE TREATMENT; *494 WATER SUPPLY; *4952 SEWERAGE; *OZONE
REVIEW CLASSIFICATION: 19

025274 *73 009887
DISINFECTION AND TEMPERATURE INFLUENCE
BERG, GERALD; CHAMBERS, CECIL
INTL WATER POLL CONF UNIV OF ALASKA JUL22 24, 70 P312 (18)
DESCRIPTORS: CONF PAPER; *COST BENEF ANALYSIS; *CHLORINE; *494 WATER SUPPLY; *WATER PURIFICATION; *WATER TEMPERATURE; *ULTRAVIOLET RADIATION; *IODINE 131; *OZONE
REVIEW CLASSIFICATION: 19

016828 *73-001418
DISINFECTION OF WATER AND WASTEWATER.
RABOSKY, JOSEPH G.
POLLUTION ENGINEERING DEC 72 V4 N9 P25 (4)
DESCRIPTORS: *MICROORGANISMS; *OZONE; *HEAVY METALS; *CHLORINATION; *ULTRAVIOLET RADIATION; *WATER PURIFICATION; *WATER TEMPERATURE; *4952 SEWERAGE; *494 WATER SUPPLY
REVIEW CLASSIFICATION: 19

013945 72-007412
ULTRAVIOLET STERILIZATION, POTENTIAL AND LIMITS.
YIP, DR. R.W.; KONASEWICH, DR. D.E.
WATER & POLLUTION CONTROL JUN 72 V110 N6 P14 (3 1/4)
DESCRIPTORS: *MICROORGANISMS; *STERILIZATION; HUMAN; *ULTRAVIOLET RADIATION; *OZONE; *WATER SUPPLY; *WATER PURIFICATION; *CHLORINATION
REVIEW CLASSIFICATION: 19

009853 72 003323
OZONE DISINFECTION.
HARRIS, WELDON C.
AWWA JOURN MAR 1972V64 N3 P182 (2)
DESCRIPTORS: *PATHOLOGY; HUMAN; *OZONE; *WASTEWATER TREATMENT; *WATER, DRINKING; *494 WATER SUPPLY
REVIEW CLASSIFICATION: 19

Print 5/5/4-29
DIALOG File6 NTIS - 64-82/Iss05 (Copr. NTIS) (Item 1 of 26) User12901 23Feb82 1434

26 off-line printouts (first 3 printed on-line)

Ozonization Used in Water and Sewage Treatment. 1970-August, 1980 (Citations from the NTIS Data Base)

National Technical Information Service, Springfield, VA. (055665000)

Rept. for 1970-Aug 80
AUTHOR: Cavagnaro, Diane M.; Hundemann, Audrey S.
G2623C2 Fld. 7A, 68D*, 99B*, 86W GRA18025
Oct 80 158p*
Supersedes NTIS/PS-79/1042, and NTIS/PS-78/0889.

Abstract: The bibliography cites Federally-funded research in the use of ozone to treat industrial waste water, sewage, and drinking water. It discusses treatment, tests, performance of equipment, and effectiveness of ozone in water pollution control. (This updated bibliography contains 132 abstracts, 36 of which are new entries to the previous edition.)

Descriptors: *Ozonization, *Water treatment, *Sewage treatment, *Industrial waste treatment, *Water pollution control, *Bibliographies, Chemical removal(Sewage treatment), Performance evaluation, Design, Chemical removal(Water treatment), Potable water, Purification, Water, Sterilization, Viruses, Pesticides, Chlorination, Water analysis, Microorganism control(Water), Filters, Abstracts

Identifiers: MUST(Medical Unit Selfcontained Transportable), Monitors, Water pollution effects(Humans), NTISNTISN

PB80-815616 NTIS Prices: PC N01/MF N01

Flotation Device with Pretreatment

Department of the Navy Washington DC (001840000)

Patent
AUTHOR: Kuepper, Theodore A.
G0504C3 Fld 13B, 90B, 68D GRA18007
Filed 30 May 78, patented 29 May 79 7p
Rept No PAT-APPL-910 328; PATENT-4 156 648
Monitor 18
Supersedes PAT-APPL-910 328-78, AD-D005 511.
Availability: This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 $0.50

Abstract: This invention relates to methods and apparatus for treating water/wastewater to remove grit, suspended and colloidal solids of organic and inorganic nature, microorganisms and surfactants. Dense suspended solids (grit) are first removed by a centrifugation process. The influent water/wastewater is then passed through coagulation and flocculation chambers, an upflow clarifier and a high-rate settling chamber for final sedimentation. Next, the influent passes through a foam filter to remove colloidal particles. The water/wastewater under treatment is then pressurized and saturated with air and subsequently depressurized, causing the dissolved gas to bubble out of soluton floating out suspended contaminants. At this point, ozone is introduced into the influent to create a thicker, more dense foam by oxidizing organic matter and for disinfection purposes. The foam floated to the surface of the influent is scraped off and furnishes the foam for the foam filter. (Author)

Descriptors: *Patents, *Flotation(Separation), *Centrifuge separation, Waste water, Coagulation, Chemical precipitation, Ozone, Colloids, Disinfection, Foam, Surface active substances, Bubbles, Sedimentation, Gases, Oxidation, Disinfection

Identifiers: PAT-CL-210-44, *Water pollution control, NTISGPN

AD-D006 683/7 NTIS Prices: Not available NTIS

(Con)

Symposium on Advanced Treatment of Biologically Treated Effluents Including Nutrients Removal, USA/USSR (7th) Held at Moscow, USSR on November 12-13, 1978

Environmental Protection Agency, Washington, DC. Office of Water Program Operations. (031287116)
GO471A4 Fld: 13B, 68D GRAI8006
Nov 79 99p
Monitor: 18
See also PB-290 996.

Abstract: The seventh cooperative US/USSR symposium on the 'Advanced Treatment of Biologically Treated Effluents, Including Nutrients Removal' was held in the Soviet Union at the Moscow headquarters of Gosstroy on November 12th and 13th, 1978. The twelve papers that were presented at the symposium (six US and six USSR) are reprinted in English. Some of the subject areas discussed in the report are: Activated carbon treatment; sewage filtration; ozonation; waste water use; and land application of waste water.

Descriptors: *Sewage treatment, *Industrial waste treatment, *Waste water reuse, *Activated sludge process, *Meetings, Activated carbon process, Municipalities, Disinfection, Chlorination, Sewage filtration, Oxidation, Aeration, Cyanides, Ozone, Ion exchanging, Desalting, Setting tanks, USSR, United States

Identifiers: *Foreign technology, Tertiary treatment, NTISEPAOWP

PB80-115801 NTIS Prices: PC A05/MF A01

Ozonization Used in Water and Sewage Treatment (Citations from the NTIS Data Base)

National Technical Information Service, Springfield, VA. (055665000)

Rept. for 1970-Aug 79
AUTHOR: Cavagnaro, Diane M.
F2393C3 Fld: 7A, 68D*, 99B*, 86W GRAI7926
Oct 79 140p*
Monitor: 18
Supersedes NTIS/PS-78/0889, NTIS/PS-77/0748, and NTIS/PS-76/0655. For the companion Published Search of the Engineering Index Data Base, see NTIS/PS-79/1043.

Abstract: The bibliography cites Federally-funded research in the use of ozone to treat industrial waste water, sewage, and drinking water. It discusses treatment, tests, performance of equipment, and effectiveness of ozone in water pollution control. (This updated bibliography contains 132 abstracts, 36 of which are new entries to the previous edition.)

Descriptors: *Ozonization, *Water treatment, *Sewage treatment, *Industrial waste treatment, *Water pollution control, *Bibliographies, Chemical removal(Sewage treatment), Performance evaluation, Design, Chemical removal(Water treatment), Potable water, Purification, Water, Sterilization, Viruses, Pesticides, Chlorination, Water analysis, Microorganism control(Water), Filters, Abstracts

Identifiers: MUST(Medical Unit Selfcontained Transportable), Monitors, Water pollution effects(Humans), NTISNTISEN

NTIS/PS-79/1042/5ST NTIS Prices: PC N01/MF N01

(con)

Characterization of Nonvolatile Organics in Disinfected Wastewater Effluents: Interim Report

Oak Ridge National Lab., TN.*Department of Energy (4832000)
AUTHOR: Jolley, R. L.; Cumming, R. B.; Denton, M. S.; Lee, N. E.; Pitt, W. W.
F2073D4 Fld: 6F, 6M, 68D, 57K GRAI7923
Feb 79 88p
Contract: W-7405-ENG-26
Monitor: 18

Abstract: Concentrates of chlorinated primary sewage effluents are highly mutagenic in bacterial tester strain TA-1535 and negative in other strains used. All other concentrates, regardless of treatment, have been negative in mutagenic tests. Some mutagenic activity was detected in fractions from the HPLC separation of the active chlorinated primary concentrates, but much of the mutagenic activity is apparently lost or inactivated during the separation process. The mutagenic activity tests thus become a very useful adjunct to analytical studies on treated effluents. Fourteen 40-liter field samples have been collected in seven collecting operations at five different sites. Chromatography and characterization of chromatographic constituents is proceeding. Thymine and uracil were identified and 14 other unknown compounds were characterized in an untreated secondary effluent control sample from the ozonation pilot plant at the Wastewater Research Division, Municipal Environmental Research Laboratory, Cincinnati. Eleven unknown compounds in the ozonated effluent were characterized with respect to gas chromatography and mass spectra. Disinfection of wastewater effluents by chlorination destroys some nonvolatile chromatographic constituents and produces other nonvolatile compounds. Disinfection of wastewater effluents by ozonation destroys some nonvolatile chromatographic constituents and produces other nonvolatile compounds. Disinfection of wastewater effluents by uv-light irradiation has relatively little chemical effect on nonvolatile chromatographic constituents. (ERA citation 04:045388)

Descriptors: *Bacteria, *Chlorination, *Disinfectants, *Organic wastes, *Ozone, *Waste water, Biological effects, Chemical analysis, Chemical effluents, Chemical properties, Chromatography, Experimental data, Graphs, Isolated values, Mutagenesis, Radiation effects, Salmonella typhimurium, Sewage, Thymine, Ultraviolet radiation, Uracils

Identifiers: ERDA/520200, ERDA/550400, NTISDE

ORNL/TM-6555 NTIS Prices: PC A05/MF A01

Water Reuse Highlights. A Summary Volume of Wastewater Reclamation and Reuse Information

American Water Works Association Research Foundation, Denver, CO.*Office of Water Research and Technology, Washington, DC.*Environmental Research Center, Cincinnati, OH.

Completion rept
AUTHOR: Heaton, Richard D.; Rehfield, Eugene
F0575G1 Fld: 13B, 68D*, 91A*, 43I GRAI7908
Jan 78 123p*
Project: OWRT-1-0058(7709)
Monitor: OWRT-1-0058(7709)(1)
Sponsored in part by Environmental Research Center, Cincinnati, OH.

Abstract: This is a comprehensive summary of municipal wastewater reclamation and reuse information gathered by the American Water Works Association Research Foundation. It provided the basis for an ongoing monthly newsletter 'Municipal Wastewater Reuse News'. The report is separated into the categories of advanced wastewater treatment (AWT), related conferences, health effects research, legislative and funding activities, modeling, position statement, published literature, regulations, water reuse plans and demonstrations.

Descriptors: *Water reclamation, *Waste water reuse, *Sewage treatment, *Reviews, Municipalities, Public health, Activated carbon treatment, Chlorination, Disinfection, Ozone, Microorganisms, Ion exchanging, Performance, Chemical removal(Water treatment), Bacteria, Viruses, Toxicity, Metal containing organic compounds, Ground water recharge

Identifiers: Tertiary treatment, Water quality criteria, Land application, NTISDIOWRT

PB-289 386/5ST NTIS Prices: PC A06/MF A01

(Con)

Methods and Apparatus for Treating Wastewater

Department of the Navy Washington DC (110050)

Patent Application
AUTHOR: Kuepper, Theodore A.
F055311 Fld: 13B, 90, 68D GRAI7908
Filed 30 May 78 15p
Rept No: PAT-APPL-910 328
Monitor: 18
Availability: This Government-owned invention available for U.S. licensing and possibly, for foreign licensing Copy of application available NTIS.

Abstract: This report describes methods and apparatus for treating water/wastewater to remove grit, suspended and colloidal solids of organic and inorganic nature, microorganisms, and surfactants. Dense suspended solids (grit) are first removed by a centrifugation process. The influent water/wastewater is then passed through coagulation and flocculation chambers, an upflow clarifier and a high-rate settling chamber for final sedimentation. Next, the influent passes through a foam filter to remove colloidal particles. The water/wastewater under treatment is then pressurized and saturated with air and subsequently depressurized, causing the dissolved gas to bubble out of solution floating out suspended contaminants. At this point, ozone is introduced into the influent to create a thicker, more dense foam by oxidizing organic matter and for disinfection purposes. The foam floated to the surface of the influent is scraped off and furnishes the foam for the foam filter. (Author)

Descriptors: *Patent applications, *Waste treatment, Waste water, Grit, Colloids, Microorganisms, Centrifuge separation, Coagulation, Sedimentation, Filtration, Foam, Ozone

Identifiers: *Water pollution control, Disinfection, Coagulation, Flocculation, NTISGPN

AD-D005 511/1ST NTIS Prices: PC A02/MF A01

Ozonization Used in Water and Sewage Treatment (Citations from the NTIS Data Base)

National Technical Information Service, Springfield, Va. (391 812)

Rept. for 1970-Jul 78
AUTHOR: Cavagnaro, Diane M.
E2244L4 Fld: 7A, 68D*, 99B*, 86W GRAI7821
Aug 78 102p*
Monitor: 18
Supersedes NTIS/PS-77/0748, and NTIS/PS-76/0655. See also NTIS/PS-78/0890.

Abstract: The bibliography cites Federally funded research in the use of ozone to treat industrial waste water, sewage, and drinking water. It discusses treatment, tests, performance of equipment, and effectiveness of ozone in water pollution control. (This updated bibliography contains 96 abstracts, 24 of which are new entries to the previous edition.)

Descriptors: *Bibliographies, *Ozonization, *Water treatment, *Sewage treatment, *Industrial waste treatment, *Water pollution control, Chemical removal(Sewage treatment), Performance evaluation, Design criteria, Chemical removal(Water treatment), Potable water, Purification, Water, Sterilization, Viruses, Pesticides, Chlorination, Water analysis, Microorganism control(Water), Filters

Identifiers: MUST(Medical Unit Selfcontained Transportable), Monitors, Water pollution effects(Humans), NTISNTISEN

NTIS/PS-78/0889/2ST NTIS Prices: PC N01/MF N01

Inactivation of Enteroviruses and Coliphages with Ozone in Waters and Waste Waters

Newcastle-upon-Tyne Univ. (England).
AUTHOR: Evison, L. M.
E2123L4 Fld: 13B, 6M, 68D, 57K, 57U STAR1616
1977 12p
Monitor: 18
Conf-Presented at the Intern. Conf. On Advanced Treatment and Reclamation of Wastewater.

Abstract: The relative resistance of enteroviruses, coliphages and E. coli was studied in laboratory experiments: Coxsackie B3 and Polio 3 were the most resistant strains, Coxsackie B5 and Polio 2 were the least resistant. Coliphages and E. coli were less resistant than any of the viruses. The effect on ozone disinfection of a range of organic and inorganic chemicals and waste water effluents was investigated.

Descriptors: *Bacteriophages, *Biodegradation, *Ozone, *Water treatment, Viruses, Antiseptics, Effluents, Organic compounds, Waste water, Water quality

Identifiers: *Enteroviruses, Disinfection, Escherichia coli, Vulnerability, *Sewage treatment, Water reclamation, Great Britain, Coxsackie viruses, Polioviruses, *Meetings, NTISNASAF

N78-25745/8ST NTIS Prices: PC A02/MF A01

(con)

Ozonation of Make-Up Water for Salmonid Fish Rearing Facilities

Idaho Univ., Moscow. Water Resources Research Inst.*Office of Water Research and Technology, Washington, D.C.

Completion rept.
AUTHOR: Colberg, Patricia J.; Edwards, Louis L.; Lingg, A. J.; Morrison, Thomas J.; Wallace, Alfred T.
E1731L3 Fld: 13B, 6C, 68D, 98F GRAI7817
Aug 77 59p
Contract: DI-14-34-0001-6013
Project: OWRT-A-053-IDA
Monitor: OWRT-A-053-IDA(3)

Abstract: An ozone pilot plant was installed at the Dworshak National Fish Hatchery to examine the efficiency of sterilizing makeup water entering this recycle hatchery. The pilot plant consisted of two separate systems operated together. A recycle system consisting of two fish tanks, a clarifier and bio-filter was in operation prior to this study. At the conclusion of the pilot plant study, an economic comparison was made of an ozone system and an ultraviolet system. Although the ozone treatment system requires a capital investment of $164,000 as opposed to $90,000 for an equivalent size ultraviolet system and an annual cost of almost $17,000 as opposed to $12,000 for the UV system, this study demonstrates the increased cost may be justified. The ozone system gave consistently greater sterilization efficiency than the ultraviolet system.

Descriptors: *Water treatment, *Ozonization, *Waste water reuse, *Fisheries, Performance evaluation, Pilot plants, Purification, Design, Sterilization, Ultraviolet radiation, Concentration(Composition), Algae, Ammonia, Biochemical oxygen demand, Inorganic nitrates, Nitrites, Bacteria, Correlation techniques, Effectiveness, Survival, Cost comparison, Idaho

Identifiers: Salmonids, NTISDIOWRT

PB-280 555/4ST NTIS Prices: PC A04/MF A01

Industrial Wastewater Recirculation System: Preliminary Engineering

Owens-Corning Fiberglas Corp., Toledo, Ohio.**Engineering-Science, Inc., Atlanta, Ga.*Industrial Environmental Research Lab., Research Triangle Park, N.C. (273 650)

Final rept May 73-Jun 76
AUTHOR: Loven, A. W.; Pintenich, J. L.
D3712C4 Fld: 7A, 68D, 99B GRAI7725
Feb 77 177p
Grant: EPA-S-801173-01-02
Monitor: EPA/600/2-77/043
Prepared in cooperation with Engineering-Science, Inc. Atlanta Ga

Abstract: The report details the preliminary engineering work done at Owens-Corning's (O-C's) Anderson, South Carolina, fibrous glass plant. The purpose of the work was to test, on a pilot plant scale, various technologies to be used to clean up industrial wastewater for a closed-loop system, i.e., for total industrial wastewater reuse. Conceptual design has been developed for the testing treatment processes of sand filtration, activated carbon adsorption, and disinfection. As a result of this work, O-C has authorized the construction of a full scale plant which will be in operation in 1978. This report makes the developed technology available to the industry prior to publication of details of final plant construction and operation.

Descriptors: *Circulation, *Industrial wastes, *Water pollution control, *Feedback control, Data analysis, Pilot plants, Technology, Filtration, Activated carbon, Disinfection, Adsorption, Biochemical oxygen demand, Inorganic compounds, Process charting, Performance evaluation, Design criteria, Coagulation, Flotation, Ozonation, Reclamation, Ion exchanging, Reverse osmosis, Chlorination, Substitutes

Identifiers: Biological industrial waste treatment, NTISEPAORD

PB 271 990/4ST NTIS Prices: PC A09/MF A01

con)

Chemical/Biological Implications of Using Chlorine and Ozone for Disinfection

Minnesota Univ.-Duluth. Dept. of Chemistry.*Environmental Research Lab.-Duluth, Minn.

Final project rept. 1972-76
AUTHOR: Carlson, Robert M.; Caple, Ronald
D351502 Fld: 13B, 7D, 68D, 99A GRAI7723
Jun 77 99p
Grant: EPA-R-800675
Monitor: EPA/600/3-77/066

Abstract: Chlorine is readily incorporated into a variety of organic materials known to be present in water subjected to chlorine-renovation procedures. The observed products can be predicted on the basis of commonly used mechanistic considerations. The aqueous ozonation studies confirm that mechanistic considerations developed in non-aqueous cases can be applied to the prediction of products from ozone addition to dilute solutions of unsaturated organics in water. The dominant feature in the observed toxicity of phenols to Daphnia magna was the lipophilic nature of the compound as represented by the partition coefficient. The partition coefficient of a compound has been shown as part of this overall study to be readily obtained from its retention properties on a 'reverse-phase' HPLC column. The effects of chlorination on biological oxygen demand (BOD) were examined by comparing the BOD requirements of a sample containing a given parent system vs that of its chlorinated progeny. The results indicate that the chlorinated material is generally degraded less than the parent and that the lowered BOD values appear, at least for phenols, to be associated with the increased toxicity of the chlorinated material to the degrading organism.

Descriptors: *Water pollution control, *Disinfection, *Chlorination, *Ozonization, *Water treatment, Biochemical oxygen demand, Potable water, Industrial waste treatment, Sewage treatment, Organic compounds, Water analysis, Chemical analysis, Chemical reactions, Phenols, Toxicity, Gas chromatography, Anilines

Identifiers: Water quality, NTISEPAORD

PB-270 694/3ST NTIS Prices: PC A05/MF A01

Detection and Inactivation of Enteric Viruses in Wastewater

Hadassah Medical School, Jerusalem (Israel) Environmental Health Lab.*Environmental Monitoring and Support Lab.-Cincinnati, Ohio. Biological Methods Branch. (409 928)

Final rept Oct 69-Jan 75
AUTHOR Shuval, Hillel I.; Katzenelson, Eliyahu
D3391B1 Fld: 13B, 6M, 68D, 57K GRAI7722
May 77 304p
Grant: EPA-S-800990
Monitor: EPA/600/2-77/095

Abstract: This report covers studies on the development and evaluation of methods for concentrating and assaying low levels of viruses in large volumes of water as well as studies on the use of ozone in inactivating viruses in water and wastewater. Of the eight virus concentration methods evaluated, filtration with cellulose nitrate membranes, aluminum hydroxide and PE-60 proved most promising. The feasibility of using hollow fiber membranes was demonstrated. A rapid method capable of detecting viruses in water in less than 24 hours using fluorescent antibodies was developed. A spectrophotometric method of detecting low concentrations of ozone in small (10 ml) samples of water was developed. Kinetic studies show that ozone inactivates enteroviruses more rapidly than chlorine under comparable conditions. With a 0.3 ppm residual ozone inactivates 99% of seeded poliovirus in clean water in less than 10 seconds as compared to 100 seconds for chlorine.

Descriptors: *Viruses, *Water pollution, *Water treatment, Bioassay, Disinfection, Monitoring, Waste water, Fluid filters, Membranes, Cellulose nitrate, Aluminum hydroxides, Ozone, Public health, Spectrophotometry, Feasibility, Evaluation

Identifiers: NTISEPAORD

PB-270 210/8ST NTIS Prices PC A14/MF A01

Ozonization Used in Water and Sewage Treatment (Citations from the NTIS Data Base)

National Technical Information Service, Springfield, Va. (391 812)

Rept. for 1970-Aug 77
AUTHOR: Cavagnaro, Diane M
D3382E4 Fld 13B, 7A, 68D*, 68E, 99B*, 86W GRAI7722
Sep 77 77p*
Monitor: 18
Supersedes NTIS/PS-76/0655. See also NTIS/PS-77/0749.

Abstract: The bibliography cites Federally-funded research in the use of ozone to treat industrial waste water, sewage, and drinking water. It discusses treatment, tests, performance of equipment, and effectiveness of ozone in water pollution control. (This updated bibliography contains 72 abstracts, 24 of which are new entries to the previous edition.)

Descriptors: *Bibliographies, *Ozonization, *Water treatment, *Sewage treatment, *Industrial waste treatment, *Water pollution control, Chemical removal(Sewage treatment), Performance evaluation, Design criteria, Chemical removal(Water treatment), Potable water, Purification, Water, Sterilization, Viruses, Pesticides, Chlorination, Water analysis, Microorganism control(Water), Filters

Identifiers: MUST(Medical Unit Selfcontained Transportable), Monitors, Water pollution effects(Humans), NTISNTISEN

NTIS/PS-77/0748/2ST NTIS Prices: PC N01/MF N01

Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations

Municipal Environmental Research Lab., Cincinnati, Ohio. Water Supply Research Div
AUTHOR: Sorg, Thomas J ; Love, O. Thomas Jr; Logsdon, Gary S
D305413 Fld 13B, 68D*, 68E, 68F, 50B GRAI7719
May 77 80p*
Rept No: EPA/600/8-77/005
Monitor: 18

Abstract: Following the passage on December 16, 1974, of Public Law 93-523, The Safe Drinking Water Act, the Interim Primary Drinking Water Regulations were promulgated on December 24, 1975, to take effect June 24, 1977. These regulations set Maximum Contaminant Levels (MCL) for ten inorganic constituents, turbidity, coliform organisms, six pesticides and radionuclides. PL 93-523 stated that the Primary Drinking Water Regulations should consist of MCLs as well as a statement of treatment technology that could be used to achieve these levels. This document provides that information. It contains five sections as related to the five groups of Interim Primary Drinking Water Regulations noted above. This document, based on the literature and the research being conducted by the Water Supply Research Division, is not meant to stifle innovative treatment technology. It attempts to be a statement of technology known at the time of the effective date of the Interim Primary Drinking Water Regulations that will allow utilities, with assistance from their consulting engineers, to apply whatever treatment might be necessary to improve their drinking water quality such that it meets the Interim Primary Drinking Water Regulations.

Descriptors: *Manuals, *Water treatment, *Potable water, *Regulations, Radioactive contaminents, Chemical removal(Water treatment), Inorganic compounds, Water pollution control, Arsenic, Barium, Cadmium, Chromium, Fluorides, Lead(Metal), Mercury(Metal), Organic compounds, Inorganic nitrates, Selenium, Cost analysis, Turbidity, Disinfection, Chlorination, Ozone, Chlorine oxides, Byproducts, Pesticides, Trace elements, Lime, Ion exchanging, Reverse osmosis, Endrin, Chlorine organic compounds, Coliform bacteria, Microorganism control(Water)

Identifiers: *Water quality, Methoxchlor, Lindane, D 2-4 herbicide, Silvex, Safe Drinking Water Act of 1974, NTISEPAORD

PB-268 029/6SI NTIS Prices: PC A05/MF A01

UV-Ozone Water Oxidation/Sterilization Process

Westgate Research Corp Marina Del Rey Calif (391630)

Final rept. 1 Jul 74-31 Aug 76
AUTHOR: Zeff, Jack D.; Wark, Jeffrey; Shuman, Raymond; Farrell, Frank C.; Alhadeff, Ezra S.
D242102 Fld: 13B, 68D GRAI7714
Nov 76 214p
Rept No: 1602
Contract: DAMD17-75-C-5013
Monitor: 18

Abstract: This report describes the second and third year efforts of Westgate Research Corporation in developing UV-Ozone Systems for the Army MUST Program and for NASA Manned Spacecraft. In the second and third years, process variables of importance were studied on the bench and then in a URM pilot plant system. The URM (Unit Reactor Module) is a basic building block module which is designed to be unitized into a full-scale UV-ozone system for the Army MUST Water Processing Element (WPE). Statistically designed experiments were conducted using both the bench system and the URM system. In these tests various compositions of synthetic waste waters, which simulate the permeate from the MUST reverse osmosis system, were used. Mathematical models of the bench system and the URM system were derived.

Descriptors: *Water treatment, Disinfection, Ozonation, Sterilization, Ultraviolet radiation, Oxidation, Waste water, Mathematical models, pH factor, Reverse osmosis, Water supplies

Identifiers: Field hospitals, Potable water, *Sewage treatment, MUST(Medical Unit Selfcontained Transportable), Hospitals, *Water pollution, NTISDODXA

AD-A038 609/4ST NTIS Prices: PC A10/MF A01

Evaluation of Ozonation and Chlorination for Disinfection of Blackwater

Abcor Inc Wilmington Mass Walden Research Div (409707)

Final rept.
AUTHOR: McNulty, Kenneth J.; Goldsmith, Robert L.
D128412 Fld: 13B, 68D GRAI7706
Dec 76 96p
Contract: DAAG53-76-C-0083
Monitor: 18

Abstract: Ozonation and chlorination were experimentally evaluated as alternative techniques for the disinfection of blackwater. The experiments focused primarily on determining the dosages of chlorine and ozone required to achieve a fecal coliform concentration of 200 colonies per 100 ml. The required ozone dosage (< 750 mg/l for the samples tested) was approximately three times as great as the required chlorine dosage (< 240 mg/l for the samples tested). Various temperatures and pH's were also investigated, but the effects of these parameters did not appear to be significant. (Author)

Descriptors: *Waste water, *Sewage treatment, *Ozonation, *Chlorination, Coliform bacteria, Concentration(Composition), Dosage, Ships, Disinfection

Identifiers: Blackwater, NTISDODXA

AD-A033 734/5ST NTIS Prices: PC A05/MF A01

New Microbial Indicators of Disinfection Efficiency

Illinois Univ At Urbana-Champaign Dept of Civil Engineering (176010)

Final rept. 1 May 72-31 Apr 75
AUTHOR: Engelbrecht, Richard S.; Severin, Blaine F.; Masarik, Mark T.; Farooq, Shaukat; Lee, Sai H.
C7621G3 Fld: 13B, 6M, 68D, 57K GRAI7625
Jul 75 88p
Contract: DADA17-72-C-2125
Monitor: 18

Abstract: Since the coliform group of organisms is less resistant to chlorine than many viral pathogens, the utility of both yeasts and acid-fast organisms as indicators of disinfection efficiency was evaluated. Four yeasts, *Candida parapsilosis, C. krusei, Trichosporon fermetans* and *Rhodotorula rubra*; and three acid-fast organisms, *Mycobacterium fortuitum, M. phlei*, and *M. Smegamtis*, were found to occur commonly in domestic wastewater. The resistance to free chlorine was: acid-fast organisms > yeasts > poliovirus type 1 Mahoney strain > Salmonella typhimurium > Escherichia coli using mixed cultures including two acid-fast organisms and four yeasts at pH 6, 7, and 10 and 5 deg and 20 deg C. The resistance to inorganic chloramines (5:1 wt. ratio Cl2:NH3-N) was M. fortuitum > C. parapsilosis > M. phlei > E. coli at pH 7 and 20 C. C. parapsilosis appeared to be more resistant to ozone than E. coli at room temperature.

Descriptors: *Disinfection, Quality assurance, Indicators, Coliform bacteria, Chlorination, Candida, Yeasts, Waste water, Resistance(Biology), Mycobacterium, pH factor, Ozonation, Escherichia coli, Salmonella typhimurium, Public health

Identifiers: Chloramines, *Indicator species, *Bioindicators, *Sewage, NTISDODXA

AD-A030 547/4ST NTIS Prices: PC A05/MF A01

Disinfection of Wastewater. Task Force Report

Environmental Protection Agency, Washington, D.C. Municipal Construction Div.
C7601G2 Fld: 13B, 68D GRAI7624
Mar 76 67p
Rept No: EPA/430/9-75/012; EPA/MCD 21
Monitor: 18

Abstract: A Task Force Report has been prepared to provide a compilation of the existing technical and scientific data related to the issues raised by wastewater disinfection. The report is divided into four main parts: Summary, Conclusions and Recommendations; *Public Health Effects and Considerations*; Toxic Effects on the Aquatic Environment; and Disinfection Process Alternatives. Also included in the report is a summary of the Agency's ongoing research and development program in the area of wastewater disinfection and alternate means of disinfection.

Descriptors: *Disinfection, *Sewage treatment, *Research projects, Activated carbon treatment, Water pollution, Public health, Waste water, Water treatment, Drinking water, Effluents, Calcium oxides, Substitutes, Industrial plants, Cost estimates, Marine biology, Toxicity, Water quality, Fresh water biology, Ozone, Sulfur dioxide, Bromine, Iodine, Ionizing radiation, Standards, Chlorine, Chlorination

Identifiers: Bromine chlorides, NTISEPAOWP

PB-257 449/9ST NTIS Prices: PC A04/MF A01

Ozonization Used in Water and Sewage Treatment (Citations from the NTIS Data Base)

National Technical Information Service, Springfield, Va. (391 812)

Rept. for 1970-Jul 76
AUTHOR: Cavagnaro, Diane M.
C7201D1 Fld: 13B, 7A, 68D*, 68E, 99B*, 86W GRAI7621
Aug 76 52p*
Monitor: 18
See also NTIS/PS-76/0656.

Abstract: The bibliography cites Federally-funded research in the use of ozone to treat industrial waste water, sewage, and drinking water. It discusses treatment, tests, performance of equipment, and how effectively ozone can control water pollution. (Contains 48 abstracts)

Descriptors: *Bibliographies, *Ozonization, *Water treatment, *Sewage treatment, *Industrial waste treatment, *Water pollution control, Chemical removal(Sewage treatment), Performance evaluation, Design criteria, Chemical removal(Water treatment), Potable water, Purification, Water, Sterilization, Viruses, Pesticides, Chlorination, Water analysis, Microorganism control(Water), Filters

Identifiers: MUST(Medical Unit Selfcontained Transportable), Monitors, Water pollution effects(Humans), NTISNTIS

NTIS/PS-76/0655/1ST NTIS Prices: PC N01/MF N01

(con)

Technical Guidelines for Public Water Systems

Clean Water Consultants, El Dorado, Calif.*Environmental Protection Agency, Washington, D.C. Div. of Water Supply.

Final rept.
AUTHOR: Culp, Russell L.
C7134G1 Fld: 13B, 68D*, 50B*, 91C* GRAI7620
16 Jun 76 474p*
Rept No: 46
Contract: EPA-68-01-2971
Monitor: 18

Abstract: This report presents technical guidelines for the design, operation, maintenance, staffing, and surveillance of public water systems including references and bibliography. Topics discussed include: general design considerations, source development, treatment, chemical application, pumping facilities, storage, distribution systems, operation and maintenance, surveillance, and personnel.

Descriptors: *Public works, *Water treatment, *Water supply, *Water pollution, *Handbooks, Natural waters, Sites, Bibliographies, Design criteria, Industrial waste treatment, Water quality, Fluoridation, Chemical removal(Water treatment), Inorganic chemicals, Organic chemicals, Pesticides, Trace elements, Metals, Radioactive isotopes, Chemical removal(Sewage treatment), Sludge disposal, Filtration, Taste, Chlorination, Ozonation, Ultraviolet radiation, Water softening, Lime-soda ash process, Ion exchanging, Brines, Disinfection, Feedwater treatment, Odors, Activated carbon, Desalting, Solid waste disposal, Operations, Materials handling, Well pumps, Water storage, Pumping, Water distribution, Maintenance, Budgeting, Financial management, Safety, Sampling, Monitoring, Personnel, Standards

Identifiers: NTISEPAOWP

PB-255 217/2ST NTIS Prices: PC A20/MF A01

Chemistry and Microbiology of Water

Cold Regions Research and Engineering Lab Hanover N H (037100)
AUTHOR: Dolivo-Dobrovolskii, L. B.; Kulskii, L. A.; Nakorchevskaya, V. F.
C7103H2 Fld: 13B, 8H GRAI7620
1975 343p
Rept No: CRREL-TL-506
Monitor: 18
Draft trans. of mono. Khimiia i Mikrobiologiia Vody, Kiev, 1971 308p.

Abstract: The book discusses the chemical and microbiological processes taking place in reservoirs, tanks and ponds, and during purification of natural and sewage waters. Particular attention is devoted to problems of chemical and biological purification, in tensification of the methods of treating natural and sewage waters, new reagents and improvement of the treatment method. The textbook is designed for students at engineering-construction institutes with the specialty of 'Water Supply and Sewage Systems'. It will also be useful to engineering and technical personnel in studying, planning and operating water lines and sewage purification installations.

Descriptors: *Sewage treatment, *Water treatment, *Water chemistry, Solubility, Sorption, Surfaces, Colloids, Surface waters, USSR, Physical properties, Chemical properties, Water analysis, Translations, Taste, Iron, Manganese, Chlorine, Silver, Iodine, Ultraviolet radiation, Ultrasonic radiation, Radioactive isotopes, Microorganisms, Bacteria

Identifiers: Water pollution control, Chemical removal(Water treatment), Chemical removal(Sewage treatment), Solutions, Micelles, Industrial waste treatment, Coagulants, Water softening, Odor, Desalting, Dissolved gases, Inorganic silicates, Degassing, Disinfectants, Ozonization, Radioactive effluents, Urban, Municipal engineering, Irrigated land, Lagoons(Ponds), NTISDODA

AD-A027 708/7ST NTIS Prices: PC A15/MF A01

Virus Elimination in Water and Wastewater

Naval Coastal Systems Lab Panama City Fla (407276)

Informal rept
AUTHOR: Katzenstein, L. B.; Braswell, J. A.
C617411 Fld 13B, 6E, 57K*, 68D*, 68G GRAI7609
Jan 76 40p
Rept No NCSL-269-76
Monitor 18

Abstract: The effectiveness of various techniques for disinfecting sewage and drinking water are discussed. Special emphasis is given to the elimination of viruses. Basic concepts of water and wastewater treatment such as coagulation, filtration, ozonation, and chlorination are reviewed. Information is presented on economically feasible methods for improving virus removal through the application of new technology to conventional treatment techniques. (Author)

Descriptors: *Waste water, *Viruses, *Water treatment, *Sewage treatment, Disinfection, Chlorination, Ozonation, Coagulation, Filtration, Sedimentation, Waste treatment, Bibliographies, Sanitary engineering, Sanitation, Cost analysis, Removal, Inactivation, Alums, Iron compounds, Calcium oxides, Residual, Public health, Drinking water

Identifiers: *Water pollution control, NTISDODXA, NTISDODN

AD-A021 773/7ST NTIS Prices: PC A03/MF A01

Laboratory Verification Test Agreement No. CJ-002

National Environmental Research Center, Cincinnati, Ohio. Water Supply Research Lab.*National Science Foundation, Washington, D.C. Office of Experimental Research and Development Incentives.*Alron Industries, Inc., Rochester, N.Y.

Final rept.
AUTHOR: Carswell, J. Keith
C4974K1 Fld 07A, 13B, 99B, 50B GRAI7518
Jul 74 83p
Monitor NSF/RA/R-74-034
Prepared in cooperation with Alron Industries, Inc., Rochester, N.Y.

Abstract: This final report provides a descriptive summary, including detailed technical data, of a project under which an innovative water purification system developed by Alron Industries of Rochester, New York, was tested for effectiveness in removing a variety of inorganic and organic contaminants. This project was funded by NSF in order to obtain verification of selected product performance parameters by an independent, scientifically recognized organization, as a means of influencing the future commercial development and marketing potential of the tested system. The system employs ozone treatment to remove bacteria, viruses, and chemical.

Descriptors: *Water treatment devices, *Ozonization, Tests, Performance evaluation, Chemical removal(Water treatment), Bacteria, Viruses, Organic compounds, Trace elements, Sterilization

Identifiers: NTISNSFRA, NTISEPA

PB-242 517/1ST NTIS Prices: PC A05/MF A01

Microstraining and Disinfection of Combined Sewer Overflows. Phase II

Crane Co., King of Prussia, Pa. Cochrane Environmental Systems Div.*National Environmental Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.

Final rept.
AUTHOR: Maher, Michael B.
C3695L1 Fld: 13B, 68D, 91A GRAI7604
Aug 74 92p
Grant: EPA-S-800966
Project: EPA-ROAP-21ASY-105
Monitor: EPA-670/2-74-049
See also PB-219 879
Paper copy available from GPO.

Abstract: Suspended solids (SS) removal using a microstrainer with a stainless steel screen having openings of 23 micrometers was studied. Report discusses coagulation using high molecular weight, cationic polyelectrolytes; coliform reductions using chlorine and ozone, and capital cost of a microstrainer installation.

Descriptors: *Sewage treatment, *Sewage filtration, *Combined sewers, *Overflows, *Microorganism control(Water), *Storm sewers, Chlorination, Coliform bacteria, Biochemical oxygen demand, Performance evaluation, Capitalized costs, Ozonization, Design criteria, Flow rate, Permeability, Polyelectrolytes, Coagulants

Identifiers: *Microstraining, Philadelphia(Pennsylvania), Chemical oxygen demand, *Water pollution control, NTISEPAORD

PB-235 771/3ST NTIS Prices: PC A05/MF A01

Ozone in Water and Waste Water Treatment. A Bibliography

Office of Water Resources Research, Washington, D C Water Resources Scientific Information Center.
C288581 Fld: 13B, 68D*, 91A GRAI7413
Apr 74 135p*
Rept No: WRSIC-74-204
Monitor: W74-07251

Abstract: The report, containing 89 abstracts, is another in a series of planned bibliographies in water resources to be produced from the information base comprising SELECTED WATER RESOURCES ABSTRACTS (SWRA). Author and subject indexes are included.

Descriptors: *Ozone, *Bibliographies, *Water treatment, *Sewage treatment, Water reclamation, Abstracts, Waste water, Disinfection, Oxidation, Potable water, Chemical analysis, Purification

Identifiers: OWRR

PB-231 797/2 NTIS Prices: PC A07/MF A01

Chem abstracts 1972-1976

24 off-line prints (first 6 were printed on-line) 1447

Print 5/5/7 35
DIALOG File3 CA Search - 1972-1976 (See 2,4,104,311) (Copr Am Chem Soc) (Item 1 of 29) User2901 23feb82

84169491 CA 84(24)169491f CONFERENCE PROCEEDING
Disinfection of water by ozone. Viruses and bacteria
AUTHOR Katzenelson, E ; Shuval, H I
LOCATION Hadassah Med Sch., Hebrew Univ , Jerusalem, Israel
JOURNAL Int. Symp Ozone Water Wastewater Treat , Proc , 1st
EDITOR Rice, Rip G (Ed), Browning, Myron E (Ed) DATE 1975 PAGES 296-316 CODEN 30YCAZ LANGUAGE English
MEETING DATE 73 PUBLISHER Int. Ozone Inst , Waterbury, Conn
SECTION
CA961004 Water
CA960XXX Sewage and Wastes
IDENTIFIERS ozone disinfection water, wastewater disinfection ozone
DESCRIPTORS
Water purification...
disinfection, by ozone
Virus,animal
inactivation of, in water by ozone
Waste water treatment ...
ozonization, disinfection by

84169488 CA 84(24)169488k CONFERENCE PROCEEDING
Ozone disinfection of the Strasburg, Pennsylvania water supply system
AUTHOR Harris, Weldon C
LOCATION Weldon C Harris Assoc., Doylestown, Pa
JOURNAL Int Symp Ozone Water Wastewater Treat., Proc., 1st
EDITOR Rice, Rip G (Ed); Browning, Myron E (Ed) DATE 1975 PAGES 186-93 CODEN 30YCAZ LANGUAGE English
MEETING DATE 73 PUBLISHER Int Ozone Inst , Waterbury, Conn
SECTION
CA961004 Water
IDENTIFIERS ozone disinfection water
DESCRIPTORS
Water purification
disinfection, by ozone

84169164 CA 84(24)169164b CONFERENCE PROCEEDING
Economical waste water disinfection with ozone
AUTHOR Rosen, Harvey M ; Lowther, Frank E ; Clark, Richard G
LOCATION Pollut Control Syst , W R Grace and Co , Columbia, Md
JOURNAL Disinfect Water Wastewater EDITOR Johnson, J Donald (Ed) DATE 1975 PAGES 233-48 CODEN 31PYAR
LANGUAGE English PUBLISHER Ann Arbor Sci , Ann Arbor, Mich
SECTION
CA960002 Sewage and Wastes
IDENTIFIERS ozone wastewater disinfection
DESCRIPTORS
Waste water treatment...
disinfection of, with ozone, economics of
CAS REGISTRY NUMBERS
10028-15-6 uses and miscellaneous, disinfection with, of waste waters

84169106 CA 84(24)169106j CONFERENCE PROCEEDING
Disinfection of municipal secondary-tertiary effluents with ozone. Five recent pilot plant studies
AUTHOR Rosen, H M ; Lowther, F E ; Clark, R. G.
LOCATION W R Grace and Co , Columbia, Md
JOURNAL Int Symp. Ozone Water Wastewater Treat., Proc., 1st
EDITOR Rice, Rip G (Ed); Browning, Myron F. (Ed) DATE 1975 PAGES 425-35 CODEN 30YCAZ LANGUAGE English
MEETING DATE 73 PUBLISHER Int. Ozone Inst., Waterbury, Conn
SECTION
CA960001 Sewage and Wastes
IDENTIFIERS ozone disinfection wastewater
DESCRIPTORS
Waste water treatment ...
ozonization, disinfection in
CAS REGISTRY NUMBERS
10028-15-6 uses and miscellaneous, in waste-water treatment, disinfection by

(Con)

84169105 CA 84(24)169105h CONFERENCE PROCEEDING
Ozone disinfection of secondary effluents. Laboratory studies
AUTHOR: Nebel, Carl; Unangst, Paul C.; Gottschling, Ronald D.
LOCATION: Welsbach Ozone Syst. Corp., Philadelphia, Pa.
JOURNAL: Int. Symp. Ozone Water Wastewater Treat., Proc., 1st
EDITOR: Rice, Rip G (Ed); Browning, Myron E (Ed) DATE: 1975 PAGES: 382-404B CODEN: 30YCAZ LANGUAGE: English
MEETING DATE: 73 PUBLISHER: Int. Ozone Inst., Waterbury, Conn
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: ozone disinfection wastewater
DESCRIPTORS:
Waste water treatment...
ozonization, decontamination and disinfection in
Detergents... Pesticides...
removal of, from wastewater by oxidn. by ozone
CAS REGISTRY NUMBERS:
57-12-5 14797-65-0 removal of, from wastewater by oxidn. by ozone
10028-15-6 uses and miscellaneous, in waste-water treatment
108-95-2 7664-41-7 uses and miscellaneous, removal of, from wastewater by oxidn. by ozone

84155184 CA: 84(22)155184w JOURNAL
Enhancement of terminal disinfection of a waste water treatment system
AUTHOR: Longley, Karl E.; Olivieri, Vincent P.; Kruse, Cornelius W.; Kawata, Kazuyoshi
LOCATION: U. S. Army Med. Dep., Washington, D. C.
JOURNAL: Water Resour. Symp. DATE: 1974 VOLUME: 7
NUMBER: Virus Survival Water Wastewater Syst. PAGES: 166-79
CODEN: WARSA9 LANGUAGE: English
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: virus inactivation wastewater treatment, chlorination wastewater virus inactivation, ozonization wastewater virus inactivation, rheol wastewater treatment virus inactivation, pH wastewater treatment virus inactivation
DESCRIPTORS:
Waste water treatment...
chlorination and ozonization, virus inactivation in
Virus,animal...
inactivation of, in waste water treatment
CAS REGISTRY NUMBERS:
10028-15-6 uses and miscellaneous, in waste water treatment, effectiveness of bacterial and viral removal in

84131058 CA: 84(19)131058g TECHNICAL REPORT
Comparative toxicity of sewage-effluent disinfection to freshwater aquatic life
AUTHOR: Arthur, John W.; Andrew, Robert W.; Mattson, Vincent R.; Olson, Donald T.; Glass, Gary E.; Halligan, Barbara J.; Walbridge, Charles T.
LOCATION: Environ. Res. Lab., Duluth, Minn
JOURNAL: U. S. Environ. Prot. Agency, Off. Res. Dev., (Rep.) EPA DATE: 1975 NUMBER: EPA-600/3-75-012 PAGES: 61 pp
CODEN: XPARD6 LANGUAGE: English
SECTION:
CA904003 Toxicology
CA960XXX Sewage and Wastes
IDENTIFIERS: aquatic animal sewage disinfection toxicity
DESCRIPTORS:
Animal...
aquatic invertebrate, sewage effluent disinfection toxicity to
Waste water treatment...
chlorination and ozonation, toxicity of, to aquatic animals
Fish...
sewage effluent disinfection toxicity to
CAS REGISTRY NUMBERS:
7782-50-5 10028-15-6 biological studies, sewage effluent disinfection by, toxicity of, to aquatic animals

84126317 CA: 84(18)126317m CONFERENCE PROCEEDING
Disinfection of water and waste water using ozone
AUTHOR: Diaper, E. W. J.
LOCATION: Cochrane Environ. Syst., Crane Co., King of Prussia, Pa.
JOURNAL: Disinfect. Water Wastewater EDITOR: Johnson, J. Donald (Ed) DATE: 1975 PAGES: 211-31 CODEN: 31PYAR
LANGUAGE: English PUBLISHER: Ann Arbor Sci., Ann Arbor, Mich
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: wastewater disinfection ozone
DESCRIPTORS:
Waste water treatment... Water purification...
disinfection, ozone in
Ozonolysis...
in water and waste water treatments

Con)

84126298 CA 84(18)126298f CONFERENCE PROCEEDING
Disinfection of waste water effluents for virus inactivation
AUTHOR: Cookson, John T., Jr.; Robson, C. Michael
LOCATION: Univ. Maryland, College Park, Md.
JOURNAL: Disinfect. Water Wastewater EDITOR: Johnson, J. Donald (Ed) DATE: 1975 PAGES: 391-417 CODEN: 31PYAR
LANGUAGE: English PUBLISHER: Ann Arbor Sci., Ann Arbor, Mich.
SECTION:
CA960000 Sewage and Wastes
IDENTIFIERS: review sewage effluent virus disinfection, wastewater virus disinfection review, chlorination virus disinfection sewage review, ozonation virus disinfection sewage review
DESCRIPTORS:
Virus...
inactivation of, in waste water
Waste water treatment...
virus inactivation

84111151 CA 84(16)111151d JOURNAL
Effect of halogens and ozone on Schistosoma ova
AUTHOR: Mercado Burgos, Nelson; Hoehn, Robert C.; Holliman, Rhodes B.
LOCATION: Civ. Eng. Dep., Virginia Polytech. Inst., Blacksburg, Va.
JOURNAL: J. Water Pollut. Control Fed. DATE: 1975 VOLUME: 47 NUMBER: 10 PAGES: 2411-19 CODEN: JWPFA5
LANGUAGE: English
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: chlorine sterilization Schistosoma ova, bromine sterilization Schistosoma ova, iodine sterilization Schistosoma ova, chloramine sterilization Schistosoma ova, ozone sterilization Schistosoma ova, Schistosoma ova sterilization halogen ozone
DESCRIPTORS:
Schistosoma mansoni...
eggs, disinfection of waste water contg., halogens and ozone in
Waste water treatment...
sterilization, Schistosoma ova removal by, halogens and ozone in
CAS REGISTRY NUMBERS:
7553-56-2 7726-95-6 7782-50-5 10028-15-6 uses and miscellaneous, waste water sterilization by, Schistosoma ova removal in

84079270 CA 84(12)79270d CONFERENCE PROCEEDING
Ozonation as a viral disinfection technique in waste water treatment systems
AUTHOR: Pavoni, Joseph L.; Tittlebaum, Marty E.; Spencer, Hugh T.; Fleischman, Marvin
LOCATION: Civ. Eng. Dep., Univ. Louisville, Louisville, Ky.
JOURNAL: Int. Symp. Ozone Water Wastewater Treat., Proc., 1st
EDITOR: Rice, Rip G. (Ed); Browning, Myron E. (Ed) DATE: 1975 PAGES: 340-66 CODEN: 30YCAZ LANGUAGE: English
MEETING DATE: 73 PUBLISHER: Int. Ozone Inst., Waterbury, Conn.
SECTION:
CA960002 Sewage and Wastes
IDENTIFIERS: ozone virus wastewater, bacteria wastewater ozone
DESCRIPTORS:
Escherichia coli...
disinfection of, by ozonization of waste water
Virus, bacterial...
f2, disinfection by ozonization of waste water contg.
Ozonolysis...
of waste water, virus disinfection by
Waste water treatment...
ozonization, virus disinfection by

84035153 CA 84(6)35153p CONFERENCE PROCEEDING
Ozone disinfection of a sea water supply system
AUTHOR: Blogoslawski, Walter J.; Brown, Carolyn; Rhodes, Edwin W.; Broadhurst, Marie
LOCATION: Middle Atl. Coastal Fish. Cent., Natl. Mar. Fish. Serv., Milford, Conn.
JOURNAL: Int. Symp. Ozone Water Wastewater Treat., Proc., 1st
EDITOR: Rice, Rip G. (Ed); Browning, Myron E. (Ed) DATE: 1975 PAGES: 674-87 CODEN: 30YCAZ LANGUAGE: English
MEETING DATE: 73 PUBLISHER: Int. Ozone Inst., Waterbury, Conn.
SECTION:
CA961004 Water
IDENTIFIERS: ozonation seawater
DESCRIPTORS:
Water purification...
ozonation, of sea water

(con)

84008712 CA: 84(2)8712p JOURNAL
Water and waste water disinfection with ozone. Critical review
AUTHOR: Kinman, Riley N.
LOCATION: Univ. Cincinnati, Cincinnati, Ohio
JOURNAL: CRC Crit. Rev. Environ. Control DATE: 1975
VOLUME: 5 NUMBER: 1 PAGES: 141-52 CODEN: CCECAU
LANGUAGE: English
SECTION:
CA960000 Sewage and Wastes
IDENTIFIERS: review water disinfection ozone chlorine
DESCRIPTORS:
Waste water treatment... Water purification...
disinfection, ozonation in

83152071 CA: 83(18)152071a TECHNICAL REPORT
The uv-ozone water oxidation/sterilization process
AUTHOR: Zeff, Jack D.; Barton, Richard R.; Smiley, Bob; Alhadeff, Ezra
LOCATION: Westgate Res. Corp., Marina Del Rey, Calif.
JOURNAL: U. S. N. T. I. S., AD/A Rep. DATE: 1974 NUMBER: No. 004205/1GA PAGES: 89 pp. CODEN: XTSRDM LANGUAGE: English CITATION: Gov. Rep. Announce. Index (U. S.) 1975, 75(7), 111 AVAIL: NTIS
SECTION:
CA961004 Water
IDENTIFIERS: UV radiation ozonation water
DESCRIPTORS:
Waste water treatment... Water purification...
oxidn. and sterilization by uv radiation and ozone
CAS REGISTRY NUMBERS:
87-66-1 127-09-3 1300-71-6 removal of, from water, by ozonization and uv radiation
57-13-6 123-31-9 uses and miscellaneous, removal of, from water, by ozonization and uv radiation

83151765 CA: 83(18)151765t JOURNAL
Tertiary treatment and disinfection of tufted carpet dye waste water
AUTHOR: Stuber, Larry M.
LOCATION: Georgia Environ. Prot. Div., Dep. Nat. Resour., Atlanta, Ga.
JOURNAL: Eng. Bull. Purdue Univ., Eng. Ext. Ser. DATE: 1974
VOLUME: 145, Pt. 2, PAGES: 964-77 CODEN: PEXSAO
LANGUAGE: English
SECTION:
CA960002 Sewage and Wastes
CA939XXX Textiles
CA940XXX Dyes, Fluorescent Whitening Agents, and Photosensitizers
IDENTIFIERS: dyeing wastewater ozonation
DESCRIPTORS:
Waste water treatment...
ozonization, of carpet dyeing effluents
Dyeing...
waste water from, tertiary treatment by ozonization

83047838 CA: 83(6)47838h JOURNAL
Ozone decolorization of pulp and paper mill secondary effluents
AUTHOR: Nebel, Carl; Gottschling, Ronald D.; O'Neill, H. J.
LOCATION: Adv. Treat. Syst., Welsbach Ozone Syst. Corp., Philadelphia, Pa.
JOURNAL: Eng. Bull. Purdue Univ., Eng. Ext. Ser. DATE: 1973
VOLUME: 142, Pt. 2, PAGES: 948-65 CODEN: PEXSAO
LANGUAGE: English
SECTION:
CA960002 Sewage and Wastes
CA943XXX Cellulose, Lignin, Paper, and Other Wood Products
IDENTIFIERS: ozone decolorization paper mill effluent, lime decolorization paper mill effluent
DESCRIPTORS:
Ozonolysis...
pulp and paper mill effluent decolorization by
Paper...
waste water from manuf. of, decolorization and disinfection by ozone in treatment of
Pulp,cellulose...
waste water from processing of, decolorization and disinfection by ozone in treatment of

83047731 CA: 83(6)47731t DISSERTATION
Relative effectiveness of three halogens and ozone against ova of Schistosoma mansoni in sewage
AUTHOR: Mercado Burgos, Nelson
LOCATION: Virginia Polytech. Inst., Blacksburg, Va
DATE: 1975 PAGES: 136 pp CODEN: DABBBA LANGUAGE: English CITATION: Diss. Abstr. Int. B 1975, 35(8), 3965
AVAIL: Xerox Univ. Microfilms, Ann Arbor, Mich., Order No. 75-3466
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: Schistosoma sewage disinfection, ozone sewage disinfection Schistosoma, halogen sewage disinfection Schistosoma
DESCRIPTORS:
Waste water treatment...
disinfection, of Schistosoma mansoni, by halogens and ozone
Schistosoma mansoni...
toxicity to, of halogens and ozone
CAS REGISTRY NUMBERS:
7553-56-2 7726-95-6 7782-50-5 10028-15-6 biological studies, toxicity of, to Schistosoma mansoni, in waste water treatment

83015174 CA: 83(2)15174x JOURNAL
Economical waste water disinfection with ozone
AUTHOR: Rosen, H. M.; Lowther, F. E.; Clark, R. G.
LOCATION: Davison Chem. Div., W. R. Grace and Co., Baltimore, Md.
JOURNAL: Prepr. Pap. Natl. Meet., Div. Environ. Chem., Am. Chem. Soc. DATE: 1973 VOLUME: 13 NUMBER: 2 PAGES: 170-6 CODEN: ACEPCF LANGUAGE: English
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: ozone disinfection wastewater
DESCRIPTORS:
Waste water treatment...
activated-sludge process and ozonization, disinfection efficiency in
Ozonolysis...
of waste water, disinfection efficiency in

83015156 CA: 83(2)15156t JOURNAL
Disinfection of water and waste water using ozone
AUTHOR: Diaper, E. W. J.
LOCATION: Cochrane Environ. Syst., Crane Co., King of Prussia, Pa.
JOURNAL: Prepr. Pap. Natl. Meet., Div. Environ. Chem., Am. Chem. Soc. DATE: 1973 VOLUME: 13 NUMBER: 2 PAGES: 166-9 CODEN: ACEPCF LANGUAGE: English
SECTION:
CA960000 Sewage and Wastes
IDENTIFIERS: review ozone disinfection sewage, wastewater disinfection ozone review
DESCRIPTORS:
Ozonolysis...
of water and waste water
Waste water treatment..., Water purification...
ozonization

82174878 CA: 82(26)174878a CONFERENCE PROCEEDING
Comparative hygienic evaluation of some reagent and combined methods for disinfection of shipboard waste waters
AUTHOR: El'piner, L. I.; Rozval, K. S.; Konstantinov, Yu. P.; Pyagina, M. S.
LOCATION: Nauchno-Issled. Inst. Gig. Vodnogo Transporta, USSR
JOURNAL: Aktual. Vopr. Sanit. Mikrobiol. EDITOR: Sidorenko, G. I. (Ed) DATE: 1973 PAGES: 122-3 CODEN: 30AIAZ LANGUAGE: Russian PUBLISHER: Akad. Med. Nauk SSSR, Inst. Obshch. Kommunal'n. Gig., Moscow, USSR
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: disinfection sewage shipboard, chlorination shipboard sewage, ozonation shipboard sewage
DESCRIPTORS:
Waste water treatment...
chlorination, sodium chloride electrolysis in, aboard ship
Ships...
waste water treatment aboard, sodium chloride electrolysis in
CAS REGISTRY NUMBERS:
7647-14-5 uses and miscellaneous, waste water treatment by, chlorination by electrolysis in, aboard ship

82034794 CA: 82(6)34794v JOURNAL
Disinfection of return water by ozone
AUTHOR: Fisher, P. N.; Morkovina, E. A.; Oleneva, Z. G.; Sergeeva, V. V.; Loginova, L. G.
LOCATION: Vses. Nauchno-Issled. Inst. Biosint. Belkovykh Veshchestv, Moscow, USSR
JOURNAL: Rum. Prom-st. DATE: 1974 NUMBER: 10 PAGES: 11 CODEN: RUMPAK LANGUAGE: Russian
SECTION:
CA960002 Sewage and Wastes
CA943XXX Cellulose, Lignin, Paper, and Other Wood Products
IDENTIFIERS: paper mill wastewater ozonation disinfection
DESCRIPTORS:
Ozonolysis...
of paper mill effluent
Paper...
waste water from manuf. of, ozonization of

82007375 CA: 82(2)7375c JOURNAL
Ozone disinfection of combined industrial and municipal secondary effluents. I. Laboratory studies
AUTHOR: Nebel, Carl; Unangst, Paul C.; Gottschling, Ronald D.
LOCATION: Ozone Syst. Div., Welsbach Corp., Philadelphia, Pa
JOURNAL: Eng. Bull. Purdue Univ., Eng. Ext. Ser. DATE: 1972
VOLUME: 141, pt. 2, PAGES: 1039-55 CODEN: PEXSAO
LANGUAGE: English
SECTION:
CA960002 Sewage and Wastes
IDENTIFIERS: ozone disinfection secondary effluent, flotation secondary effluent ozone
DESCRIPTORS:
Waste water treatment...
ozonization, disinfection and flotation in, of industrial and municipal secondary effluents
Ozonolysis...
waste water treatment by, disinfection and flotation, of combined industrial and municipal secondary effluents

81158567 CA: 81(24)158567x JOURNAL
Inactivation of poliovirus in water by ozonation. Errata
AUTHOR: Majumdar, Somendu B.; Ceckler, William H.; Sproul, Otis J.
LOCATION: USA
JOURNAL: J. Water Pollut. Control Fed. DATE: 1974
VOLUME: 46 NUMBER: 8 PAGES: 2048-53 CODEN: JWPFA5
LANGUAGE: English
SECTION:
CA961004 Water
CA960XXX Sewage and Wastes
IDENTIFIERS: poliovirus inactivation ozonation water, virus inactivation waste water
DESCRIPTORS:
Virus,animal...
inactivation of, in water disinfection
Water purification...
ozonation, inactivation of poliovirus in

81140508 CA: 81(22)140508u JOURNAL
Ozone disinfection of combined industrial and municipal secondary effluents. II. Pilot plant studies
AUTHOR: Nebel, Carl; Unangst, Paul C.; Gottschling, Ronald D.; Hutchison, Richard L.; McBride, Thomas J.; Taylor, Dean M.
LOCATION: Ozone Syst. Div., Welsbach Corp., Philadelphia, Pa.
JOURNAL: Eng. Bull. Purdue Univ., Eng. Ext. Ser. DATE: 1972
VOLUME: 141, pt. 2, PAGES: 1056-71 CODEN: PEXSAU
LANGUAGE: English
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: ozone disinfection municipal effluent, froth removal municipal effluent, industrial effluent ozone disinfection
DESCRIPTORS:
Waste water treatment...
disinfection, ozone in
Ozonolysis...
of wastewater, disinfection by

81068090 CA: 81(12)68090g TECHNICAL REPORT
Feasibility of ozone disinfection of secondary effluent
AUTHOR: Greening, Elaine
LOCATION: Illinois Inst. Environ. Qual., Chicago, Ill
JOURNAL: U. S. Nat. Tech. Inform. Serv., PB Rep. DATE: 1974
NUMBER: No. 228524/5GA PAGES: 48 pp CODEN: XPBRCA
LANGUAGE: English CITATION: Govt. Rep. Announce. (U.S.) 1974, 74(9), 130 AVAIL: NTIS
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: ozone disinfection sewage effluent
DESCRIPTORS:
Waste water treatment...
disinfection, by ozone
CAS REGISTRY NUMBERS:
10028-15-6 uses and miscellaneous, waste water disinfection by

80073969 CA: 80(14)73969j JOURNAL
Ozone disinfection of industrial-municipal secondary effluents
AUTHOR: Nebel, Carl; Gottschling, Ronald D.; Hutchison, Richard L.; McBride, Thomas J.; Taylor, Dean M.; Pavoni, Joseph L.; Tittlebaum, Marty E.; Spencer, Hugh E.; Fleischman, Marvin
LOCATION: Welsbach Corp., Philadelphia, Pa.
JOURNAL: J. Water Pollut. Contr. Fed. DATE: 1973 VOLUME: 45 NUMBER: 12 PAGES: 2493-507 CODEN: JWPFA5
LANGUAGE: English
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: wastewater ozonation disinfection
DESCRIPTORS:
Ozonolysis...
of waste water, disinfection and oxidn. and flotation in
Waste water treatment...
ozonization, disinfection and oxidn. and flotation in

END

78128257 CA: 78(20)128257s JOURNAL
Ozone, the add-nothing sterilant
AUTHOR: Tenney, Robert I.
LOCATION: Winnetka, Ill.
JOURNAL: Tech. Quart., Master Brew. Ass. Amer. DATE: 1973
VOLUME: 10 NUMBER: 1 PAGES: 35-41 CODEN: TQMBAC
LANGUAGE: English
SECTION:
CA961000 Water
CA960XXX Sewage and Wastes
IDENTIFIERS: review ozone water purifn, waste water ozone review
DESCRIPTORS:
Waste water treatment... Water purification...
ozonization
Air conditioning...
sterilization, by ozone
CAS REGISTRY NUMBERS:
10028-15-6P prepn. of

78033573 CA: 78(6)33573c JOURNAL
Ozone disinfection of water and waste water
AUTHOR: Nebel, Carl; Forde, N. A.; O'Neill, H. J.
LOCATION: Welsbach Corp., Philadelphia, Pa.
JOURNAL: CTFA (Cosmet., Toiletry Fragrance Ass.) Cosmet. J.
DATE: 1972 VOLUME: 4 NUMBER: 1 PAGES: 26-7 CODEN: CTFJA5 LANGUAGE: English
SECTION:
CA960001 Sewage and Wastes
IDENTIFIERS: ozone disinfection waste water
DESCRIPTORS:
Waste water treatment... Water purification
ozonization
Ozonolysis...
waste water treatment by

76158017 CA: 76(26)158017q JOURNAL
Ozonization as a method for complete purification and disinfection of waste waters previously biologically treated
AUTHOR: Livke, V. A.; Velushchak, S. I.; Plysyuk, A. A.
LOCATION: USSR
JOURNAL: Khim. Prom. (Moscow) DATE: 1972 VOLUME: 48
NUMBER: 3 PAGES: 183-5 CODEN: KPRMAW LANGUAGE: Russian
SECTION:
CA960000 Sewage and Wastes
CA939XXX Textiles
IDENTIFIERS: ozonization biol treated waste water, disinfection biol treated waste water, caprolactam waste water ozonization
DESCRIPTORS:
Waste water treatment...
ozonization
Ozonolysis...
waste water treatment by

Chem Abstracts 1977-1979

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DIALOG File104. CA Search - 1977-1979 (See 2,3,4,311) (Copr Am Chem Soc) (Item 1 of 10) User12901 23feb82 3331

90162887 CA: 90(21)162887e JOURNAL
Acute lethality of waste water disinfection alternatives to juvenile rainbow trout (Salmo gairdneri)
AUTHOR: Cairns, V. W.; Conn, K.
LOCATION: Wastewater Technol. Cent., Environ. Prot. Serv., Ottawa, Ont.
JOURNAL: Res. Rep. - Res. Program Abatement Munic. Pollut. Provis. Can.-Ont. Agreement Great Lakes Water Qual. DATE: 1979 VOLUME: 92, PAGES: 30 pp. CODEN: RAPCDZ ISSN: 0381-2146 LANGUAGE: English
SECTION:
CA004003 Toxicology
CA060XXX Sewage and Wastes
CA061XXX Water
IDENTIFIERS: sewage disinfection fish toxicity
DESCRIPTORS:
Wastewater treatment,UV irradn.... Wastewater treatment,ozonization...
#to
Salmo gairdneri...
disinfected sewage toxicity to
Wastewater treatment,chlorination...
rainbow trout response to

90076080 CA: 90(10)76080e CONFERENCE PROCEEDING
Use of ozone for purification and disinfection of waste water
AUTHOR: Svatikov, V. P.; Stepanova, N. M.; Taradin, Ya. I.; Sidel'nikova, T. Ya.; Sukharenok, B. L.; Shlygina, G. S.
LOCATION: Vses. Nauchno-Issled. Inst. Sint. Kauch., Voronezh, USSR
JOURNAL: Mater. - Vses. Mezhvuz. Konf. Ozonu, 2nd EDITOR: Mal'tsev, Yu. A (Ed) DATE: 1977 PAGES: 128-9 CODEN: 38YOAT LANGUAGE: Russian PUBLISHER: Moskovskii Gos. Univ., Moscow, USSR
SECTION:
CA060002 Sewage and Wastes
IDENTIFIERS: ozonization wastewater, Nekal water pollution
DESCRIPTORS:
Water pollution...
by Nekal
Wastewater treatment,ozonization...
disinfection by
CAS REGISTRY NUMBERS:
12653-75-7 water pollution by, ozone in treatment of

89220479 CA: 89(26)220479r PATENT
Renovation of waste water
INVENTOR(AUTHOR): Besik, Ferdinand
LOCATION: Can.
ASSIGNEE: Central Mortgage and Housing Corp.
PATENT: Canada: CA 1034267 DATE: 780704
APPLICATION: Canada; CA 218165 DATE: 750116
PAGES: 25 pp. CODEN: CAXXA4 CLASS: 362012000
SECTION:
CA060001 Sewage and Wastes
IDENTIFIERS: primary secondary tertiary sewage treatment, sewage complete treatment system, disinfection complete sewage treatment system, biooxidn complete sewage treatment system, adsorption complete sewage treatment system, ozonization complete sewage treatment system, coagulation complete sewage treatment system
DESCRIPTORS:
Wastewater treatment,primary-secondary-tertiary...
multistage system for, aerobic biol.-adsorption biooxidn.-coagulation ozonization-adsorption biooxidn. processes in
Nitrates,uses and miscellaneous... Nitrites...
removal of, from wastewater, multistage primary-secondary-tertiary system for
CAS REGISTRY NUMBERS:
7727-37-9D compds., removal of, from wastewater, multistage primary-secondary-tertiary system for
7440-44-0D org. compds., removal of, from wastewater, multistage primary-secondary-tertiary system for
7664-41-7 uses and miscellaneous, removal of, from wastewater, multistage primary secondary-tertiary system for

89220378 CA: 89(26)220378g CONFERENCE PROCEEDING
Use of ozone for disinfection of waste water from biological enterprises
AUTHOR: Shlygina, I. N.; Klimova, T. P.; Komelov, K. I.
LOCATION: Vses. Nauchno-Issled. Tekhnol. Inst. Biol. Prom., Moscow, USSR
JOURNAL: Mater. - Vses. Mezhvuz. Konf. Ozonu, 2nd EDITOR: Mal'tsev, Yu. A (Ed) DATE: 1977 PAGES: 109 CODEN: 38YOAT LANGUAGE: Russian PUBLISHER: Moskovskii Gos. Univ., Moscow, USSR
SECTION:
CA060002 Sewage and Wastes
CA063XXX Pharmaceuticals
IDENTIFIERS: vaccine manuf wastewater ozonization
DESCRIPTORS:
Wastewater treatment,ozonization...
of vaccine manuf. effluents
Animal,livestock...
vaccine manuf. for, wastewater from, ozonization of
Vaccines...
wastewater from manuf. of, for livestock, ozonization of

(con)

89152524 CA: 89(18)152524z JOURNAL
Inactivation of enteroviruses and coliphages with ozone in waters and waste waters
AUTHOR: Evison, Lillian M
LOCATION: Dep. Civ. Eng., Univ. Newcastle upon Tyne, Newcastle upon Tyne, Engl.
JOURNAL: Prog. Water Technol. DATE: 1978 VOLUME: 10 NUMBER: 1-2 PAGES: 365-74 CODEN: PGWTA2 ISSN: 0306-6746 LANGUAGE: English
SECTION:
CA061008 Water
IDENTIFIERS: ozone virus disinfection water, chem ozone water disinfection
DESCRIPTORS:
Bentonite,uses and miscellaneous... Kaolin,uses and miscellaneous... Peptones...
effect of, on ozone disinfection
Escherichia coli... Virus,entero-...
inactivation of, by ozone
Wastewater treatment,ozonation...
inorg. chems. in
CAS REGISTRY NUMBERS:
10028-15-6 biological studies, disinfection with, of viruses, org., and inorg. chems.
50-99-7 56-40-6 56-41-7 56-86-0 56-89-3 57-48-7 61-90-5 63-68-3 74-79-3 7664-41-7 9004-54-0 9005-25-8 biological studies, effect of, on ozone disinfection
52-89-1 69-79-4 9005-65-6 50642-01-8 56748-40-4 effect of, on ozone disinfection

89079687 CA: 89(10)79687y JOURNAL
Contribution to the study of the disinfection of waste water by the action of an oxygen-ozone mixture
AUTHOR: Hugues, B.; Plissier, M.; Torres, J. P.
LOCATION: Lab. Munic. Reg. Hyg., Nice, Fr.
JOURNAL: Eau Ind. DATE: 1977 VOLUME: 20, PAGES: 67-72
CODEN: EINSDK LANGUAGE: French
SECTION:
CA060002 Sewage and Wastes
IDENTIFIERS: ozone inactivation virus wastewater, Salmonella inactivation wastewater ozone, Echovirus inactivation wastewater ozone
DESCRIPTORS:
Echovirus... Salmonella brancaster... Salmonella typhimurium ... Virus,animal...
inactivation of, in wastewater, by ozone treatment
Wastewater treatment,ozonation...
virus in activation in

87162364 CA: 87(21)162364v TECHNICAL REPORT
Chemical/biological implications of using chlorine and ozone for disinfection
AUTHOR: Carlson, Robert M.; Caple, Ronald
LOCATION: Univ. Minnesota, Duluth, Minn.
JOURNAL: U. S. Environ. Prot. Agency, Off. Res. Dev., (Rep.) EPA DATE: 1977 NUMBER: EPA-600/3-77-066 PAGES: 87 pp.
CODEN: XPARD6 LANGUAGE: English
SECTION:
CA004003 Toxicology
IDENTIFIERS: waste water chlorine ozone interaction
DESCRIPTORS:
Wastewater treatment...
by chlorine and ozone, toxicol. interaction in
Phenols,reactions...
chlorine and ozone reaction with, during waste water teratment, toxicity in realtion to
Toxicity...
of chlorination and ozonization products, during waste water treatment
Molecular structure-biological activity relationship,toxic...
of waste water chlorination products
CAS REGISTRY NUMBERS:
112-80-1 biological studies, ozonization of, in waste water treatment, toxicity in relation to
7782-50-5 10028-15-6 biological studies, waste water treatment by, toxicol. interaction in
25512-42-9 27323-18-8 formation of, during waste water treatment with chlorine
98-55-5 ozonization of, in waste water treatment, toxicity in relation in

87090132 CA: 87(12)90132t CONFERENCE PROCEEDING
Ozone disinfection of wastewater, optimum system design
AUTHOR: Armstrong, F. T.
LOCATION: Armstrong Eng. Consultants, Inc., Butler, N. J.
JOURNAL: Proc. - Forum Ozone Disinfect. EDITOR: Fochtman, Edward G. (Ed); Rice, Rip G. (Ed); Browning, Myron F (Ed) DATE: 1977 PAGES: 89-97 CODEN: 35VHAY LANGUAGE: English MEETING DATE: 76 PUBLISHER: Int. Ozone Inst., Inc., Syracuse, N. Y.
SECTION:
CA060001 Sewage and Wastes
IDENTIFIERS: ozone disinfection wastewater
DESCRIPTORS:
Wastewater treatment,ozonization...
disinfection by
CAS REGISTRY NUMBERS:
10028-15-6 biological studies, waste water disinfection by

END

86160961 CA: 86(22)160961t JOURNAL
The new lake water plant of the City of Biel (Switzerland)
AUTHOR: Renz, E.
LOCATION: Gas- Wasserversorg., Biel, Switz.
JOURNAL: Gas, Wasser, Abwasser DATE: 1976 VOLUME: 56
NUMBER: 9 PAGES: 492-6 CODEN: GWASA4 LANGUAGE: German
SECTION:
CA061004 Water
IDENTIFIERS: lake water treatment potable water, flocculation lake water treatment, chlorination lake water treatment, ozonization lake water treatment, disinfection lake water treatment
DESCRIPTORS:
Water purification...
of lake water, for water supply of Biel, Switzerland
CAS REGISTRY NUMBERS:
10049-04-4 lake water disinfection by, in biel, Switzerland
10043-01-3 lake water purifn. by flocculation with, in Biel, Switzerland
1310-73-2 reactions, lake water neutralization by, in Biel, Switzerland
10028-15-6 reactions, lake water oxidn. by, in Biel, Switzerland
7440-44-0 uses and miscellaneous, active, lake water purifn. by, in Biel, Switzerland

86110872 CA: 86(16)110872u PATENT
Applying ozone and sonic energy to sterilize and oxidize waste water
INVENTOR(AUTHOR): Henderson, Angus D.; Perlale, John M.
LOCATION: USA
ASSIGNEE: TII Corp.
PATENT: United States; US 4003832 DATE: 770118
APPLICATION: United States; US 431012 DATE: 740107
PAGES: 22 pp. CODEN: USXXAM CLASS: 210019000, C02B-003/08
SECTION:
CA060001 Sewage and Wastes
IDENTIFIERS: cavitation wastewater sterilization, ozone sterilization wastewater, sonic cavitation wastewater purifn
DESCRIPTORS:
Wastewater treatment,ozonization-sonic cavitation...
in tertiary clarification
Cavitation,sonic...
in tertiary treatment of wastewater

INDUSTRIAL WASTE WATER.
WARD, RONALD W. ; DEGRAEVE G. MICHAEL
GRAND VALLEY STATE COLLEGES.
WATER RESOURCES B. FEB 80, V16, N1, P41 (8)
RESEARCH REPORT: THE ACUTE TOXICITY OF INDUSTRIAL AND DOMESTIC WASTEWATER DISINFECTANTS TO FISH AND AQUATIC INSECTS WAS INVESTIGATED. DISINFECTANTS STUDIED WERE CHLORINE, BROMINE CHLORIDE, AND OZONE. THE RESIDUAL TOXICITY OF EFFLUENT DECHLORINATED WITH SULFUR DIOXIDE WAS ALSO TESTED. RESIDUAL CHLORINE EFFECTIVELY ELIMINATED THE TOXICITY OF CHLORINATED EFFLUENT. RESIDUAL OZONE PRODUCED MORTALITY IN TEST ORGANISMS ONLY WHEN SUBJECTS WERE EXPOSED TO EFFLUENT IMMEDIATELY AFTER IT WAS IN CONTACT WITH OZONE. (20 REFERENCES, 6 TABLES)
DESCRIPTORS: *DISINFECTION ; *PATHOLOGY, FISH-LAB ; *PATHOLOGY, INSECT-LAB ; *AQUATIC ECOSYSTEMS ; *CHLORINATION ; *BROMINE ; *OZONIZATION ; WATER TEMPERATURE
REVIEW CLASSIFICATION: 19

5/5/2
141283 #80-001352
THERMAL CONDITIONING OF DOMESTIC-TANNERY SLUDGE AT GRAND HAVEN-SPRING LAKE, MICHIGAN.
VAN DAM DORIS
GRAND HAVEN-SPRING LAKE WASTEWATER TREATMENT PLANT, MICH.
PRESENTED AT WWEMA 7TH ANNUAL INDUSTRIAL POLLUTION CONF, PHILADELPHIA, JUN 5-7, 79, P89 (12)
TECHNICAL REPORT: AT THE GRAND HAVEN-SPRING LAKE, MICH., WASTEWATER PLANT, THERMAL CONDITIONING OF MORE THAN 50,000 GPD OF MIXED RAW PRIMARY AND WASTE ACTIVATED SLUDGE FROM DOMESTIC AND TANNERY SOURCES PRODUCES A STERILIZED MATERIAL THAT DEWATERS TO 32% SOLIDS ON VACUUM FILTERS. PROBLEMS CAUSED BY THE TANNERY PORTION OF THE WASTES ARE IDENTIFIED. ODORS COLLECTED FROM THE DECANT TANK, THICKENERS, AND GRIT BUILDING SYSTEMS, INEFFECTIVELY TREATED BY OZONE AND INCINERATION, ARE SUCCESSFULLY DIFFUSED IN AERATION TANKS. HYDROGEN PEROXIDE WAS CHECKED, BUT NOT CONSISTENTLY ELIMINATED, SEPTIC ODORS DERIVING FROM RECONTAMINATION OF OXIDIZED SLUDGE IN THE DECANT TANK.
DESCRIPTORS: *SEWAGE-WASTEWATER TREATMENT ; *ODORS ; *SEPTIC TANKS ; *ECONOMICS, ENV-WATER ; *ACTIVATED SLUDGE ; *CLARIFICATION ; *SLUDGE DEWATERING ; FILTRATION ; CHLORINATION ; MICHIGAN ; OZONIZATION ; CORROSION CONTROL ; CAPITAL COSTS ; CONF PAPER
REVIEW CLASSIFICATION: 19

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? s ozon? and acid?(F)solution

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118 ACID?(F)SOLUTION
6 3 OZON? AND ACID?(F)SOLUTION — 3 citations involving ozone
? t pr 6/5/1-3

5/5/1
120376 77-002735
OZONOLYSIS OF CHLOROPHENOLS AND MALEIC ACID IN AQUEOUS SOLUTION.
GILBERT ERNST
INST FOR RADIOCHEMIE, W GERMANY.
PRESENTED AT INTL OZONE INST 2ND SYM ON OZONE TECHNOLOGY, MONTREAL, MAY
-14, 75, P253 (9)
RESEARCH REPORT: OZONE OXIDATION OF MONO-, DI-, AND TRI-CHLOROPHENOLS AND
LEIC ACID IN AQUEOUS SOLUTION IS EXPLORED. DATA INDICATE THAT THE ORGANIC
-LORINE IS CONVERTED TO CHLORIDE. AND THE YIELD OF THE RESULTING CHLORIDE
FROM 60-95% OF THE THEORETICAL VALUE. OXIDATION PRODUCTS ARE
BIODEGRADABLE. OZONE OXIDATION OF MALEIC ACID GIVES GLYOXYLIC ACID, OXALIC
ACID, FORMIC ACID, AND CARBON DIOXIDE. (2 DIAGRAMS, 5 GRAPHS, 1 TABLE)
DESCRIPTORS: *OZONIZATION ; *PHENOL ; *CHLORINE ; *ACIDS ; ORGANIC
COMPOUNDS ; CONF PAPER
REVIEW CLASSIFICATION: 19

6/5/2
119788 77-002147
REMARKS ON THE OXIDATION OF ODOROUS SUBSTANCES IN WASTE AIR BY WASHING
WITH AN OZONE-CONTAINING AQUEOUS SYSTEM.
SCHNEIDER WILHELM K. G.
INST FRESENIUS, W GERMANY.
PRESENTED AT INTL OZONE INST 2ND SYM ON OZONE TECHNOLOGY, MONTREAL, MAY
11-14, 75, P82 (19)
TECHNICAL REPORT: EXPERIENCES WITH OZONE TREATMENT OF WATER HAVE BEEN
APPLIED TO GAS WASHING BY OZONE-CONTAINING AQUEOUS SOLUTIONS. THOUGH THE
SYSTEM IS EFFECTIVE IN NEUTRAL SOLUTIONS, MORE FAVORABLE RESULTS ARE
OBTAINED WITH A TWO-STAGE PROCEDURE EMPLOYING OZONE-CONTAINING SODIUM
HYDROXIDE SOLUTION AND SULFURIC ACID. THE METHOD HAS OFTEN BEEN USED FOR AN
EFFICIENT PURIFICATION OF WASTE GASES AND REMOVAL OF ODOROUS SUBSTANCES.
(21 GRAPHS, 7 TABLES)
DESCRIPTORS: *OZONIZATION ; *WATER PURIFICATION ; *WATER ODORS ; *REDOX ;
*SULFURIC ACID ; *AIR PURIFICATION ; *OXIDATION ; OZONE ; PHENOL ; ORGANIC
COMPOUNDS ; INORGANIC COMPOUNDS ; CONF PAPER
REVIEW CLASSIFICATION: 01

6/5/3
119463 77-001922
DURATION OF OZONE IN WATER IN THE UPPER SOLUBILITY RANGE.
WALTER, REGINALD H. ; SHERMAN RUTH M.
CORNELL UNIV.
J FOOD SCIENCE, SEP-OCT 76, V41, N5, P993 (3)
TECHNICAL REPORT: A SERIES OF KINETIC EXPERIMENTS WITH AQUEOUS OZONE
SOLUTIONS SHOWED THAT THE EQUATION LN CO LN C - KT HAS APPROXIMATELY LINEAR
OVER A PERIOD OF SEVERAL HOURS. THE STRAIGHT LINE SEGMENT OF THIS FUNCTION
WAS EXTRAPOLATED TO 0 HR. AND THE SLOPE FOR EACH EXTRAPOLATED STRAIGHT
LINE, REPRESENTING K, WAS DERIVED. RESIDUAL CONCENTRATIONS (C) FROM
CORRECTED CO VALUES COULD THEN BE CALCULATED. FIFTY SUCH CALCULATIONS
RESULTED IN AN AVERAGE OF 65% RETENTION OF OZONE CONCENTRATION IN THE UPPER
[illegible] THE FIRST HOUR. THIS RESIDUE REQUIRED MORE

```
SOLUBILITY RANGE AT THE END OF THE FIRST HOUR.  THIS RESIDUE REQUIRED MORE
THAN 8 HR FOR COMPLETE DISAPPEARANCE.  OZONE CONCENTRATION INCREASED
SIGNIFICANTLY UPON SMALL ADDITIONS OF ACETIC ACID TO WATER.  IN CONTRAST,
SODIUM CHLORIDE AT A CERTAIN CONCENTRATION ACCELERATED THE LOSS OF OZONE
FROM SOLUTION. (7 GRAPHS, 1 PHOTO, 19 REFERENCES)
  DESCRIPTORS: *OZONIZATION ; *SOLUBILITY, GASEOUS :  ACETIC ACID :  SODIUM
CHLORIDE
  REVIEW CLASSIFICATION: 16

? s compara?(F)stud??? ? and ozon? and hypochlor?

              190 COMPARA?(F)STUD??? ?
             1665 OZON?
               58 HYPOCHLOR?
         7      0  COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?

? end/save temp

Serial#T2WU
          23Feb82 17:23:18 User12901
  $12.01  0.154 Hrs File40 13 Descriptors
   $3.60  24 Prints
  $15.61  Estimated Total Cost

? begin 68

          23Feb82 17:23:36 User12901
  $0.47   0.006 Hrs File40

File68:Environmental Bibliography - 74-81/Dec
          Set Items Description
          --- ----- -----------

? .execute steps t2wu

      1        0 WATER AND (WASTE OR
      2        0 WATER ANDFD LOGOFF
           13763 WATER
            3239 WASTE
            1070 SUPPLY?
             210 DISINFECT?
             125 STERILIZ?
      3       10  WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
      4      726 OZON?
      5        0  3 AND 4
             726 OZON?
              76 ACID?(F)SOLUTION
      6        1  OZON? AND ACID?(F)SOLUTION )
             190 COMPARA?(F)STUD??? ?
             726 OZON?
                 HYPOCHLOR?
                 ... AND OZON? AND HYPOCHLOR?
```

End of Environline
Data Base

Environmental Bibliography Data Base

no citations involving main terms

```
      0  COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
? combine 6 and 3

          8     0  6 AND 3
? type 6/5/1

6/5/1
 1017603
  A   quantitative   investigation   of   the   reaction   of   ozone  with
p-toluenesulfonic acid in aqueous solution as a model compound for  anionic
detergents
  Eberle, S. H.; Gilbert, E.; Joy, P.
  Water Research,   1980 VOL. 14, NO. 10,   p. 1509
  Descriptors: Detergent, anionic; Water research;  Ozone;  Toluenesulfonic
acid

? end/save temp

Serial#T2WZ
          23Feb82 17:27:57 User12901
  $4.44   0.074 Hrs File68 13 Descriptors

? begin 6

          23Feb82 17:28:09 User12901
  $0.24   0.004 Hrs File68


File6:NTIS - 64-82/Iss05
(Copr. NTIS)
          Set Items Description
          --- ----- -----------
.execute steps t2wz

          1      0 WATER AND (WASTE OR
          2      0 WATER ANDFD LOGOFF
              66399 WATER
              18985 WASTE
               9010 SUPPLY?
                384 DISINFECT?
               1006 STERILIZ?
          3     98  WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
          4   2475 OZON?
          5     29  3 AND 4
               2475 OZON?
                121 ACID?(F)SOLUTION
          6      0  OZON? AND ACID?(F)SOLUTION
               1058 COMPARA?(F)STUD??? ?
               2475 OZON?
                114 HYPOCHLOR?
                 ... ? AND OZON? AND HYPOCHLOR?
```

End of Env. Bib Data Base
Not successful

NTIS Data Base

29 citations involving main 2 sets of terms
3 printed here
26 printed off-line

114 HYPOCHLOR?
7   ?? COMPARO?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
8   0 6 AND 3

type 5/5/1-3

5/5/1
Comparison of Ozone and Chlorine Toxicity to the Developmental Stages of Striped Bass, 'Morone saxatilis'

Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.*Environmental Research Lab., Gulf Breeze, FL. (055244002)

Journal article
AUTHOR: Hall, Lenwood W. Jr; Burton, Dennis T.; Richardson, Leonard B.
G5912A4   Fld: 6C, 6T, 68D, 57Y, 57Z   GRAI8205
Nov 81   9p
Grant: EPA-R-804683
Monitor: EPA-600/J-81-475
Pub. in Canadian Jnl. of Fisheries and Aquatic Sciences, v38 n7 p752-757 1981.

Abstract: Toxicity of ozone-produced oxidants (OPO) to striped bass, Morone saxatilis, eggs, larvae, and fingerlings were determined under continuous-flow conditions. Eggs, tested in both fresh and estuarine water, were found to be significantly (P<0.001) more sensitive to OPO in freshwater. The higher sensitivity found for striped bass eggs in freshwater suggests that ozone could have a more pronounced effect if discharged in freshwater industrial or municipal wastewaters located in the vicinity of a striped bass spawning area. The ozone data collected in this study were compared with previously published chlorine toxicity data for each striped bass life stage.

Descriptors: *Oxidizers, *Bass, *Toxicity, *Water pollution, Ozone, Chlorine, Waste water, Tolerances(Physiology), Fresh water, Salt water, Larvae, Comparison, Life cycles, Disinfection, Water treatment, Comparison, Reprints

Identifiers: *Morone saxatilis, NTISEPAORD

PB82-129412   NTIS Prices: PC A02/MF A01

5/5/2
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light

Radian Corp., Austin, TX.*Municipal Environmental Research Lab., Cincinnati, OH. (029117000)
AUTHOR: Fluegge, R. A.; Metcalf, T. G.; Wallis, C.
G480?K3   Fld: 6M, 6F, 57K, 68D   GRAI8120

G4802K3   Fld: 6M, 6F, 57K, 68D   GRAI8120
May 81   77p
Grant: EPA-R-804991
Monitor: EPA-600/2-81-088
Prepared in cooperation with New Hampshire Univ., Durham. Dept. of Microbiology, and Baylor Univ., Houston, TX. Dept. of Microbiology.

Abstract: In this investigation four wastewater treatment plants were studied and compared in their ability to inactivate naturally occurring enteroviruses. Of the four plants tested, two used chlorine as the disinfectant, one used ozone, and one used ultraviolet light. Results of field testing are summarized as follows. Both virus titers and isolation rates (percentage of samples positive for virus) were low in the undisinfected effluents. As a result there was no consistent correlation between virus numbers and any of the traditionally measured bacteriological indicators. Also, no seasonal variation in virus titers was detected in any of the effluents. However, a diurnal variation was observed in one of the plants during two separate samplings. Virus titers and isolation rates in the disinfected effluents were significantly lower than in the undisinfected controls. However, the numbers were too low to detect differences between plants or disinfectants. At least 10 different virus types were isolated in the tested effluents. The predominant virus type was poliovirus 1. Seeding experiments with attenuated strains of poliovirus were performed to evaluate the recovery efficiency in each effluent. Efficiencies were low and markedly variable.

Descriptors: *Viruses, *Waste water, *Chlorine, *Ozone, *Ultraviolet radiation, Effluents, Enteroviruses, Microorganisms, Disinfectants, Water pollution

Identifiers: Sewage treatment effluents, Water pollution control, NTISEPAORD, NTISEPAORD

PB81-208183   NTIS Prices: PC A05/MF A01

5/5/3
The Effect of Ozonation of Organics in Wastewater

Colorado Univ. at Denver.*Health Effects Research Lab., Cincinnati, OH. (068648000)

Rept. for 1 Ma, 76-30 Apr 79
AUTHOR: Chappell, Willard R.; Sievers, Robert E.; Shapiro, Robert H.
G3653A3   Fld: 7D, 68D, 99F, 99A   GRAI8109
Jan 81   148p
Grant: EPA-R-804472
Monitor: EPA-600/1-81-005

Abstract: The effect of ozone treatment of domestic wastewater and various model compounds has been determined with respect to trace organic components. Organic constituents were identified in wastewater that was [illegible] Thompson Sanitation District Treatment

```
Plant.  Estes Park. Colorado.  The primary products of ozonation of this
wastwater are n-alkanes and n-aldehydes.  Additional wastewater from this
and other sources, including paper mills and chemical manufacturing
facilities, were ozonated under laboratory conditions to determine the
chemical effect of ozone treatment.  Laboratory studies were made of
ozonation of several model compounds, including caffeine, oleic acid,
saturated aldehydes, dicyclopentadiene, diisopropylmethylphosphonate, an
p-chlorophenylmethyl sulfone and reaction products determined.

Descriptors: *Organic compounds, *Ozonation, *Sewage treatment, *Industral
waste treatment, *Water pollution control, Disinfection, Trace elements,
Paper industry, Chemical industry, Aldehydes, Xanthines, Pyrimidines, Fatty
acids, Reaction kinetics, Molecular structure, Chemical reactions, Water
analysis, Chemical analysis, Samples, Mass spectoscopy

Identifiers:  Water pollution detection, Estes Park(Colorado), Chemical
reaction mechanisms, NTISEPAORD

PB81-135360   NTIS Prices: PC A07/MF A01

? print 5/5/4-29

Printed5/5/4-29  Estimated Cost: $2.60 (To cancel, enter PR-)
? end/save temp

Serial#T2XA
        23Feb82 17:35:36 User12901
  $5.04  0.126 Hrs File6 13 Descriptors
  $2.60  26 Prints
  $7.64  Estimated Total Cost

? begin 2

        23Feb82 17:35:52 User12901
  $0.24  0.006 Hrs File6


File2:CA Search - 1967-1971 (See 3,4,104,311)
(Corr. Am. Chem. Soc.)
        Set Items Description
        --- ----- -----------
? .execute steps t2xa

            1      0 WATER AND (WASTE OR
            2      0 WATER ANDED LOGOFF
               48004 WATER
                7096 WASTE
                 951 SUPPLY?
                 849 DISINFECT?
                 953 STERILI??
                 … (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
```

End of NTIS

Chemical Abstracts
1967-1971

```
3      26  WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
4    1914 OZON?
5       1  3 AND 4
        1914 OZON?
        1523 ACID?(F)SOLUTION
6          0  OZON? AND ACID?(F)SOLUTION
        2428 COMPARA?(F)STUD??? ?
        1914 OZON?
         726 HYPOCHLOR?
7          0  COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
8          0  6 AND 3
 type 5/5/1

5/5/1
73018335     CA: 73(4)18335e     JOURNAL
  Use  of  ozone  for  precleaning  and disinfecting biochemically purified
waste waters
  AUTHOR: Kul'skii, L. A.; Plysyuk, A. A.; Slipchenko, V. A.
  LOCATION: Inst. Kolloid. Khim. Khim. Vody, Kiev, USSR
JOURNAL:  Khim.  Prom.  Ukr.      DATE:  1970    NUMBER:  2    PAGES:  58-61
CODEN: KPRUAM    LANGUAGE: Russian
  SECTION:
CA860000 Sewage and Wastes
  IDENTIFIERS:  ozone disinfection waste waters,  decolorizing waste waters
ozone, deodorizing waste waters ozone
  DESCRIPTORS:
Wastes...
    oxidn. of, chem. combined, after biol. treatment, ozone in
  CAS REGISTRY NUMBERS:
10028-15-6  uses and miscellaneous, in waste water treatment

? end/save temp

Serial#T2XK
          23Feb82 17:40:15 User12901
  $4.74   0.074 Hrs File2 13 Descriptors
  $0.10   1 Types
  $4.84   Estimated Total Cost

? begin 3

          23Feb82 17:40:31 User12901
  $0.38   0.006 Hrs File2

File3:CA Search - 1972-1976 (See 2,4,104,311)
(Corr. Am. Chem. Soc.)
          Set Items Description
          --- ----- -----------
? .execute steps t2xk
```

1 citation involving main terms printed here

End Chem. Abstracts 1967-1971

Chem. Abstracts 1972-1976

```
? .execute steps 12sk

1        0 WATER AND (WASTE OR
2        0 WATER AMDFD LOGOFF
     82642 WATER  (SEE ?IGNOTE)
     22993 WASTE
      1532 SUPPLY?
      7309 DISINFECT?
      1267 STERILIZ?
3     207  WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
4    3856 OZON?
5      35  3 AND 4
      3856 OZON?
      2178 ACID?(F)SOLUTION
        31 OZON? AND ACID?(F)SOLUTION
6     3498 COMPARA?(F)STUD???
      3856 OZON?
      1184 HYPOCHLOR?
7        0 COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
8        0 6 AND 3
? type 5/5 1-5

      TYPE 5/5 1-5
      Invalid item-range syntax
? type 5/5/1-5

5/5/1
85197691     CA: 85(26)197691k     JOURNAL
  Physicochemical  aspects  of disinfection of water by means of ultrasound
and ozone
  AUTHOR: Dahi, E.
  LOCATION: Dep. Sanit. Eng., Tech. Univ. Denmark, Lyngby, Den.
JOURNAL:  Water Res.        DATE:  1976    VOLUME:  10    NUMBER:  8    PAGES:
677-84     CODEN: WATRAG     LANGUAGE: English
  SECTION:
CA960002 Sewage and Wastes
  IDENTIFIERS: ultrasound ozone disinfection water
  DESCRIPTORS:
Waste water treatment...
    disinfection, by ultrasound and ozone, mechanism of
Sound and Ultrasound,biological effects...
    water disinfection by ozone and, mechanism of
  CAS REGISTRY NUMBERS:
10028-15-6   biological  studies,   water  disinfection  by ultrasound and,
    mechanism of

5/5/2
85197622     CA: 85(26)197622p     JOURNAL
  Disinfection of viruses in sewage by ozone
  AUTHOR: Katzenelson, E.; Biedermann, N.
  LOCATION: Hadassah Med. Sch., Hebrew Univ., Jerusalem, Israel
                                             NUMBER:  7    PAGES:
```

- (beside set 6) not printed here because when combined with 2 main terms 0 citations
- 35 citations involving 2 main terms
- 6 printed here
- 29 printed off-line

LOCATION: Hadassah Med. Sch., Hebrew Univ., Jerusalem, Israel
JOURNAL: Water Res. DATE: 1976 VOLUME: 10 NUMBER: 7 PAGES: 629-31 CODEN: WATRAG LANGUAGE: English

get abstract?

SECTION:
CA960002 Sewage and Wastes
IDENTIFIERS: ozone disinfection sewage, virus removal sewage ozone, poliovirus inactivation sewage ozonization
DESCRIPTORS:
Waste water treatment...
ozonization, of sewage, poliovirus inactivation in
Virus,animal...
polio-, inactivation of, in sewage by ozone
CAS REGISTRY NUMBERS:
10028-15-6 biological studies, poliovirus inactivation in sewage by

5/5/3
85166117 CA: 85(22)166117y JOURNAL
Ozone provides alternative for secondary effluent disinfection. Part 3
AUTHOR: Nebel, Carl; Gottschling, Ronald D.; Unangst, Paul C.; O'Neill, H. J.; Zintel, George V.
LOCATION: Welsbach Ozone Syst. Corp., Philadelphia, Pa.
JOURNAL: Water Sewage Works DATE: 1976 VOLUME: 123 NUMBER: 6 PAGES: 81-3 CODEN: WSWOAC LANGUAGE: English

get abstract

SECTION:
CA960002 Sewage and Wastes
IDENTIFIERS: ozone disinfection wastewater
DESCRIPTORS:
Waste water treatment...
disinfection, ozone in
Ozonolysis...
waste water treatment by, for disinfection
CAS REGISTRY NUMBERS:
10028-15-6 uses and miscellaneous, disinfection by, of waste water

5/5/4
85129906 CA: 85(18)129906j JOURNAL
Ozone provides alternative for secondary effluent disinfection. Part 2
AUTHOR: Nebel, Carl; Gottschling, Ronald D.; Unangst, Paul C.; O'Neill, H. J.; Zintel, George V.
LOCATION: Welsbach Ozone Syst. Corp., Philadelphia, Pa.
JOURNAL: Water Sewage Works DATE: 1976 VOLUME: 123 NUMBER: 5 PAGES: 82-5 CODEN: WSWOAC LANGUAGE: English
SECTION:
CA960000 Sewage and Wastes
IDENTIFIERS: review ozonization secondary wastewater
DESCRIPTORS:
Waste water treatment...
ozonization, and secondary effluent disinfection

5/5/5
85112323 CA: 85(16)112323u JOURNAL
Ozone provides alternative for secondary effluent disinfection. Part 1

```
H. J.; Zintel, George V.
  LOCATION: Welsbach Ozone Syst. Corp., Philadelphia, Pa.
JOURNAL:  Water Sewage Works     DATE:  1976    VOLUME:  123     NUMBER:   4
PAGES: 76-8    CODEN: WSWOAC    LANGUAGE: English
  SECTION:
CA960000 Sewage and Wastes
  IDENTIFIERS: review sewage disinfection ozone
  DESCRIPTORS:
Waste water treatment...
    ozonization, disinfection of secondary effluents by

? type 5/5/6

5/5/6
85067574    CA: 85(10)67574p    JOURNAL
  Bacteriological   and   chemical   studies   on   the   ozone   treatment   of
biologically purified city waste water in a test plant
  AUTHOR: Scherb, K.; Heuschmann-Brunner, G.
  LOCATION: Bayer. Biol. Versuchsanst., Munich, Ger.
JOURNAL:  Muench.  Beitr.  Abwasser-,  Fisch.-  Flussbiol.     DATE:   1975
VOLUME: 26    NUMBER: Wasser Erholungslandschaft    PAGES: 179-90    CODEN:
MABFAI    LANGUAGE: German
  SECTION:
CA960001 Sewage and Wastes
  IDENTIFIERS: ozone wastewater treatment, bacterial wastewater ozone,  org
matter wastewater ozone, nitrogen compd wastewater ozone
  DESCRIPTORS:
Aeromonas...   Escherichia  coli...   Nitrates,uses  and   miscellaneous...
Nitrites...
    in waste water, ozonization in relation to
Organic matter...
    oxidn. of, in waste water by ozone
Waste water treatment...
    ozonization, disinfection and oxidn. in
Ozonolysis...
    waste water treatment by
  CAS REGISTRY NUMBERS:
14798-03-9  uses and miscellaneous, in waste water, ozonization in relation
    to

print 5/?-35

        PRINT 5/?-35
        Invalid item-range syntax
? print 5/5/?-35

Printed5/5/?-35  Estimated Cost: $5.80 (To cancel, enter PR-)
? end/save temp

Serial#[illegible]
        [illegible] 17:48:58 User12901
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serial#12XY
          23Feb82 17:48:58 User12901
  $9.09   0.142 Hrs File3 13 Descriptors
  $0.60   6 Types
  $5.80   29 Prints
 $15.49   Estimated Total Cost
```

End Chem Abstracts 1972-1976

```
? begin 4
          23Feb82 17:49:12 User12901
  $..32   0.005 Hrs File3

File4:CA Search - 1980-1981 (See 2,3,104,311)
(Copr. Am. Chem. Soc.)
          Set Items Description
          --- ----- -----------
? .execute steps t2xy

          1      0 WATER AND (WASTE OR
          2      0 WATER ANDFB LOGOFF
             43583 WATER
             13161 WASTE
               985 SUPPLY?
              3669 DISINFECT?
               604 STERILIZ?
          3     18 WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
          4   3058 OZON?
          5      7 3 AND 4
              3058 OZON?
               880 ACID?(F)SOLUTION
          6      3 OZON? AND ACID?(F)SOLUTION
              2000 COMPARA?(F)STUD???
              3058 OZON?
               707 HYPOCHLOR?
          7      8 COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
          8      0 6 AND 3
? type 5/5/1-7

5/5/1
95192148    CA: 95(22)192148k     JOURNAL
  Postpurification   use   of   biochemically   treated   wastewaters   in   a
circulating water supply
  AUTHOR: Zamelin, V. I.; Gavrikov, I. I.; Ivanova, N. F.
  LOCATION: USSR
JOURNAL: Khim. Volokna     DATE: 1981     NUMBER: 4     PAGES: 53-5     CODEN:
 KVKA4     ISSN: 0023-1118   LANGUAGE: Russian
  SECTION:
CA 51004 Water
CA 60XXX Sewage and Wastes
```

Chem Abstracts 1980-1981

- not printed here

7 citations involving main terms all 7 printed here

CA060XXX Sewage and Wastes
IDENTIFIERS: biochem wastewater treatment reuse
DESCRIPTORS:
Water purification,absorption...
activated carbon in, for addnl. treatment of biol. treated wastewater effluents for reuse
Wastewater treatment,recycling... Water purification,disinfection-ozonization... Water purification,recycling...
of biol. treated wastewater and sewage effluents, for reuse in circulating water supply systems
Water purification,flotation-filtration...
of storm water for use in circulating water supply systems

5/5/2
94070715 CA: 94(10)70715b JOURNAL
Ozone disinfection and waste water treatment: importance of interface action
AUTHOR: Richard, Y.; Conan, M.
LOCATION: Soc. Degremont, 92500, Rueil Malmaison, Fr.
JOURNAL: Ozone: Sci. Eng. DATE: 1980 VOLUME: 2 NUMBER: 2
PAGES: 139-58 CODEN: OZSEDS LANGUAGE: English
SECTION:
CA060002 Sewage and Wastes
IDENTIFIERS: disinfection wastewater ozonization polyelectrolyte addn, acrylamide copolymer ozonization wastewater disinfection
DESCRIPTORS:
Wastewater treatment,ozonization...
acrylamide cationic polymer improvement of
Bacteria,chloroform...
removal of, from wastewater, by ozonization, cationic acrylamide copolymers for improvement of
CAS REGISTRY NUMBERS:
79-06-1D copolymers, cationic, ozone disinfection of wastewater improvement by

5/5/3
93191405 CA: 93(20)191405p JOURNAL
High level ozone disinfection of waste water for shellfish water discharges
AUTHOR: Stover, Enos L.; Jarnis, Robert N.
LOCATION: Metcalf and Eddy, Inc., Boston, MA, 02114, USA
JOURNAL: Ozone: Sci. Eng. DATE: 1980 VOLUME: 1 NUMBER: 4
PAGES: 335-46 CODEN: OZSEDS LANGUAGE: English
SECTION:
CA060001 Sewage and Wastes
IDENTIFIERS: ozonization sewage effluent coliform disinfection, shellfish wastewater ozonization disinfection
ESCRIPTORS:
Wastewater treatment,ozonization...
of shellfish processing effluents
..llfish...
of wastewater from ozonization of

5/5/4
9312[illegible]69 CA: 93(12)120169d JOURNAL
Analysis of disinfection by-products in water and waste water
AUTHOR: Glaze, William H.; Peyton, Gary R.; Saleh, Farida Y.; Huang, Francis Y.
LOCATION: Inst. Appl. Sci., North Texas State Univ., Denton, TX, 76203, USA
JOURNAL: Int. J. Environ. Anal. Chem. DATE: 1979 VOLUME: 7 NUMBER: 2 PAGES: 143-60 CODEN: IJEAA3 ISSN: 0306-7319 LANGUAGE: English
SECTION:
CA061004 Water
IDENTIFIERS: chlorination water byproduct, disinfection wastewater byproduct chlorination
DESCRIPTORS:
Wastewater treatment,disinfection... Wastewater treatment,chlorination... Wastewater treatment,ozonation... Water purification,disinfection... Water purification,ozonation... Water purification,chlorination...
by-products from
Halides,org....
formation of by-product, in chlorination and ozonation of pollutant waters and wastewaters conts. hexachlorobiphenyl
CAS REGISTRY NUMBERS:
75-27-4 124-48-1 formation of by-product, in chlorination and ozonation of pollutant waters and wastewaters conts. hexachlorobiphenyl
1344-32-7 12002-48-1 25167-82-2 25429-29-2 28655-71-2 30583-33-6 31155-09-6 74695-93-5 74695-94-6 74695-95-7 74695-96-8 74695-97-9 74695-98-0 74695-99-1 74696-00-7 formation of, in ozonation and photolytic ozonation of hexachlorophenyl, by-product formation in disinfected waters and wastewaters in relation to
33979-03-2 ozonation and photolytic ozonation of, by-product in disinfected waters and wastewaters in relation to
67-66-3P preparation, formation of by-product, in chlorination and ozonation of pollutant waters and wastewaters conts. hexachlorobiphenyl
74-82-8D trihalo compds., formation of by-product, in chlorination and ozonation of pollutant waters and wastewaters conts. hexachlorobiphenyl
7440-44-0 7664-41-7 7723-14-0 uses and miscellaneous, removal of, from lake water, ozonation and chlorination in, by-product formation in relation to
7727-37-9 uses and miscellaneous, removal of org., from lake water, ozonation and chlorination in, by-product formation in relation to

5/5/5
92027993 CA: 92(4)27993n JOURNAL
Application and effects of plate ozonizer on deodorization, decolorization, and sterilization in treatment of waste water, night soil, and industrial waste water
AUTHOR: Ikemoto, Norio; Kubota, Shoji
LOCATION: Kokubu Works, Hitachi Ltd., Hitachi, Japan
JOURNAL: PPM DATE: 1979 VOLUME: 10 NUMBER: 6 PAGES: 28-37
CODEN: PPMMDV LANGUAGE: Japanese !
SECTION:

ODEN: PPMMDU LANGUAGE: Japanese !
SECTION:
A060002 Sewage and Wastes
IDENTIFIERS: ozone wastewater treatment, deodorization wastewater treatment ozone, decolorization wastewater treatment ozone, sterilization wastewater treatment ozone
DESCRIPTORS:
Wastewater treatment,adsorption-ozonization...
decolorization and deodorization and sterilization by
CAS REGISTRY NUMBERS:
7440-44-0 biological studies, activated, and ozone in decolorization and deodorization and sterilization of wastewater
75-18-3 removal of, from wastewater, activated carbon and ozone in
74-93-1 7664-41-7 7783-06-4 uses and miscellaneous, removal of, from wastewater, activated carbon and ozone in

5/5/6
92027965 CA: 92(4)27965e TECHNICAL REPORT
Field-scale evaluation of waste water disinfection by ozone generated from oxygen
AUTHOR: Jain, Jain S.; Presecan, Nicholas L.; Fitas, Michael
LOCATION: Eng.-Sci., Ltd., Cleveland, OH, USA
JOURNAL: U. S. Environ. Prot. Agency, Off. Res. Dev., (Rep.) EPA DATE: 1979 NUMBER: EPA-600/9-79-018, Prog. Wastewater Disinfect. Technol.
PAGES: 198-209 CODEN: XPARD6 LANGUAGE: English MEETING DATE: 78
SECTION:
CA060001 Sewage and Wastes
IDENTIFIERS: disinfection wastewater ozone oxygen
DESCRIPTORS:
Wastewater treatment,disinfection...
by ozone, generated from oxygen, field scale evaluation of
CAS REGISTRY NUMBERS:
7782-44-7 uses and miscellaneous, ozone generated in, wastewater disinfection by, field scale evaluation of
10028-15-6 uses and miscellaneous, wastewater disinfection by, generated from oxygen, field scale evaluation of

5/5/7
92027964 CA: 92(4)27964d TECHNICAL REPORT
Field scale evaluation of waste water disinfection by ozone generated from air
AUTHOR: Rakness, Kerwin L.; Hess, Bob A.
LOCATION: M and I, Inc., Fort Collins, CO, 80525, USA
JOURNAL: U. S. Environ. Prot. Agency, Off. Res. Dev., (Rep.) EPA DATE: 1979 NUMBER: EPA-600/9-79-018, Prog. Wastewater Disinfect. Technol.
PAGES: 174-97 CODEN: XPARD6 LANGUAGE: English MEETING DATE: 78
SECTION:
CA060001 Sewage and Wastes
IDENTIFIERS: disinfection wastewater ozone air
DESCRIPTORS:
Wastewater treatment,disinfection...
... scale evaluation of

```
treatment,disin...
  by ozone-conts. air. Field scale evaluation of
r...  ozone generation in, wastewater disinfection by, field scale evaluation
    of
CAS REGISTRY NUMBERS:
028-15-6  uses and miscellaneous,  wastewater disinfection by air conts.,
  field scale evaluation of

? end/save temp

Serial#T2Y9
          23Feb82 17:57:46 User12901
  $9.22   0.144 Hrs File4 13 Descriptors
  $0.70   7 Types
  $9.92   Estimated Total Cost

? begin 104

          23Feb82 17:58:03 User12901
  $0.38   0.006 Hrs File4

File104:CA Search - 1977-1979 (See 2,3,4,311)
(Copr. Am. Chem. Soc.)
          Set Items Description
          --- ----- -----------

? .execute steps t2y9
            1       0 WATER AND (WASTE OR
            2       0 WATER ANDFD LOOOFF
                60517 WATER
                19831 WASTE
                 1264 SUPPLY?
                 5157 DISINFECT?
                  813 STERILIZ?
            3      51  WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
            4    3948 OZON?
            5      13  3 AND 4
                 3948 OZON?
                 1334 ACID?(F)SOLUTION
            6       9  OZON? AND ACID?(F)SOLUTION
                 2725 COMPARA?(F)STUD???
                 3948 OZON?
                  860 HYPOCHLOR?
            7       0  COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
            8       0  6 AND 3
? type 5/5/1-3

5/5/1
91216170    CA: 91(26)216170s    TECHNICAL REPORT
   .. water effluents by chlorine, ozone, and
```

End Chem Abst. 1980-1981

Chem. Abstracts 1977-1979

not printed

13 citations involving main terms

3 printed here

10 printed off-line

91216170   CA: 91(26)216170   TECHNICAL

Virus inactivation in waste water effluents by chlorine, ozone, and ultraviolet light

AUTHOR: Fluegge, R. A.; Metcalf, T. G.; Wallis, C.

LOCATION: Carborundum Co., Niagara Falls, NY, USA

JOURNAL: U. S. Environ. Prot. Agency, Off. Res. Dev., (Rep.) EPA DATE: 1979 NUMBER: EPA-600/9-79-018, Prog. Wastewater Disinfect. Technol. PAGES: 223-32 CODEN: XPARD6 LANGUAGE: English MEETING DATE: 78

SECTION:

CA060002 Sewage and Wastes

IDENTIFIERS: virus inactivation wastewater, chlorine virus inactivation wastewater, ozone virus inactivation wastewater, UV virus inactivation wastewater

DESCRIPTORS:

Virus,animal, Coxsackie B... Virus,animal, polio-... Virus,animal, Coxsackie A...

inactivation of, in wastewater, by chlorine and ozone and UV light

Wastewater treatment,disinfection...

virus inactivation by, chlorine and ozone and UV light in

5/5/2

91162652   CA: 91(20)162652u   PATENT

Chemical waste water treatment

INVENTOR(AUTHOR): Horvath, Peter Joseph

LOCATION: USA

ASSIGNEE: Carvalho, Rocky Jack

PATENT: South Africa; ZA 7705461 DATE: 790305

APPLICATION: South Africa; ZA 775461 DATE: 770912

PAGES: 33 pp. CODEN: SFXXAB LANGUAGE: English CLASS: C02C

SECTION:

CA060001 Sewage and Wastes

IDENTIFIERS: coagulation disinfection multistage sewage treatment, oxidizing agent multistage sewage treatment, portland cement coagulation aid wastewater, permanganate multistage wastewater treatment, ozonization multistage wastewater treatment, sand filtration multistage wastewater treatment

DESCRIPTORS:

Cement,portland...

coagulation aid, in wastewater multistage treatment

Wastewater treatment,multistage...

coagulation-oxidn.-filtration-ozonization in, of sewage

CAS REGISTRY NUMBERS:

7722-64-7 in wastewater multistage treatment

5/5/3

91096434   CA: 91(12)96434x   JOURNAL

Selection of a disinfectant and the site of its introduction in a circulating water supply system

AUTHOR: Salamatov, Yu. P.; Ivanchin, Yu. A.

LOCATION: Krasnoyarsk. Politekh. Inst., Krasnoyarsk, USSR

JOURNAL: Khim. Prom-st., Ser.: Prom-st. Khim. Volokon DATE: 1979 NUMBER: 9 PAGES: 16-20 CODEN: KPSVDX LANGUAGE: Russian

```
SECTION:
CA061004 Water
CA039XXX Textiles
  IDENTIFIERS:   ozone  disinfectant circulating water supply,  rayon manuf
water disinfection
  DESCRIPTORS:
Water purification,disinfection...
    by ozone, of circulating water in rayon manuf.
Rayon,preparation...
    manuf. of, water in, ozone in disinfection of
  CAS REGISTRY NUMBERS:
10028-15-6  biological studies,  disinfection by,  of circulating water  in
    rayon manuf.

? print 5/5/4-13

Printed5/5/4-13  Estimated Cost: $2.00 (To cancel, enter PR-)
? end/save temp

Serial#T2YJ
         23feb82 18:04:00 User12901
  $6.46  0.101 Hrs File104 13 Descriptors
  $0.30  3 Types
  $2.00  10 Prints
  $8.76  Estimated Total Cost

? begin 311

         23feb82 18:04:15 User12901
  $0.38  0.006 Hrs File104


File311:CA Search 1982/VOL 96(06) (See 2,3,4,104)
(Copr. Am. Chem. Soc.)
         Set Items Description
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? .execute steps t2yj

          1      0 WATER AND (WASTE OR
          2      0 WATER ANDFD LOGOFF
              2142 WATER
              1235 WASTE
                42 SUPPLY?
               159 DISINFECT?
                29 STERILIZ?
          3      1 WATER AND (WASTE OR SUPPLY?) AND (DISINFECT? OR STERILIZ?)
          4    146 OZON?
          5      0 3 AND 4
               146 OZON?
                44 ACID?(F)SOLUTION
          6      1 OZON? AND ACID?(F)SOLUTION
```

End Chem Abst. 1977-1979

Chem Abstracts 1982 to present

Zero citations

```
        146 OZON?
         44 ACID?(F)SOLUTION
    6     1 OZON? AND ACID?(F)SOLUTION
        100 COMPARA?(F)STUD??? ?
        146 OZON?
         20 HYPOCHLOR?
    7     0 COMPARA?(F)STUD??? ? AND OZON? AND HYPOCHLOR?
    8     0 6 AND 3
? logoff

      23feb82 18:06:19 User12901
 $2.30  0.036 Hrs File311 13 Descriptors

LOGOFF 18:06:25

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