ROBERT GEORGE KALEY, II

Address

Home:
1965 Schoettler Valley Drive
Chesterfield, MO 63017
Telephone: 314-537-1659

Work:
Monsanto Company
800 North Lindbergh Boulevard
St. Louis, MO 63167
Telephone: 314-694-8558

Employment Record

September 1986 -- Manager, Environmental Technical Support
May 1985-September 1986 -- Product and Environmental Safety Manager
February 1981-May 1985 -- Senior Research Specialist/Mass Spectrometry
January 1978-February 1981 -- Research Group Leader, Environmental Analysis
December 1973-January 1978 -- Senior Research Chemist, Monsanto Company
September 1973-December 1973 -- Research Assistant, University of Illinois, School of Chemical Sciences, Urbana, IL 61801
September 1968-September 1973 -- Teaching Assistant, University of Illinois

Education

Ph.D., Analytical Chemistry, University of Illinois, January 1974, Thesis: An Atom Reservoir for Automated Atomic Fluorescence Spectrometry, Advisor: Dr. Howard V. Malmstadt
M.S., Analytical Chemistry, University of Illinois, February 1971
B.S. in Chemistry (with Distinction), Purdue University, West Lafayette, IN, June 1968
High School Diploma, John Adams High School, South Bend, IN, June 1964

Personal Information

Birth Date: November 8, 1945
Height: 5'10"
Weight: 170 lbs.
Marital Status: Married, 3 children
Health: Excellent
Citizenship: U.S.A.



Professional Memberships and Awards

American Association for the Advancement of Science
American Chemical Society
American Society for Mass Spectrometry
American Society for Testing and Materials
Sigma Xi
St. Louis Society of Analysts, 1980 Chairman
St. Louis Chromatography Discussion Group, 1980-81 Chairman
Monsanto Achievement Award, 1980 - Incorporation of Good Laboratory Practices

WATER_PCB-SD0000008091

Robert G. Kaley, II

Technical Expertise

Environmental and health aspects of industrial chemicals
Polychlorinated biphenyl issues
Gas chromatography/mass spectrometry - qualitative and quantitative
Mass spectrometry/mass spectrometry
Gas chromatography
Environmental trace organic analysis - instrumental
General analytical chemistry
Application of Good Laboratory Practices
Flame (atomic) spectroscopy

Publications

"Characterization of PCBs", National Conference on PCBs, Chicago, IL, November 19, 1975

"Tissue Residues from Subacute Oral Feeding of PCB Dielectric Fluids", Bull. Env. Contam. and Toxicol., 15, 699 (1967)

"Determination of Trace Amounts of Chlorodibenzo-p-dioxins and Chlorodibenzofurans in Technical Grade Pentachlorophenol", J. Chrom. Science, 15, 275 (1977)

"Activated Sludge Degradation of Adipic Acid Esters", Appl. & Env. Microbiology, 31, 746 (1976)

"Environmental Fate of Selected Phosphate Esters", Env. Sci. & Tech., 13, 840 (1979)

"An Environmental Assessment of Butyl Benzyl Phthalate", Env. Sci. & Tech., 14, 301 (1980)

"Application of Laboratory Freshwater Lake Model in the Study of LAS Biodegradation",
EPA Workshop-Microbial Degradation of Pollutants in Marine Environment, EPA-600/9-79-012, April 1979

"Environmental Concentrations of Butyl Benzyl Phthalate",
Conference proceedings to be published.

"Exposure Studies Relating to Industrial Processes Containing Incidental PCB,"
Advances in Exposure, Health and Environmental Effects Studies of PCBs: Symposium Proceedings,
(NTIS PB84-135771) Bethesda, MD, May 12-13, 1982

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Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63167
Phone: (314) 694-1000

April 13, 1987

Robert A. Hall, Esq.
Woodard, Hall & Primm
600 Travis Street
Suite 4700
Houston, TX 77002

Re: Cecil Scott et al. v. Monsanto Company

Dear Mr. Hall:

This letter constitutes my report to you in the above-captioned matter. Attached is a copy of my CV which sets forth my educational background and my employment history at Monsanto Company. As my CV reflects, from December 1973 through May 1985, I worked as a research analytical chemist in Monsanto Industrial Chemicals Company (1973-1981) and Monsanto Corporate Research and Development Staff (1981-1985). In the course of these assignments, I performed analytical tests on polychlorinated biphenyls (PCBs) produced by Monsanto Company. I am familiar with the analytical testing performed by Monsanto Company on its PCBs. I am also familiar with the scientific literature relating to analyses performed on PCBs produced both by Monsanto Company and by other manufacturers. Based on my experience and familiarity with the literature, I can advise you that polychlorinated dibenzo-p-dioxins (PCDDs) have never been detected in PCBs produced by Monsanto Company or any other manufacturer. Further, it is my opinion with a reasonable degree of scientific certainty that it is highly improbable that PCDDs would be formed from PCBs.

In the early 1970's, Monsanto's PCBs were analyzed and found to be free from polychlorinated dibenzofurans (PCDFs) at the level of detection then achievable. Improved analytical techniques and instrumentation available in the mid-1970's showed that some PCBs produced by Monsanto Company contained very low levels of PCDFs.

Very truly yours,

Robert G. Kaley, II

Robert G. Kaley, II, Ph.D.

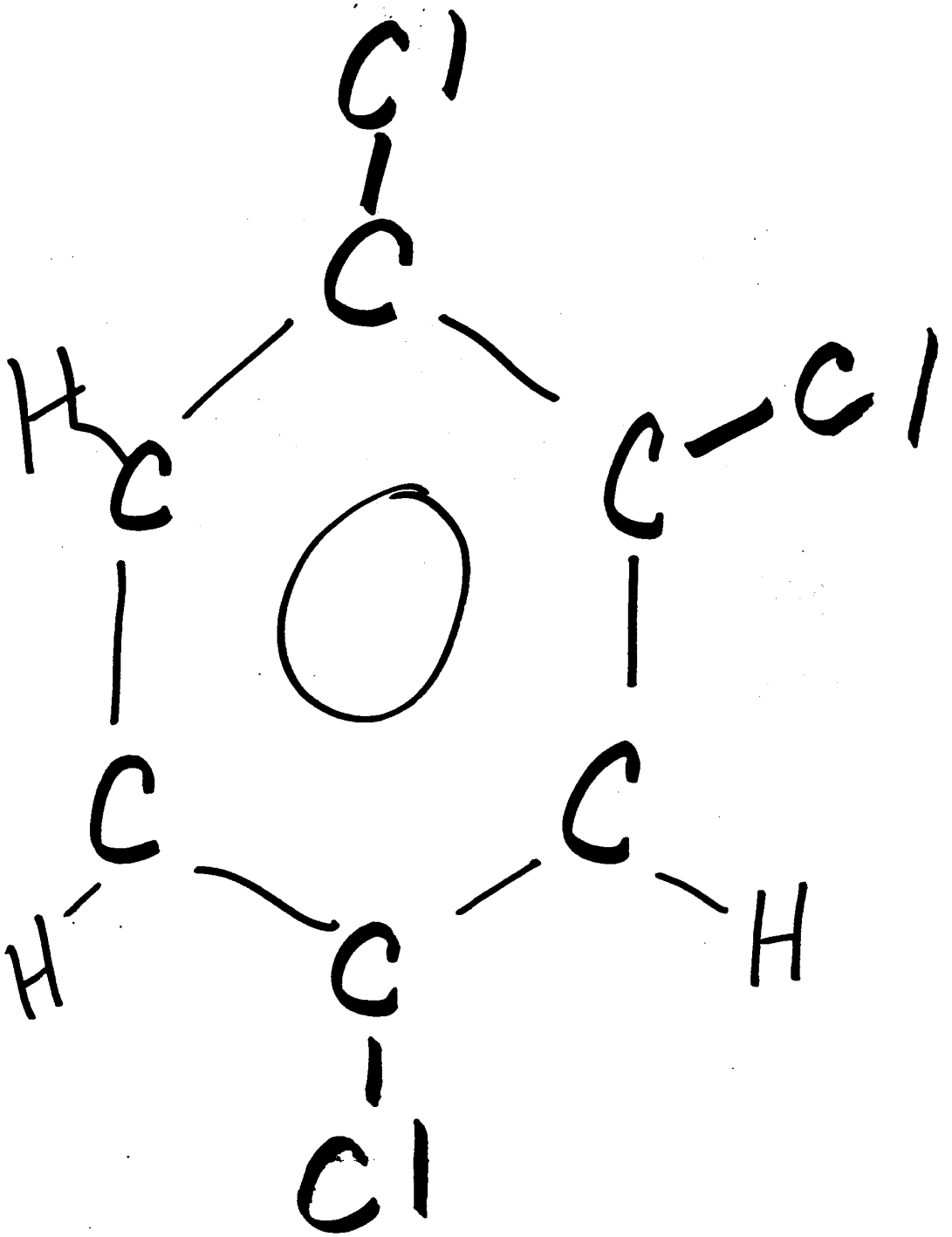
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Enclosure

cc: Mr. T. M. Bistline



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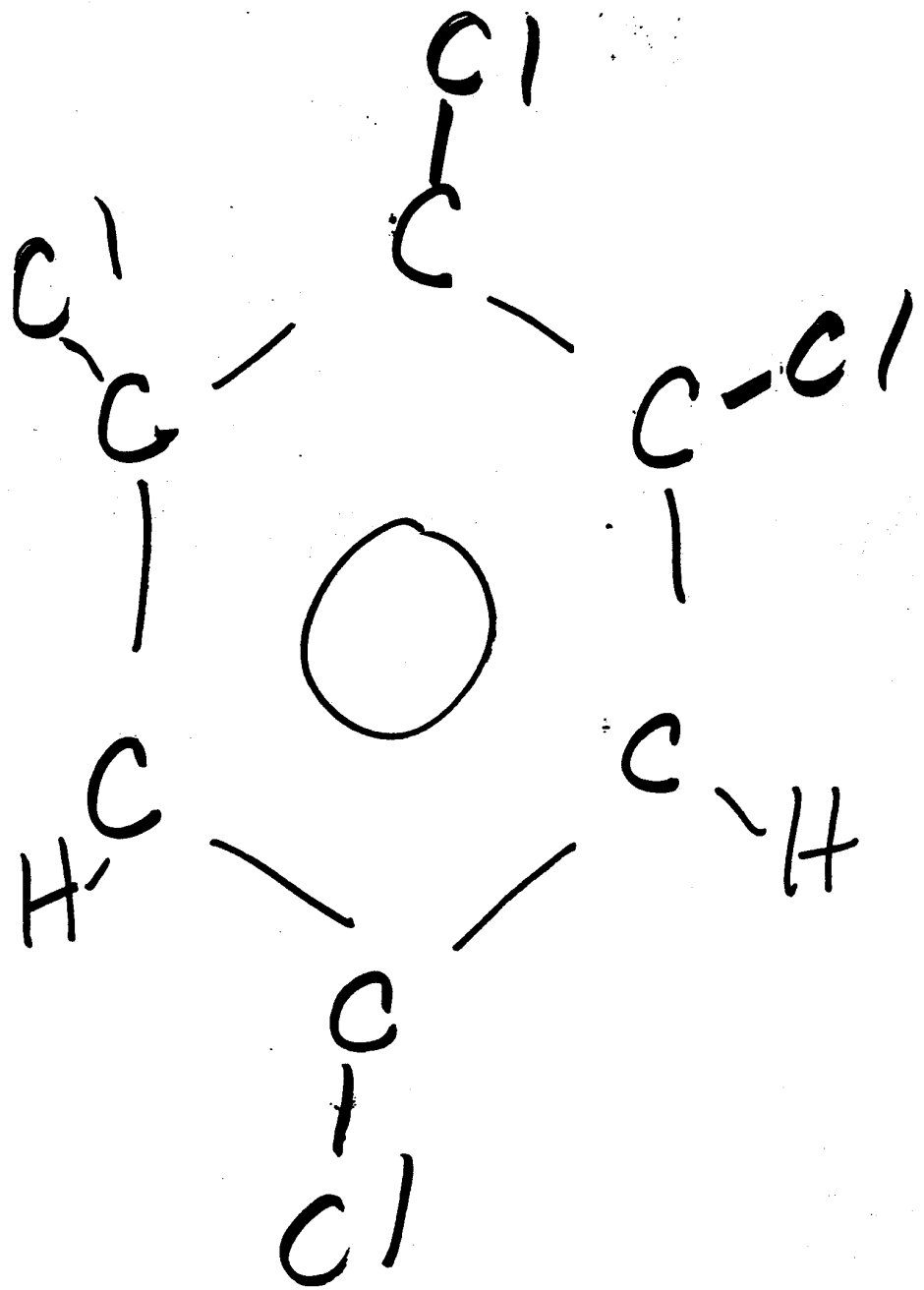
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BENZENE

REPRODUCTION COPY 3 KALEY

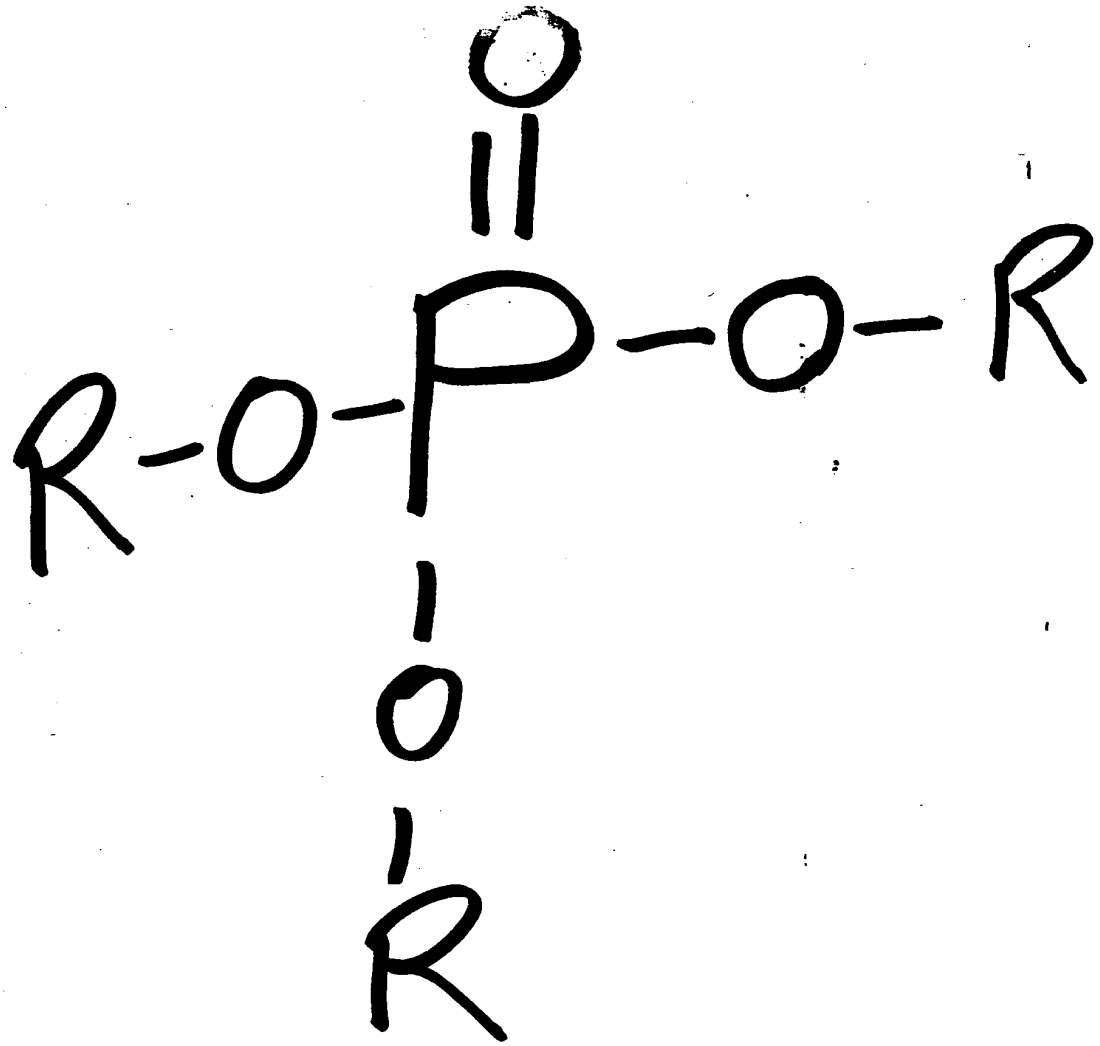
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1,2,3,5-TETRACHLOR
BENZENE

KALPY

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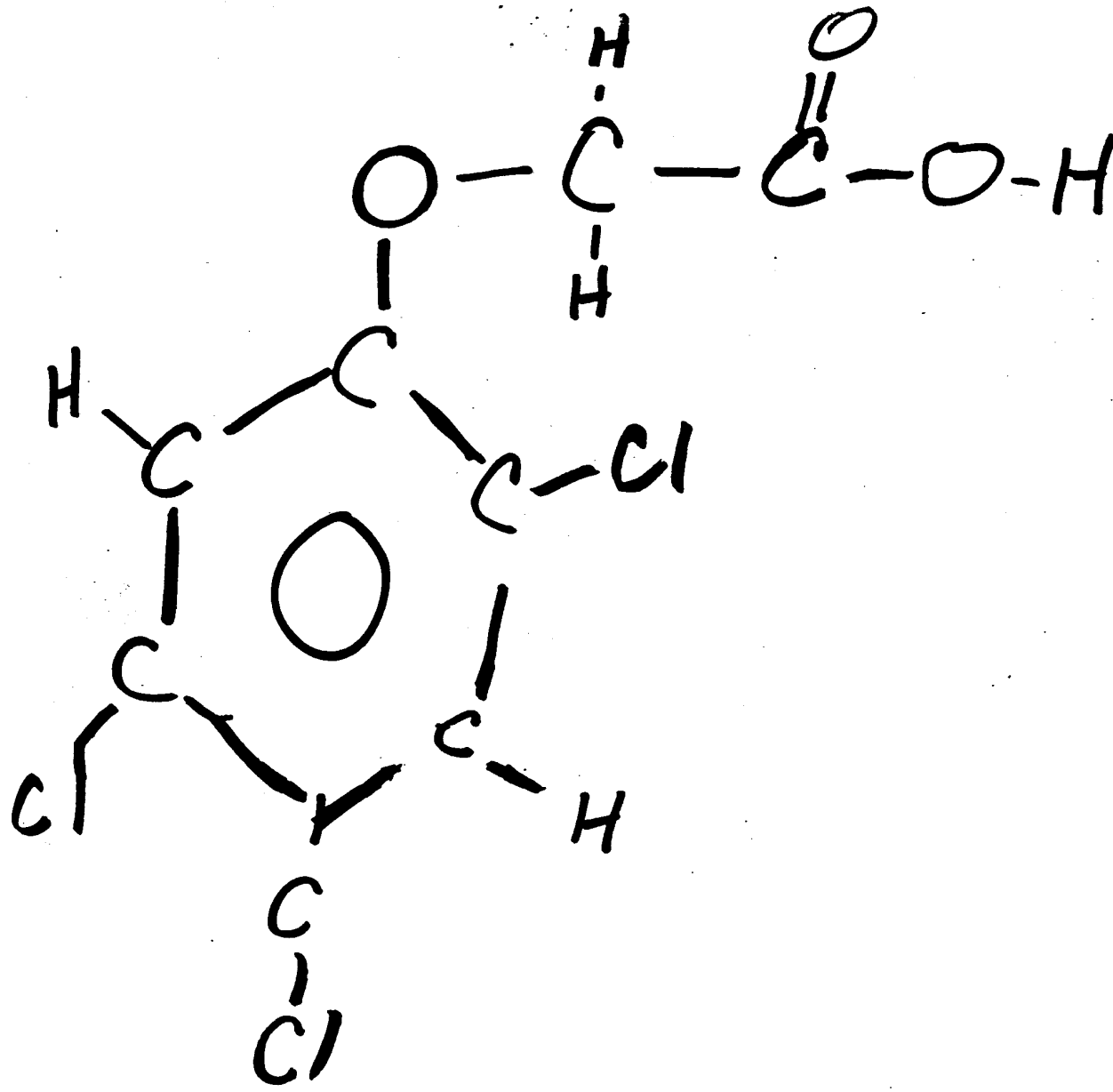


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Industrial and
Hazardous Waste
Management

DEPOSITION EXHIBIT 8 KALEY

Pyroplasma Waste Destruction

The Westinghouse Plasma Systems PYROPLASMA waste destruction unit destroys liquid organic materials by breaking the molecular structure of chemical wastes and changing hazardous wastes into non-hazardous, potentially useful substances. The highly efficient mobile destruction process is based on the concept of pyrolyzing waste molecules using a thermal plasma field.

Description of Technology

The Pyroplasma process is based on the concept of pyrolyzing waste molecules using a thermal plasma field. The heart of the destruction system is a plasma torch which was designed by Westinghouse Electric Corporation and Pyrolysis Systems Inc. Similar torches have been used commercially for years in practical applications ranging from blast furnaces and boiler ignition to the testing of atmospheric reentry heat shields by NASA and development of Mach 6 aircraft engines.

The Pyroplasma unit is entirely contained in a 48 foot tractor trailer and requires only power, water and sanitary sewer discharge lines (see Figure 1). The power requirements are 4160 volts, 3-phase. Domestic water supply and access to a sewage treatment plant (STP) are the only additional external requirements other than a waste source. Only a matter of a few days are required for complete system mobilization to the point of actual operation. There are currently two commercial size units available: a 1 gallon per minute (GPM) unit operating at 350 kW and a 3 GPM (1 ton/hour) unit operating at 750 kW. Mobile units may be designed with throughput capacities as high as 6 GPM and still be contained in a single trailer. While current emphasis has been on the design of mobile units for reasons of lower environmental risk and greater public acceptance, the construction of fixed facilities is possible in the event that higher throughput capacities are required.

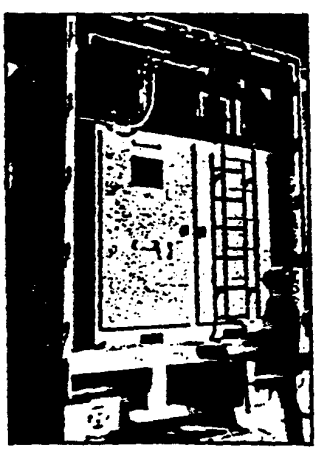
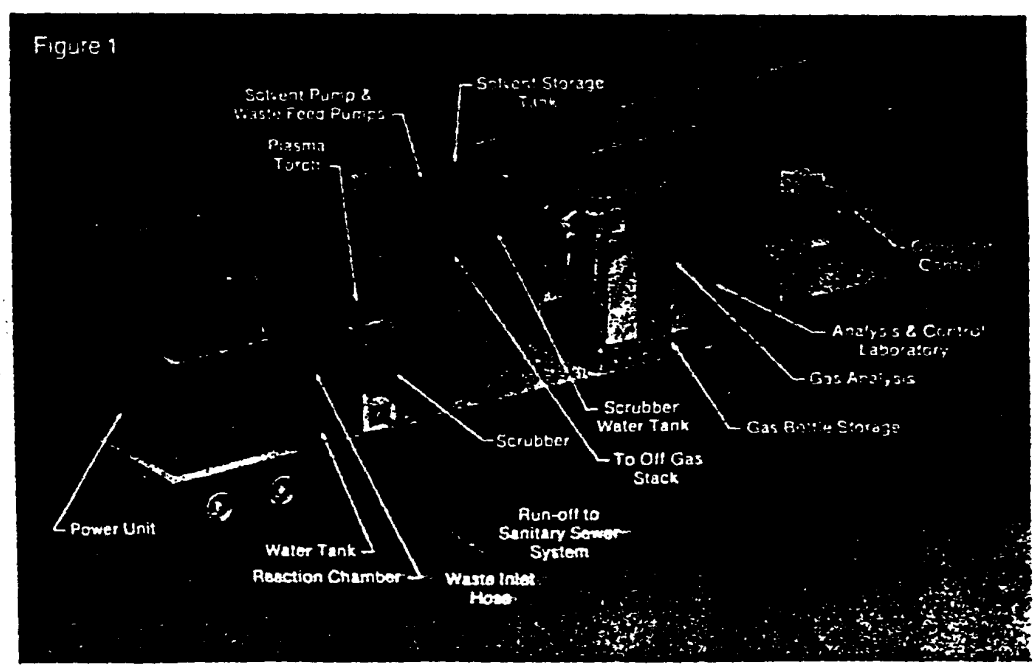


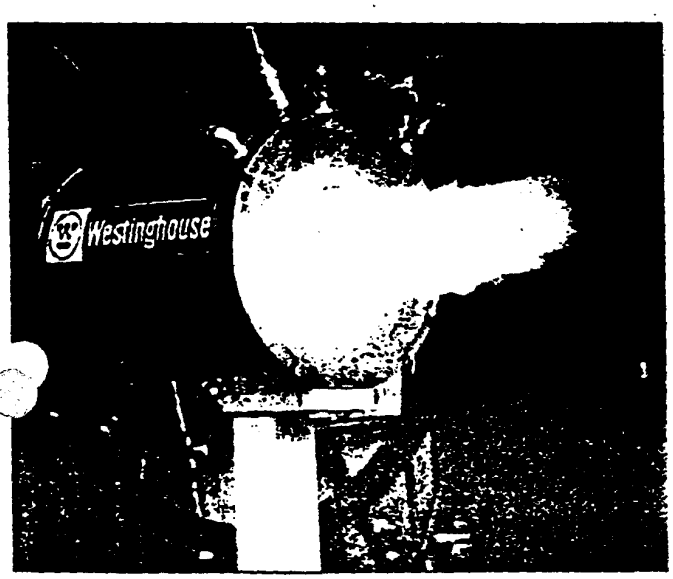
Figure 1

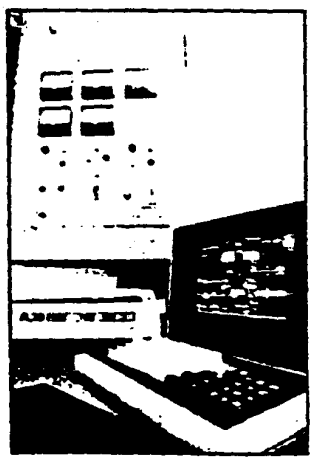


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Pyroplasma Process

The 3 GPM unit uses 750 kW of electric power across a colinear electrode assembly producing an electric arc which causes an injected low pressure air stream to be ionized forming a thermal plasma with temperatures in the 5-15,000 degree Celcius range. Waste molecules introduced to the process are completely dissociated into their atomic components because of the unique properties of the plasma for the breaking of bonds holding molecules together. These atoms then recombine in the reaction chamber to form non-toxic gases, typically carbon monoxide, nitrogen, and hydrogen along with some lower molecular weight hydrocarbons (i.e. methane, ethane, etc.). Acid gas (hydrogen chloride-HCl) formed from the destruction of chlorinated wastes and the subsequent combination of hydrogen and chlorine gases is neutralized in a wet scrubber with caustic soda (sodium hydroxide-NaOH) to form a slightly salted (sodium chloride-NaCl) water effluent. Particulate carbon produced is also removed in this stream. The product gas (usually about 40% hydrogen, 25% carbon monoxide, 15% nitrogen and 10% water) is drawn off by an induction fan and flared directly. The fuel value of the product gas is 2-3 times the actual power required for the torch due to the large amount of energy released from the breaking of waste molecular bonds combined with the high efficiency of the plasma torch in converting electrical energy into heat.





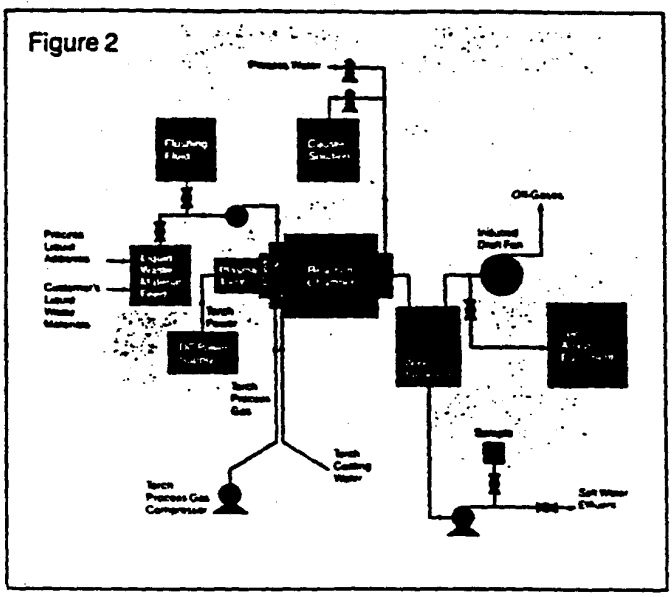
When the waste feed is analyzed, the molecular components of the waste can be computer modeled to give predicted theoretical product gas values closely approximating those of the product gas actually produced by the unit. Careful blending of the waste prior to destruction can alter gas constituents and their relative amounts to within +/- 1% of desired ranges.

The unit is started by electrically powering the torch which activates the plasma instantaneously. Operation begins with the use of a non-toxic on board solvent (i.e. methanol) and is continued for approximately 15 minutes until the reactor stabilizes at a predetermined temperature, typically around 1200 degrees C. Stable reaction chamber temperatures indicate adequate quenching of the torch power thus ensuring effective destruction of the incoming waste. The destruction process is pyrolytic in nature occurring in the plasma field and not a combustion process occurring in the reactor; thus, system destruction efficiencies do not depend upon reactor temperatures or residence times. Reaction chamber temperature is controlled by adjusting either torch power, waste feed flow or torch process gas flow and is established to control the types of recombination products being formed. The entire system is process computer controlled through a series of temperature, pressure, electrical and flow sensors. While the operation of the unit is monitored and directed by a technically experienced person the computer has overriding control. This is based on a series of control parameters set according to operational limits inside which system efficiency may be ensured and risk to the environment eliminated. There are numerous failsafes built into the system even in anticipation of a complete power failure, a worst case situation. In addition, there are several gas monitors ensuring that the system is operating according to theoretical models and therefore in an efficient manner. See Figure 2 for a schematic of the process.

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Figure 2



History of Development

Dr. Thomas Barton, a professor at the Royal Military College in Kingston, Ontario, Canada developed the application of the Westinghouse plasma torch to destroy hazardous wastes. In 1982, a cooperative agreement with the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) was signed to fund the construction and demonstration of this plasma arc process for the high efficiency destruction of liquid hazardous wastes. The process was tested successfully at the Royal Military College using solvents, carbon tetrachloride and PCBs (Askarels). The first mobile unit is installed at the New York State Love Canal hazardous waste facility.

In 1985, Westinghouse Electric and Pyrolysis Systems Incorporated formed a joint venture company, Westinghouse Plasma Systems to commercialize the Pyroplasma and other waste treatment processes. A second mobile unit was completed in October, 1986.



Operations and Applications

The Pyroplasma process is capable of destroying a wide spectrum of liquid organic hazardous wastes. The materials which have been tested were selected to demonstrate the ability of the plasma system to deal with difficult to destroy highly chlorinated organic wastes. In 1985 and early 1986, a rigorous series of tests were conducted with methyl ethyl ketone (MEK), ethanol (EtOH), methanol (MeOH), carbon tetrachloride (CCl_4) and transformer Askarel fluids (PCBs and trichlorobenzene).

When configured as a mobile unit, the technology can be transported and used in emergency response to clean up hazardous materials spills or to perform waste site cleanups. It has been important to maintain the single trailer configuration to assure a truly mobile system. However, the Westinghouse Pyroplasma technology can be reconfigured to be permanently installed in industrial production lines to alter and/or recycle chemicals or recover energy from waste streams as they are generated.

Field Tests

Preliminary field testing of the Pyroplasma mobile unit was completed in early 1986 as part of the contract between Pyrolysis Systems and New York State. All tests were observed by both federal and state authorities from the United States, as well as federal, provincial and local Canadian authorities. Chemical analyses of both gas and water effluent streams were performed externally by Zenon Environmental (Burlington, Ontario) and stack testing was conducted by GCA Corporation of the U.S. and IMET Incorporated of Canada.

Mechanical operation of the mobile plasma pyrolysis system was first verified by processing a non-chlorinated blend of MEK/MeOH (1:1 volume). Following this, three, one-hour carbon tetrachloride runs were conducted to demonstrate (i) the destruction efficiency of the plasma process with a difficult to destroy chlorinated compound, (ii) the stability of the system upon exposure to high concentrations of chlorine, and (iii) the effectiveness of the scrubber for HCl removal. The carbon tetrachloride was blended with MEK, MeOH, H_2O and fed at a rate of one kilogram of CCl_4 per minute.

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Destruction efficiencies were greater than 99.99995% for all three runs based on measured residuals in all effluent streams. Stack emissions for CCl_4 were analytically non-detectable. See Table 1 for results.

After completion of the CCl_4 runs, seven tests were performed using a blend of Askarel (Aroclors 1254 and 1260 in trichlorobenzene) in MEK/MeOH to determine the PCB destruction capabilities of the process. Three one-hour, one two-hour and three five-hour tests gave destruction removal efficiencies consistently greater than 99.99999%. See Table 2 for results.

Table 3 summarizes the HCl, particulate, NO_X, O_2, CO, and CO_2 emissions for the flared product gas of the seven PCB test runs. Emissions of HCl, particulate and NO_X were below accepted Canadian and American regulatory agency guidelines.

In addition to the high destruction efficiencies of the chlorinated test runs, emissions of products of incomplete combustion (PICs, specifically chlorinated dioxins and furans) were usually non-detectable in both the stack gas and water effluent. For example, no dioxins were detected in either the gas or water effluents in PCB test #9.

Technology Advantages

The Westinghouse Plasma Systems mobile Pyroplasma unit provides unique advantages over other conventional technologies. The most important of these is the very low emissions resulting from the high destruction efficiencies combined with the low PIC formation. The technology itself is pyrolytic in nature and does not require the large volumes of air needed for combustion. The lower gas volumes and thus lower quenching and scrubbing water volumes lend themselves to a small, compact process which is easily made mobile. The entire system is housed on a 48 foot tractor trailer which can be operational with only two days setup. The only operating requirements are, 4160 volt-3 phase power, access to a water supply and a sanitary sewer system. It also takes about two days to demobilize the system. This eliminates the hazards and liabilities associated with the transport of toxic wastes.

The product gas from the process is rich in hydrogen and carbon monoxide and is a potential source of energy. Two to three times as much potential thermal energy is produced than the energy required to power the torch to destroy the wastes.

Table 1

CCl_4 Test Results

Test (#)	Mass (%)	Input (kg/hr)	Air (mg/hr)	Output Water (mg/hr)	Total (mg/hr)	DE (%)
1	35.0	64.2	29.27*	2.51	31.78	99.99995
2	40.0	60.6	22.79*	9.85	32.64	99.99995
3	35.0	64.2	22.89*	6.26	29.15	99.99995

*number reported is analytical detection limit

Table 2

PCB Test Results

Test (#)	Mass (%)	Input (kg/hr)	Air (mg/hr)	Output Water (mg/hr)	Total (mg/hr)	DRE (%)
3	14.1	23.9	0.65*	4.08	4.73	99.999997
4	14.1	18.6	2.00	10.16	12.16	99.999994
5	11.5	19.8	6.96	18.76	25.72	99.99986
6	14.5	18.0	0.43	9.41	9.84	99.999995
7	12.5	17.5	0.02*	24.12	24.14	99.999999
8	12.8	16.9	0.03*	19.76	19.79	99.999999
9	17.5	26.7	0.33	0.75	1.08	99.999999

*number reported is analytical detection limit

Table 3

Flared Product Gas Parameters[a]

Test (#)	O_2 (%)	CO (%)	CO_2 (%)	HCl (mg/M^3)	NO_X (ppm)	particulate (mg/M^3)
3	14.0	0.01	5.5	NA	117	10
4	14.5	0.01	5.0	43	NA	180
5	16.5	0.01	3.0	68	139	12.5
6	15.8	0.00	3.8	1.07	96	15.84
7	14.0	0.00	5.1	2.68	115	7.60
8	15.3	0.00	4.3	1.30	108	10.90
9	13.3	0.00	5.2	26.8	81	11.9

[a] refers to PCB tests #3-#9 of Table 2

Conclusions

These tests have proven the ability of the mobile Pyroplasma system to efficiently destroy a variety of toxic chlorinated wastes. The list of chemicals successfully processed by the unit includes methanol, ethanol, methyl ethyl ketone, water, carbon tetrachloride, and Askarel (a mixture of PCBs and chlorobenzenes) along with low levels of dioxins and furans.

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