1-) **MICROWAVE PLASMA CHAMBER TREATMENT** of persistent organic wastes such as PCBs, Kepone, and others soon may be simple and easy using portable versions of the device shown at left. Dr. Lionel Ballin, left, and Dr. Barry Hertzler, both of Lockheed Missiles & Space Co.'s Palo Alto Laboratories, Palo Alto, CA, have scaled up their earlier version of the microwave system. The system will detoxify wastes at rates of 4.5 to 13.6 kg/hr (10 to 30 lb/hr).

INDUSTRIAL RESEARCH/DEVELOPMENT—MAY 1978

2-) **Irradiation destroys PCB's in wastes**

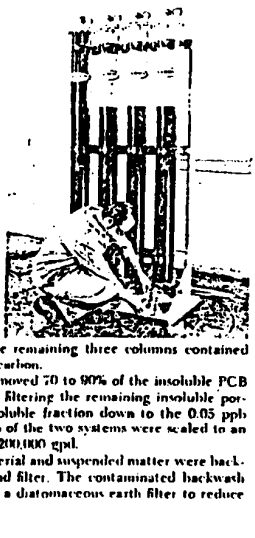
As part of its experimental wastewater and sludge disinfection project using an electron accelerator, Massachusetts Institute of Technology has found that one herbicide and two polychlorinated biphenyls (PCB's) can be destroyed by irradiation with the high-energy electrons. Dosages range from 400 kilorads to 5 megarads, depending on the type of PCB solution. The electron radiation breaks down water molecules into free radicals, some of which break down the PCB's. The research was carried out at Boston's Deer Island treatment plant, an MIT and Ciba-Geigy team told the 70th annual meeting of the American Institute of Chemical Engineers in New York City last week.

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3)

Carbon reduces PCBs to 0.05 and 0.08 ppb

Polychlorinated biphenyls were consistently reduced to an average 0.05 and 0.08 parts per billion in two pilot studies using granular activated carbon. PCB influent concentrations to the two pilot carbon systems varied widely from 0.66 to 1061 ppb.



The carbon systems consisted of four 5" diam plexiglass columns. The first column contained four ft of #1½ coal and 10 x 16 mesh sand installed to remove suspended solids and insoluble PCB ahead of the carbon. The remaining three columns contained four ft each of granular carbon.

The coal/sand filter removed 70 to 90% of the insoluble PCB material with the carbon filtering the remaining insoluble portion and adsorbing the soluble fraction down to the 0.05 ppb level. Flows through each of the two systems were scaled to an equivalent plant flow of 200,000 gpd.

The insoluble PCB material and suspended matter were backwashed from the coal/sand filter. The contaminated backwash water then was treated in a diatomaceous earth filter to reduce to a minimum the final volume of insoluble PCB for disposal. Filtrate from the DE filter was cycled to the granular carbon for removal of the soluble fraction.

Both the soluble and insoluble PCB material concentrated in the carbon and diatomaceous earth can be disposed of by high temperature incineration. The EPA has outlined conditions for incineration of PCB-containing wastes in the April 1 issue of the Federal Register.

(Pilot studies using Filtrasorb 300 granular activated carbon at a 12-ft depth duplicates the depth of granular carbon normally used in each of the two vessels in series which are the key element in the Calgon Adsorption Service available from Calgon Corp., Calgon Center, Box 1346, Pittsburgh, PA 15230.)

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4)

PCBs can be made virtually harmless. D Liu, a research scientist at the Canada Center for Inland Waters (Burlington, Ont), has developed a technique for rendering PCBs harmless. The technique may also help answer environmental problems related to other persistent toxic chemicals. The discovery involves a newly developed strain of bacteria and a special technique for providing them with access to the hitherto almost indestructible compound. Dr Liu increased the Ultra-Sonic Vibration to disperse the PCB's into very fine particles, and a common pulp-mil effluent was added to maintain an emulsified suspension. Bacteria were introduced, which then fed on the dispersed PCB's. Initially, the bacteria suffered an extremely high mortality rate, but the process of

adaptation began and a new strain emerged. [illegible] they that even the highly chlorinated and most stubborn members of the PCB family are reduced in one week from concentrations of 300,000 ppb to 19

Chem Cda 6/76 p15,16

A double-barreled technique to split polychlorinated biphenyls into harmless fragments has been devised by Dr Dickson Liu, a biochemist at the Canada Center for Inland Waters (Burlington, Ont). Wastewaters containing PCBs are exposed to ultrasound, which vibrates the organic chemicals into millions of globules. This gives the PCBs an extremely large surface area, which is retained by adding an emulsifying agent.

A specially developed strain of Pseudomonas bacteria is then introduced into the mixture. The bacteria consume the organic chains of the PCBs at appropriate points, rendering the chemical harmless. Concentrations of the most resistant PCBs have been reduced by the bacteria from 300,000 to 19 ppb, well below the federally mandated standard of 5,000 ppb. So far, the technique has provided itself on a small scale, but Liu is now developing an industrial scale operation.

Ind Res 5/76 p26,28

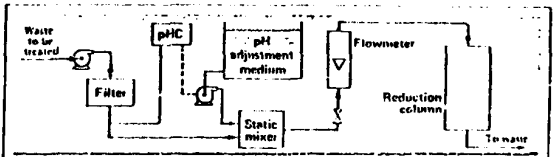
5)

Process gobbles up chlorinated compounds

This catalyzed reduction system removes chlorinated pesticides from effluent streams. And tests indicate that the method may be effective in getting rid of PCB's and reportedly carcinogenic "light ends," too.

☐ This treatment process, which uses a catalyzed-iron reducing agent, reduces the small amounts of water-soluble chlorinated compounds found in effluent streams of plants making or using such substances to within acceptable federal limits. These effluent streams, generally containing 1 ppm or less of chlorinated toxicants, are difficult to treat economically because of the low concentrations of the materials. But field tests at a chlorinated-pesticide plant have shown that the firm's catalyzed reduction system can lower the chlorinated-compound concentration of an effluent stream from 100 ppb-1 ppm to 10 ppt-1 ppb.

Laboratory tests conducted by the manufacturer show that materials amenable to the system's reductive degradation method include: cyclodiene pesticides, such as aldrin, dieldrin, and endrin; DDT and related materials, such as DDD and methoxychlor; the chlorinated camphene, toxaphene; the chlorinated cyclohexane, lindane; and the chlorinated phenoxyacetic-acid herbicides, 2,4-D and 2,4,5-T. Indications have also been seen, says the company, that the system can also remove "light ends," such as chloroform, carbon tetrachloride and ethylene dichloride. And the firm is optimistic that the process can reduce polychlorinated biphenyl (PCB) levels in effluent streams. In recent tests, the treatment system reduced the PCB concentration of an effluent stream from a saturated level of 200 ppb to less than 1 ppb.



System reduces chlorine-compound content

The firm estimates the total cost of the system (reagents, operator, maintenance and supplies, utilities and amortized capital investment) to be about $0.72/1,000 gals treated, based on a 100-gal/min unit (photo). The units come skid-mounted and consist of 25-gal/min modules. Thus, if a plant expands, additional modules may be added to maintain required capacity. For very large treatment systems, larger-than-25-gal/min modules can also be fabricated.

STRAIGHTFORWARD PROCESS—Treatment begins (see flowchart) with a filter that can be a cartridge, sand, carbon or other type, depending on the characteristics of the effluent being handled. Additional bed for such a unit contains 3,000 lb of iron powder and 12,000 lb of sand.

Other metal reductants besides iron may be used, but the maker notes that the use of iron avoids toxicity problems connected with other metals.

COMPATIBLE SYSTEM—The treatment system operates at ambient temperatures. A small pressure, supplied by a pump, is sometimes needed to regulate flowrate. Materials of construction vary to meet the needs of individual effluent streams.

The manufacturer sells complete systems and will provide startup assistance as needed.—*Envirogenics Systems Co., El Monte, Calif.* 351

flowstream purification, such as oil removal, etc., would also be done at this point. Following pH adjustment (the company indicates the optimal pH is 7), the effluent is metered into a reduction column that contains an iron powder (100-200 mesh) reductant in a sand-bed matrix.

The maker uses an unidentified metallic catalyst that attaches to the iron and enhances the reduction reaction. According to the company, the catalyst gives a more complete reaction by speeding up the reduction and limiting the number of intermediates formed.

Iron powder costs about $0.28/lb, and the catalyzed iron powder just a few pennies more, according to the manufacturer. Because of the small amounts of toxicants actually removed, the reduction bed should last a long time before needing replacement; the present estimate for a 100-gal/min unit is a year or longer. The

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Chem. Eng. Aug 16, 1976

WESTGATE RESEARCH CORPORATION
13478 BEACH AVENUE
MARINA DEL REY, CALIFORNIA 90291
213-822-1817

UV-OX^{tm} WATER PURIFICATION

A new water treatment system called UV-OX^{tm} has been developed by Westgate Research Corporation for the removal of trace organics and microorganisms from water. The process involves treatment with ozonated air in the presence of ultraviolet radiation. This potent combination oxidizes soluble organic materials to CO_2 with resulting TOC values approaching zero. No regeneration cycles or disposal of sludges or absorbents are involved.

It has been demonstrated on waste waters containing microorganisms, phenols, urea, sodium acetate, chloroform, trinitrotoluene, polychlorinated biphenyls, cyclotrimethylenetrinitramine, detergents, alcohols and other refractory solutes.

Examples of the effectiveness of the UV-OX^{tm} Process for clean-up of secondary effluent from the Los Angeles Hyperion Sewage Treatment Plant and destruction of acetic acid are shown below:

