Synopsis

Project Number: 02
Start: June 1, 1994
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Title: Testing of a New Polymeric Water Disinfectant

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Focus Categories: Treatment, Water Quality, Wastewater

Keywords: Water Treatment, Wastewater Treatment, Water Quality Control, Disinfection, Bacteria, Bromination, Urban Water Systems, Environmental Sanitation

Congressional District: Third

Problem and Research Objectives:

A major problem in the disinfection of potable water for municipalities as well as rural areas in this region is the concomitant introduction of toxic chemicals into the water during the disinfection process. The most widely used disinfectant for potable water is free chlorine, which is an adequate disinfectant, but unfortunately it is reactive with organic impurities in water to produce toxic trihalomethanes, which are known to cause cancer in laboratory animals. Alternate disinfectants, such as ozone and chlorine dioxide, can also react with organic matter to produce byproducts of unknown health risks. Thus, there is a need for a new disinfectant which kills microorganisms, but which is unreactive with organic impurities and does not elute
undesirable chemicals into the water.

There is also a need for a disinfectant for wastewater which is persistent for long periods of time in the presence of heavy organic load. Disinfectants such as chlorine, ozone, and chlorine dioxide must be replaced frequently in wastewater treatment because they are extremely reactive with the organic matter in the wastewater.

The objective of this research was to evaluate a new insoluble biocidal polymer (Poly-IBr below), which had been synthesized recently in these laboratories,

![Chemical Structure](image)

as to its potential to function in a cartridge filter in inactivating pathogenic microorganisms in water flowing through it. Parameters to be studied experimentally included necessary contact times as a function of flow rate, relative efficacies of inactivation of various microorganisms at a given flow rate, longevity of the filter material as a function of total organic load, and potential for regeneration of the biocidal material by exposure to aqueous solutions of free bromine.

**Methodology:**

The Poly-IBr material described above which is an insoluble granular solid was packed into a glass filter tube to a length of 5.1 cm (2.3 grams). The filter tube was connected to a peristaltic water pump. Solutions of microorganisms were pumped through the filter at varying flow rates, pH's, temperatures, and water qualities. The effluent water was analyzed for viable microorganisms to evaluate the biocidal efficacy of the polymeric material.

**Principal Findings and Their Significance:**

The following points were demonstrated for the biocidal Poly-IBr filter material: (1) At pH 7.0 and 22°C using demand-free water, the polymer was able to cause a 6-log inactivation of the microorganisms *S. aureus*, *P. aeruginosa*, *E. coli* and *C. albicans* in one liter solutions of the
organism pumped through it. The flow rate in the experiments was slightly less than 100 mL per minute. Thus, a broad variety of microorganisms in aqueous solution can be killed by the polymer. (2) A 6-log inactivation of *E. coli* was obtained at 22°C and pH values of 4.5, 7.0, and 9.5; thus, the polymer biocide functions satisfactorily over a broad range of pH's. For an industrial water disinfection application the pH of the influent would not require adjustment before pumping through a filter of the N-Cl polymer. (3) In a variable temperature study, it has been shown that the polymer inactivates *E. coli* at temperatures in the range 4-37°C at the flow rate studied (ca. 100 mL per minute). (4) Once the polymer becomes ineffective due to the depletion of all of its active bromine caused by organic load or a reducing agent, it can be regenerated by simply pumping an aqueous solution of free bromine through it. This factor should be very important in reducing costs to the consumer.

**Publications:**


**Presentations:**
