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CLAM SURVIVAL IN CHLORINATED WATER

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by

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ABSTRACT

Applications of 10-40 ppm chlorine were ineffective in control of Asiatic clams that had colonized the suction well of a cooling water pump for one of the Savannah River production reactors. Accumulated mud on the floors and walls of the basin protected large numbers of clams from lethal chlorine exposures. After clams were removed from chlorine exposures of 9, 17, 25, and 54 hours, respective survivals after seven days in a recovery chamber were 97%, 84%, 47%, and 10%. Of the clams that were protected by mud during the entire test (54 hours), 65% were alive after seven days in the recovery chamber.

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CLAM SURVIVAL IN CHLORINATED WATER

INTRODUCTION

Asiatic clams (*Corbicula manilensis*) have been colonizing the suction wells of pumps that circulate secondary cooling water through the heat exchangers of the Savannah River Plant production reactors. Clam populations have occasionally increased in size and density to an extent where flow of coolant water through pumps and heat exchangers was restricted. These coolant flow restrictions have, in turn, caused nonscheduled reactor shutdowns followed by costly and troublesome service work. Problems have been overcome by periodic mechanical removal of clams, but as part of a program to find a simpler and less expensive method of control, an existing chlorination method was applied to water in a suction well (in the C Area reactor) in which both wall- and floor-dwelling clams were found.

TEST PROCEDURE

Experimental water chlorination was carried out in a C-Area suction well that was first isolated and drained to allow personnel to enter and sample clams from the walls and from the mud that covered the floor. Sampling from areas obviously altered during water drainage was avoided. As expected, clams occupied only the upper 2-3 inches of the floor mud; densities were of the order of thousands per square meter. Densities of clams on the walls were similar, but sizes were much smaller, the largest being about 7 mm long.

After the initial clam samples were taken and examined, specimens of clams taken from the bottom mud were placed in mesh baskets that were suspended in the well; additional specimens were placed in baskets in a nearby upstream basin as a control. The well was then refilled and chlorinated.

Concentrations of chlorine in the basin were monitored during the 54-hr test by sampling the water with specially installed siphon lines. Chlorine concentrations greater than 40 ppm were noted and, except for brief periods in one location, the concentrations did not fall below 10 ppm at any time during the test. Water temperature variations during the test were less than 5°C.

During the chlorination test, survival observations were made periodically on samples (ten clams each) that were removed

from the baskets that were suspended in both the well and the control basin. For the survival observations, samples were placed in recovery chambers suspended in fresh, unchlorinated water at the same temperature as the well and basin water. At the conclusion of the chlorination test, the basin was again drained to allow personnel entry and clam sampling. Survivals of wall-dwelling clams were determined on scrapings that were taken before the start and after the conclusion of the chlorination. Direct observations of *in situ* survival could not be made because clams were too small and were covered by the mud clinging to the concrete. Clams that remained in the bottom mud during the chlorination test were sampled at the end of the exposure, and their survival rate was compared with that of clams that were periodically removed from the basket in the control basin.

RESULTS

Figure 1 shows the survival rate of clams that were taken from the mud and then held in baskets during exposure to water of various chlorine concentrations for various times. According to Figure 1, at a given chlorine concentration, increased exposure times caused successively higher mortality rate, but much of the induced mortality was delayed several days. Clams that were exposed for the full period of the 54-hour test experienced about 90% mortality within 7 days. Clams that remained in the mud during the entire exposure period experienced only about 35% mortality in the same time, as shown in Figure 2. Subsequent observations revealed no other important differences in death rates between control and exposed clams.

Microscope counts of small (<7-mm length) clams taken from the walls showed that chlorine exposure during this test caused 50% mortality. The smallest of these wall-dwelling clams (<2 mm) showed much greater resistance to the chlorine than the larger ones, probably because the smaller clams are more completely buried in and protected by the mud and worm (oligochaetes) tubes on the walls. The effectiveness of this protection is supported by the fact that the microscopic worms living in the tubes appeared to be largely unaffected by the chlorine exposure although their bodies are delicate and readily attacked by free chlorine when the worms are outside their burrows.

CONCLUSION

The results of this chlorination test do not support the use of acute doses of chlorine as the procedure for controlling the invasion of suction wells by young clams. Other possibilities to be considered include other biocides, chronic dosage with lower levels of chlorine, and periodic temperature shock. The effect of chlorine treatments on larvae could not be considered here but is being investigated in laboratory tests.

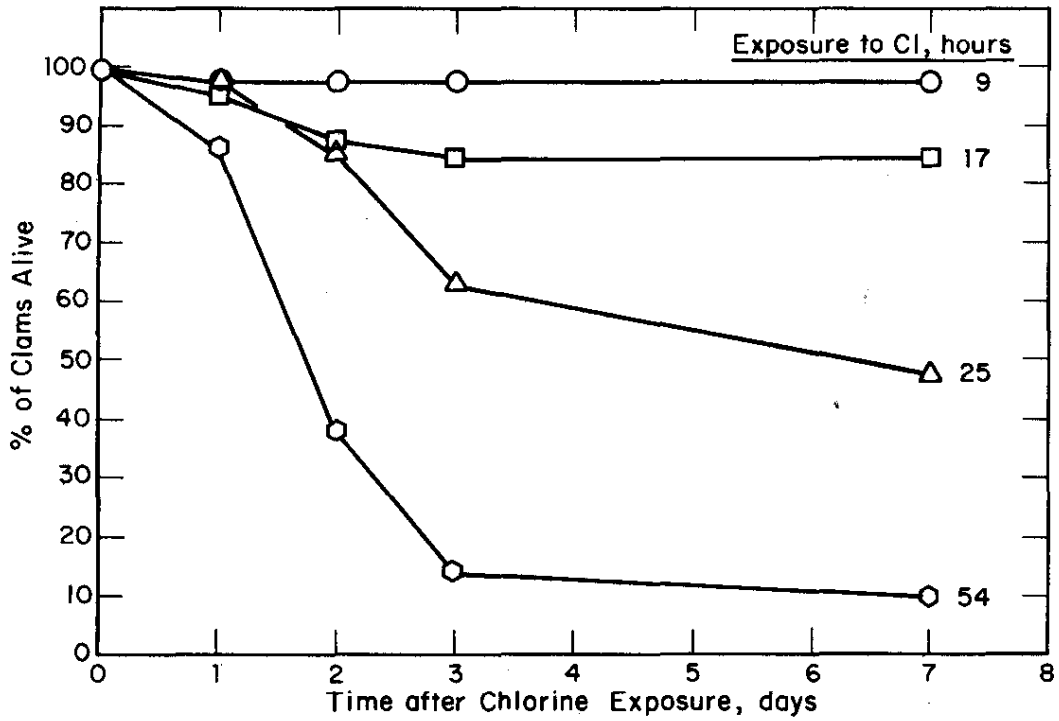


FIGURE 1. Survival of Clams Taken from Well-Bottom Mud, Then Held in Baskets During 54-hr Water Chlorination Test (C-Area Suction Well)

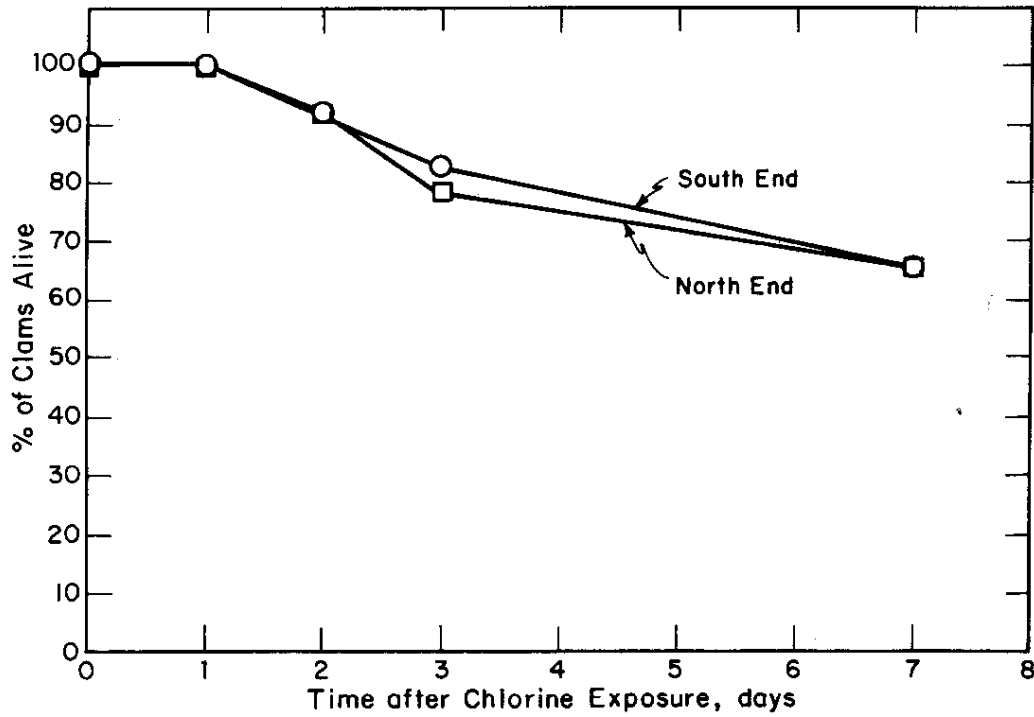


FIGURE 2. Survival of Clams Residing in Mud During Water Chlorination for 60 hr, Including 6 hr Required for Draining Well and Sampling Clams (C-Area Suction Well)