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CHEMICAL OXYGEN DEMAND OF THE ANTITRANSPIRANT, FOLICOTE[1]

by

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ABSTRACT

During a standard bioassay using fish and the antitranspirant Folicote, a significant deoxygenation of the water was observed. Oxygen demand tests without fish using distilled water indicated that at 25°C Folicote reduced D.O. from saturation (8 ppm) to 0.1 ppm within 60 hrs. Oxygen consumptive qualities of Folicote should be taken under consideration during actual field applications.

INTRODUCTION

Folicote is a wax base chemical antitranspirant that is being considered for spray application to riparian vegetation in order to coat their leaves and reduce water loss due to transpiration (Davenport, present journal). Desert southwest riparian areas are a principal location of potential use. Many riparian areas also contain surface waters which have fisheries resources, especially sport fish and native fishes. The following study examines the effect Folicote has on dissolved oxygen concentrations of water.

In order to determine the ecological effects antitranspirants might have on the aquatic community, static bioassays were conducted using mosquitofish, Gambusia affinis, in various concentrations of Folicote. These standard bioassays included monitoring of various physical and chemical parameters such as temperature, pH and dissolved oxygen as well as fish mortalities (Sprague 1973, Doudoroff 1951). During the bioassays, a significant decrease in the amount of dissolved oxygen (D.O.) in the tanks containing Folicote was observed. So, in addition to monitoring the bioassay D.O. changes, further tests without fish were conducted to investigate the chemical oxygen demand of Folicote. All tests were designed to simulate static pool environments in nature because the greatest effects of low oxygen on aquatic life would probably be found in these habitats.

MATERIALS AND METHODS

TESTS WITH FISH

These experiments utilized 12, 21 l., all glass aquaria which were placed in a 112 X 193 X 36 cm. water bath. A constant temperature in all tanks was maintained by thermostat controlled immersion heaters and a circulating pump in the water bath. Each experimental aquarium contained 10 l. of test solution and ten fish. Two controls using only test water and no Folicote were also maintained during the tests. Dissolved oxygen saturation was insured by vigorous aeration from an air pump. Aeration was stopped at the beginning of the test when the chemical was introduced. Dissolved oxygen was monitored at 1, 2, 4, 8, 16, 24, 33, 48, 72 and 96 hr. after the test began using a Yellowspring Instruments Model 57, temperature-oxygen meter. All test water originated from a well at the fisheries research facility of the School of Renewable Natural Resources, University of Arizona, Tucson, Arizona.

TESTS WITHOUT FISH

Four, 1 l. graduated cylinders were used in tests without fish. Prior to tests, the cylinders were cleaned with a 10% solution of HCl and then rinsed with distilled water. Two cylinders were filled with distilled water (control) and two contained water + Folicote (experimental). A 5% solution of Folicote (50 mls. Folicote - 950 mls. distilled water) comprised the test solution. The test was conducted at 25°C.

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Membranes on the oxygen meter were changed every 24 hr. to eliminate error due to wax build-up from the Folicote. Dissolved oxygen readings were taken at 0, 4, 12, 17, 24, 30, 40, 44, 48, 53, 61 and 70 hr. after the start of the experiment using Folicote. Readings of the control solutions were made at 0, 8, 45, 58 and 72 hr. after the start of the experiment.

RESULTS

TESTS WITH FISH

During the 96-hr. experiments, some deoxygenation of the water occurred in all tests, including those tests without Folicote (Figure 1). However, there was a much greater rate of deoxygenation in the tanks containing Folicote. Within 24 hr., dissolved oxygen levels in the tanks containing a 3.5% solution declined from 7.8 ppm to 0.3 ppm. They remained at that level for the duration of the experiment.

TESTS WITHOUT FISH

There was a slight drop from atmospheric saturation even in the cylinders containing only distilled water (Figure 2). However, the decrease was only 0.5 ppm over the 72-hr. period. This was probably due to the inevitable contamination by microorganisms over the 3-day period. In tests containing a 5% solution of Folicote, complete deoxygenation of the distilled water occurred after 61 hr.

DISCUSSION

In these experiments, the antitranspirant Folicote demonstrated a significant oxygen demand in water. The factors in Folicote that are responsible for this phenomenon are unknown. If Folicote is aerially applied to phreatophyte areas which contain surface water, some of it will undoubtedly fall into the water. Since it is very miscible with water, it can exert an oxygen demand throughout the water column.

Moore (1942) using seven species of fish, concluded that an oxygen content of less than 3.5 ppm was essential to the maintenance of fish life at summer temperatures. Doudoroff (1970) indicated that any reduction in the concentration of dissolved oxygen places some stress on fish. In the desert southwest, high summer temperatures coupled with vigorous respiration of aquatic vegetation at night often creates critically low dissolved oxygen problems for aquatic life (Deacon and Minckley 1973). The additional 24 hr. oxygen demand created by Folicote would further stress the system. Field experiments should be conducted to clarify the total effect on the aquatic habitat under normal application rates.

The data in this paper regarding the oxygen demand properties of Folicote should be taken under consideration along with field application rates. Dilution factors should also be estimated prior to application. Factors such as algal blooms, natural night-time D.O. levels and critical biological areas for fish, i.e., spawning or nursery grounds, where accumulation of the chemical may occur, should also be taken into consideration prior to actual field application of Folicote.

Further investigation into the identity of the oxygen consumptive agent in the chemical as well as its biological half-life may be necessary if the dilution factor in actual spraying conditions approximate those in this experiment.

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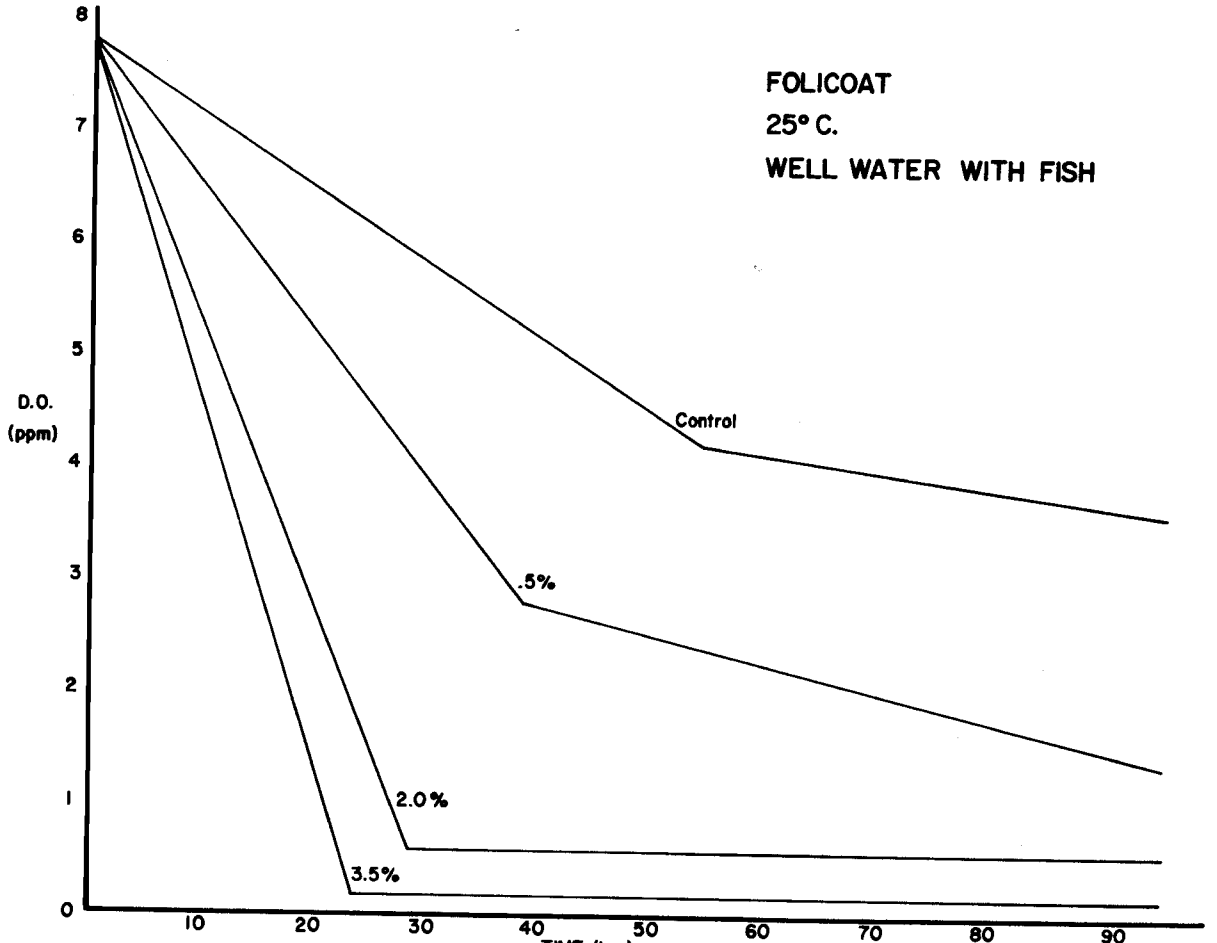

Figure 1. Deoxygenation of water containing fish by Folicote.

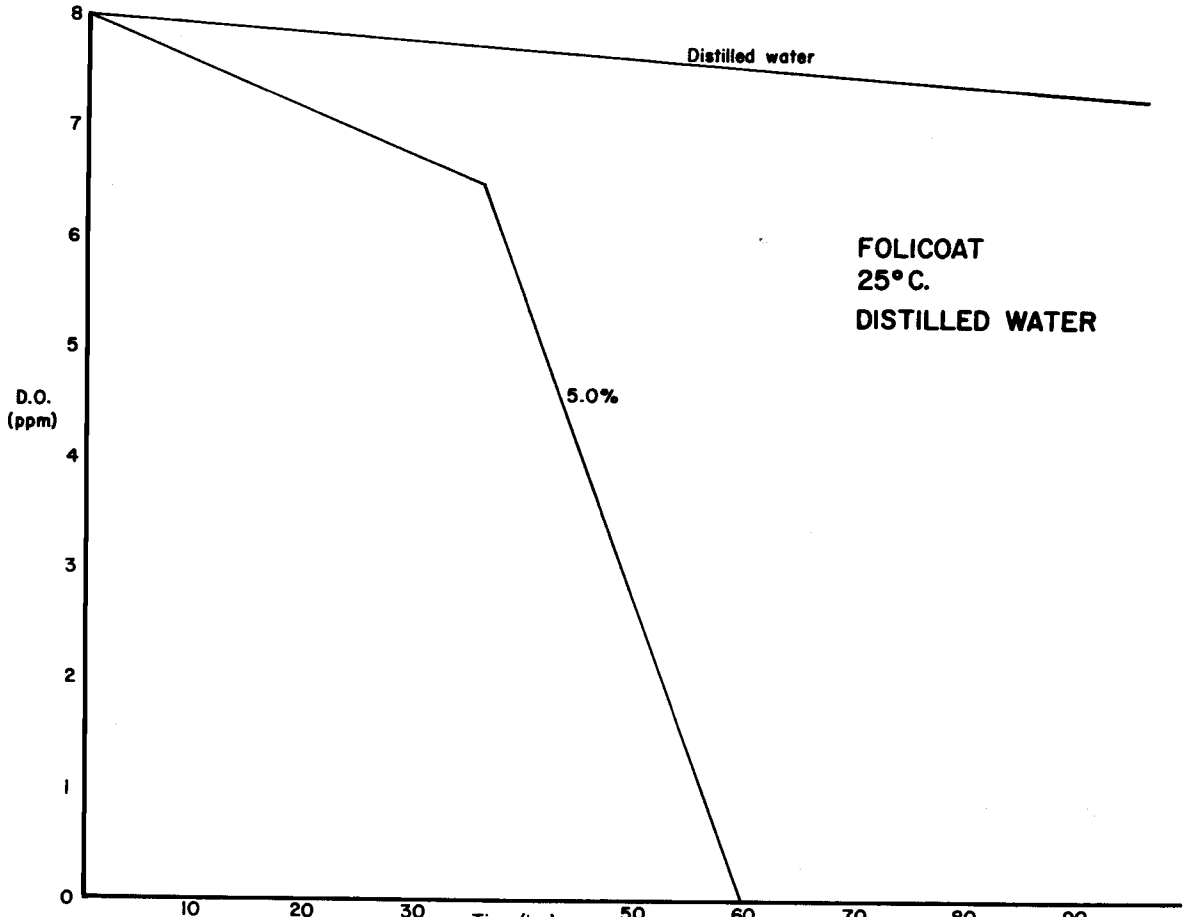

Figure 2. Deoxygenation of distilled water by Folicote.