

PRELIMINARY REPORT ON THE USE OF POTASSIUM PERMANGANATE TO PRODUCE OXYGEN AND COUNTERACT HYDROGEN SULFIDE GAS IN FISH PONDS¹

By WILLIAM P. MATHIS, LEE E. BRADY AND WILLIAM J. GILBREATH
Arkansas Game and Fish Commission

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ABSTRACT

Potassium permanganate is dissolved in fish hatchery ponds and minnow hatchery ponds at the rate of from two to six parts per million to produce oxygen during acute oxygen shortage caused by excessive organic decay and to counteract hydrogen sulfide gas during seining operations. Potassium permanganate treatments are also used as prophylactic measures to prevent expected oxygen depletion. Empirical evidence indicates the efficaciousness of these treatments. A specially designated boat for the application of the chemical to the water was developed.

INTRODUCTION

The literature is full of references on the use of potassium permanganate for hatchery sanitation and disease and parasite treatments. In recent years potassium permanganate has come into general use for oxidizing rotenone during fish population samples in public waters and in fish ponds (Lawrence, 1955).

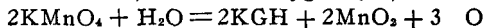
At the suggestion of Mr. George Scruggs, Fishery Biologist, United States Fish and Wildlife Service, potassium permanganate (to produce oxygen) was first applied to hatchery ponds at the Joe Hogan State Fish Hatchery, Lonoke, Arkansas, during the summer of 1958. Results were spectacular in that fish suffering at the surface due to acute oxygen depletion, in many cases, could be "put down" in a period of ten or fifteen minutes. Further investigations on the use of potassium permanganate by a survey of the literature² indicated that potassium permanganate would also counteract hydrogen sulfide gas. It is believed that hydrogen sulfide gas is often a problem during seining operations in drawn down ponds during warm weather.

Empirical evidence obtained on the use of potassium permanganate, during seining operations in drawn down ponds in warm weather, indicate that it does counteract "toxic substances" that are stirred up from the bottom muds.

The use of potassium permanganate for producing oxygen in oxygen deficient ponds quickly spread to the other State Fish Hatcheries and several of the larger commercial minnow and food fish hatcheries. The practice is in common use in Arkansas today.

DISCUSSION

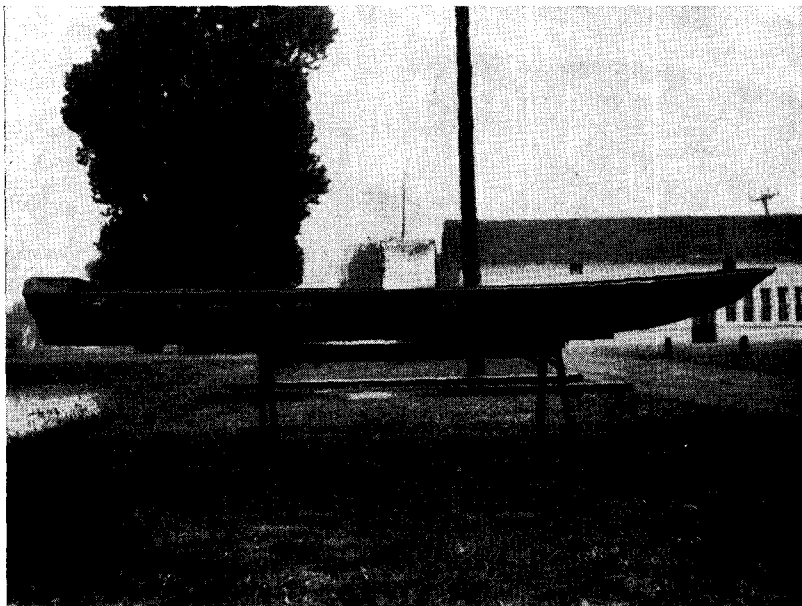
At the Centerton State Fish Hatchery, Centerton, Arkansas, potassium permanganate treatments are commonly used as a prophylactic measure to prevent or "head off" expected oxygen depletions.³ In this technique, the chemical is used as an oxidizing agent on the biological oxygen demand (B. O. D.) of the pond as an algacide. The molecular oxygen (O) which is released in the process has a greater affinity for the decomposing organic matter than does the free, dissolved oxygen (O₂):



¹ Paper presented at the 16th Annual Meeting of the Southeastern Association of Game and Fish Commissioners, Charleston, S. C.

² Carus Chemical Company, Inc., Bulletin No. 1. Properties and uses of Potassium Permanganate.

³ Bruce Crawford, 1962. Personal Communication.



Figs. 1a and 1b. Chemical Application Boat



The oxidation strength of potassium permanganate depends upon the following factors:

1. pH. The oxidation potential increases as the acidity increases or the pH is lowered. The pH of the Lonoke Hatchery ponds is high, *i. e.*, 8-10. In this alkaline water somewhat less than the full potential of the chemical is probably realized.
2. Concentration: The effective oxidation strength increases as the concentration of potassium permanganate increases. In a four acre pond at Lonoke, some 60,000 catfish had already died before the oxygen depletion was discovered, the remaining 150,000 catfish were suffering. Knowing that they would also die unless something was done speedily, 440 pounds of potassium permanganate (12 PPM) was quickly applied. No further losses occurred. Usually we try not to exceed 6 PPM, a sub-lethal dose under normal conditions.
3. Temperature: The rate of oxidation increases as the temperature increases. We have no control over the temperature in ponds, but most all of our trouble comes in the summer.
4. Agitation: The rate of oxidation increases and side reactions decrease as the agitation is increased. Therefore, the more agitation the better during prophylactic treatments. However, it has been our experience that a minimum of agitation is usually desirable during acute oxygen depletion. During extreme cases, it seems that the foul water from beneath the surface is brought to the top and the fish suffer even more than they did before agitation began. Therefore, experience is required in the proper use of the treatment. An airdrive outboard motor would be ideal for application with a minimum of agitation if enough speed could be obtained.

Since the conception of this idea, we have constantly improved our method of applying potassium permanganate to the ponds. From dragging a burlap bag of chemical behind the boat, we evolved the technique of dragging buckets with chemical in them through the water until the chemical dissolved.

All previously tried methods of application proving too slow, a special chemical application boat was developed (figure 1a and 1b). This boat is a modification of an ordinary flat bottomed "live-well" aluminum paddle boat. Large water scoops were installed on each side of the boat with three closable holes (for adjustment of water flow) leading into the live well. It was found that the live well would fill with water and overflow, therefore, the "live-well" enclosure was extended eleven inches above the top profile of the boat. Overflow slots were cut into the side of the boat near the top railing. The chemical is placed in the "live well" and due to the specific gravity of the potassium permanganate only dissolved chemical overflows through the slots with the water. For propulsion, our 5 horse power airdrive outboard motor would not make the boat go fast enough to "scoop" the water, so an ordinary 5½ h. p. outboard motor is used. With this boat we can apply 110 pounds of potassium permanganate in 15 minutes. This, when speed is so important, was a great innovation. We also apply other chemicals such as sodium arsenite, benzene hexachloride and copper sulfate with this boat.

LITERATURE CITED

- Carus Chemical Company. Bulletin No. 1. Properties and Uses of Potassium Permanganate.
- Lawrence, J. M., 1955. Preliminary Results on the use of Potassium Permanganate to Counteract the Effects of Rotenone on Fish. Proc. 9th Annual Conf. Southeast. Assoc., Game and Fish Comm., pp. 87-92.