# A Water Quality Problem in Lobster Holding Tanks



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The development of the offshore lobster fishery has led to widespread use of refrigeration to maintain desirable temperatures in holding tanks and this practice has done much to alleviate thermal shock with its attendant mortality. Nevertheless high mortalities have been experienced from mid-summer to early autumn in some shore holding facilities. This time coincides with both maximum surface water temperatures and a relatively high percentage of newly moulted lobsters in the catch.

Newly moulted lobsters are under greater stress than their heavily shelled counterparts and have a higher oxygen requirement. In investigating a case where excessive mortality was experienced in a refrigerated holding facility employing recirculation, water quality was implicated as a possible cause of high mortality.

When periods of heavy landing coincide with high seawater temperature (70 F) and air temperature (70-85 F), water is sometimes recirculated longer than desirable in order to maintain a low temperature in the system. This practice may

in part be due to a lack of understanding of water quality requirements, inadequate refrigeration, or both. The particular operation studied had a high level of shipments which resulted in an increased work load for the attendants and they tended to neglect tank monitoring. As a result weak and dead lobsters remained in some tanks for excessive periods. Unfortunately assistance was requested only after a very large number of lobsters were lost and the water discharged from the system, so it was not possible to carry out a water analysis. Personnel interviewed reported the water had been in use for approximately ten days.

In this facility, the lobsters were placed in a total of 24 glass reinforced plastic tanks averaging 5 feet x 10 feet x 1.5 feet with the tanks stacked three high in a stepped arrangement. Water was introduced to the top tank from an overhead distribution line and successively cascaded downward and discharged from the bottom tank to a collection sump. Water samples were taken from all three tanks in a number of stacks and analyzed for ammonia five hours after the introduction of fresh seawater. The average ammonia concentration was observed in water after passing from the top tank to the bottom tank in a stack.*

Samples taken the following morning averaged 3.7 ppm ammonia and samples taken from the same tanks six hours later averaged 4.8 ppm. Oxygen levels were determined at the second sampling and averaged 6.0 ppm. Water samples taken 42 hours later ranged from 9.2 to 14 ppm ammonia. Thus, the initially observed increase in ammonia of 1.1 ppm in six hours closely approximates that for the longer period, namely almost 4 ppm/24 hours. Quite obviously the lack of specific loading values (pounds of lobsters in the system) greatly limits the value of the determinations. The volume of water in the system was calculated, and approximated 64,400 liters Thus, the daily production of ammonia during this period averaged 258 grams.

Specific information is lacking on the toxicity of ammonia for lobsters. However, it is probably safe to assume

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*Ammonia determinations in this study were made using an Orion specific ion electrode and an Orion Model 407 specific ion meter. Although instrumental techniques provide for high accuracy and ease of determination, the ammonia concentration can be sound with simple, inexpensive equipment. Test kits suitable for determining dissolved oxygen, ammonia and other metabolites are available from Hach Chemical Company, P.O. Box 907 FF, Ames, Iowa 50010 and many other chemical supply companies.*

that concentrations greater than 10 ppm may be unsafe. If we assume that lobster loading during the period of highest mortality was equivalent to or greater than that during the period observed, ammonia levels of 40 ppm or higher were reached at the time the water was discharged from the system.

At an average lobster loading the water from the system would have had to be discharged every 2 to 2.5 days to keep the ammonia level below 10 ppm. This posed a problem in that the refrigeration capacity was limited to 25 tons, and from 24 to 30 hours were required to bring a fresh change of seawater down to 42°F, the desired holding temperature. The apparent solution to the problem was the installation of additional refrigeration tonnage and, possibly, insulation of the holding tanks.

An alternative was to encourage the development of marine nitrifying micro-organisms that would convert the toxic ammonia to less toxic nitrate. In an attempt to determine the feasibility of the alternate approach, ten preformed PVC modules measuring 2 feet x 2 feet x 4 feet and providing 27 square feet of surface area per cubic foot with 97 percent void space were made available by the Agricultural Experiment Station at the University of Rhode Island. These modules providing 4,320 square feet of total surface area were placed in the water sump where they were submerged. The high void space provided for minimum restriction of flow, and no hydraulic problems were encountered. Although the desired water temperature for holding lobsters (42°F) is suboptimal for nitrification, the rate of ammonia accumulation in the system was observed to be slower than it was prior to the installation of the filter elements. Water samples taken 48 hours after a change of water averaged 3.5 ppm of ammonia. After 96 hours, the ammonia concentration averaged 3.8 ppm and after 10 days, 7.5 ppm. A subsequent set of samples taken after water had been in the system for one week averaged 6.5 ppm of ammonia.

The results of this investigation suggest that water quality should be routinely monitored in lobster holding facilities if mortality is to be minimized during periods of high stress. Ammonia concentrations higher than 10 ppm may be detrimental. Research to establish the relationship among temperature, salinity, dissolved oxygen and ammonia concentration is desperately needed if future high mortalities are to be avoided in lobster holding facilities. Biological filtration offers a possibility for increasing the length of time that water can be safely recirculated. Little is known about the toxicity of nitrite and nitrate for lobsters in marine systems. Research in this area is also needed.

*See Meade, T. L., 1969. Factors Involved in the Storage and Transport of the American Lobster, Publication 3, New England Marine Resources Information Program, University of Rhode Island, Narragansett, Rhode Island 02882. Additional copies of Marine Memorandum 31 also may be obtained from the same address. Kingston 1973.*