# Removal of Radon Gas Liberated by Aeration Columns in Fish Hatcheries

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The high levels of radon gas measured in hatchery buildings is in some cases due to the water

flowing through the aeration columns. By developing new and more effective methods to degas and aerate water, we have created a new, but not insurmountable, problem. Radon gas, a radioactive by product of uranium decay, is found naturally in the ground water in some areas of the country. Aeration of this water can cause some of it to be released into the atmosphere. Exposure to radon gas at sufficient concentrations is a health concern. As it decays other solid radioactive particles are formed which may lodge in the lungs. Bombardment of lung tissue by the alpha radiation from the solid particles can increase the risk of lung cancer (Henschel 1988).

A traditional method to lower radon gas concentrations in the atmosphere has been by ventilation (Henschel 1988). Diluting high gas levels is very effective, however, may not be the most energy efficient method in some climates since large volumes of outside air are needed and heated inside air is lost. A more energy efficient method is to collect the radon gas given off in the aeration process and vent it to the outside. This requires less air exchange to get rid of the radon gas and waste less heat energy.

The purpose of this note is to report a simple inexpensive method used to address a radon problem at Ennis NFH. Radon levels in their hatchery building were measured at 200 to 250 picocuries of radon per L of air (pCi/L). EPA guidelines currently suggest remedial action when radon levels exceed 4 pCi/L ((Henschel 1988)). On November 6, 1990 I traveled to Ennis NFH to discuss installing devices to collect the off gas from the open packed columns used in the hatchery building. The columns are used to decrease nitrogen gas supersaturation and to increase the oxygen content of the fish rearing water, there are 38 tanks with columns in the building so a large amount of off gas is generated when all are in operation.

Correctly operating packed columns act like a pump. Large quantities of air is drawn through them so there is a large amount of air water interface (Figure 1). This is why there is a gas exchange. If the DO in the water is below equilibrium with the atmosphere, oxygen is absorbed; in water supersaturated with dissolved nitrogen, nitrogen gas is given off. This is also true for other gases to include radon (Dixon et al. 1991). By installing a collector on the bottom of the column all released gases are collected (Figure 2).

An off-gas collector prototype was installed in one of the tanks at Ennis NFH to demonstrate that it would be possible to trap the column off gas and to vent it to the outside. The base of the column was fitted through an inverted 14 by 18 inch tub to capture the escaping gas from the bottom of the column. The tub was sealed around the column and extended 3-4 inches below the

tank water level in order to prevent gas from escaping to the atmosphere within the building. A vent pipe was placed in the collector and the column was operated at normal flows. The radon monitor was used to measure the radon content of the off gas from the vent. The average reading after 24 hours was 428 pCi/L, demonstrating that a significant amount of radon was being liberated from the water flowing through the column.

Since then off-gas collectors have been placed on all of the columns in the building and vented outside. A 1-inch plastic pipe fitting was installed into each collector. The gas was vented through the 1-inch pipe to a 2-inch pipe which was extended through the wall to the outside of the building. Four, 8-inch columns operated with flows of 60 gallons per minute were vented through one 2-inch pipe without creating back pressure.

Thirty-eight columns were retrofitted with off gas collectors at a cost of $600. After installation of the collectors at Ennis National Fish Hatchery radon gas levels have decreased from 250 pCi/L to 25-40 pCi/L. This is a simple relatively inexpensive method to reduce the magnitude of a dangerous health problem.

## References

Dixon, K. L., R. G. Lee, J. Smith, and P. Zielinski. 1991. Evaluating Aeration Technology for Radon Removal. Journal of American Water Workers Association. April, 141-148.

Henschel, D. B. 1988. Radon Reduction Techniques for Detached Houses, Technical guidance (Second Edition). EPA/625/5-87/019, Revised 1988. Air and Energy Engineering Research Laboratory, U.S. EPA, Research Triangle Park, North Carolina 27711.

## Caption to Figures

Figure 1. Diagram of a packed column during normal operation. Air is drawn into the top of the

column and the off-gas is liberated at the bottom.

Figure 2. Diagram of a packed column with an off-gas collector installed. Air is drawn into the top of the column and the off-gas os collected and vented.

# COLUMN WITH OFF GAS COLLECTOR