Progress Report Series No. 90 November, 1968

Agricultural Experiment Station
AUBURN UNIVERSITY

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AIR FLOW THROUGH POROUS CURTAIN WALL MATERIALS

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THE USE OF POROUS wall-covering material on the sidewalls of poultry houses is increasing.

Such material, used as an intake device, supposedly provides low-velocity incoming ventilation air over a wide area, creating a so-called breathing wall. Materials used range from burlap to tightly woven plastic. These are often accepted by the poultry producer as satisfactory methods of supplying ventilation without drafts from high-velocity air currents. The poultry producer attempts to control the air flow through such material and the air exchange through the animal shelter by fan ventilation. Fans located in the sidewalls or ceiling are usually designed to exhaust air from inside the building, causing fresh air to flow through the porous wall material. Fans are controlled by thermostats, humidistats, or time clocks. These devices supposedly regulate the rate of air exchange and provide the necessary control for one or more environmental parameters.

A study was begun at the Auburn University Agricultural Experiment Station to determine air-flow characteristics of various porous wall materials and to investigate, under actual field conditions, the utilization of such materials. In theory, air flow through porous wall materials is dependent upon the difference in pressure across the material. As the difference in pressure increases, the rate of air flow increases. The air flow is from the area of high pressure to the area of low pressure.

A pressure difference can be created with a fan, which can be arranged either to increase or decrease the pressure in the building relative to the prevailing atmospheric pressure. The pressure differential and consequent air flow through the porous wall material can be regulated by using variable-speed fans or several individually controlled fans.

Pressure differences on a side wall can also be created by natural air movement. The force of wind against the sidewall of a building creates a positive pressure on the outside surface and causes air to flow into the structure. This same wind causes a negative pressure on the opposite side of the building, causing air to flow out of the building through that sidewall. When a wind hits a wall at an angle of less than 90° with the wall, varying patterns of air pressure develop along the length of the building. These cause uneven flow patterns into and out of the building, depending on the wind direction and length of building walls. In all cases, the actual pressure developed is dependent upon the wind direction and velocity. The higher the wind, the greater the pressure differential.

Various porous wall materials were tested in the mass air-flow device *(1,2,3)* of the Station. Air flow through square samples, measuring 3 feet on each side, were tested. Air flow through the different porous wall materials was measured in cubic feet per minute per square foot of wall material. These measurements were made at pressure differentials ranging up to 2 inches of water.

Materials tested were various types of wire screening, burlap, woven plastic, and perforated hardboard. The materials fell into 3 distinct generalized patterns. The various metalic screening materials were the least restrictive and provided little difference in pressure, less than 5/100 inch of water, at air flow rates

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of 700 cubic feet per minute per square foot of material surface. The burlap materials were intermediate in restricting air flow, while the perforated hardboard and woven plastic materials were most restrictive, Figure 1.

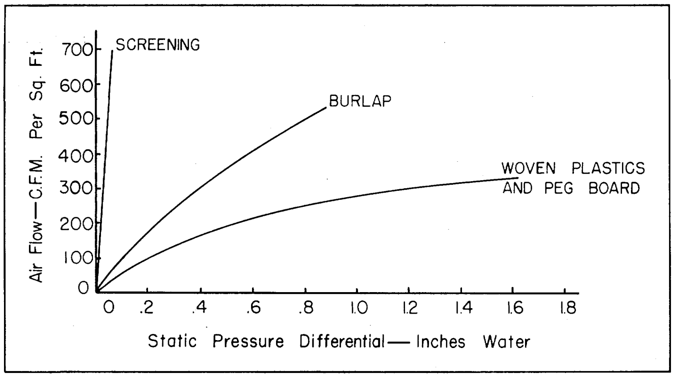

FIG. 1. Air flow through porous materials.

Three woven plastics, each with a different trade name, were tested. Results are shown in Figure 2. No significant difference was noted within the pressure range tested. The three materials reacted similarly to static pressure ranging up to 1.6 inches of water.

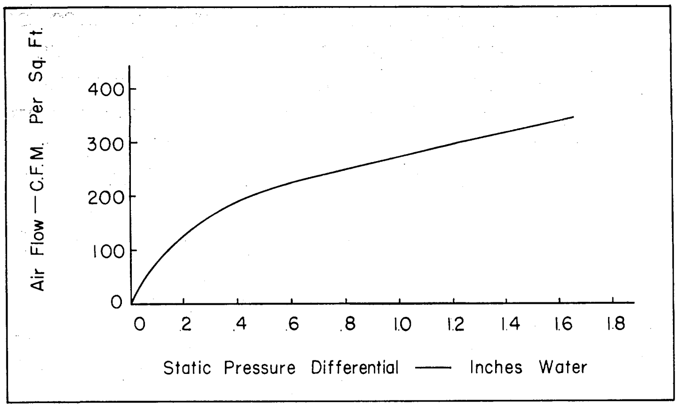

FIG. 2. Air flow through woven plastic materials.

Metallic materials tested were ⅛- to 1-inch hardware cloth, 1- to 2-inch poultry wire, and aluminum and galvanized screening. Results are shown in Figure 3. Aluminum screening, the wire mesh with the greatest projected surface, restricted air flow the most. The material with the least projected surface, 2-inch poultry mesh, restricted air flow the least.

Both ⅛- and ¼-inch perforated hardboard were tested in single sheets and double sheets separated by a 1-inch air space, Figure 4. The ⅛-inch peg board was perforated with one ⅛-inch diameter hole per square inch of board surface. The ¼-inch peg board sheet was perforated with one ¼-inch hole per square inch. The ⅛-inch perforated board offered less resistance per unit rate of air flow than did the ¼-inch board.

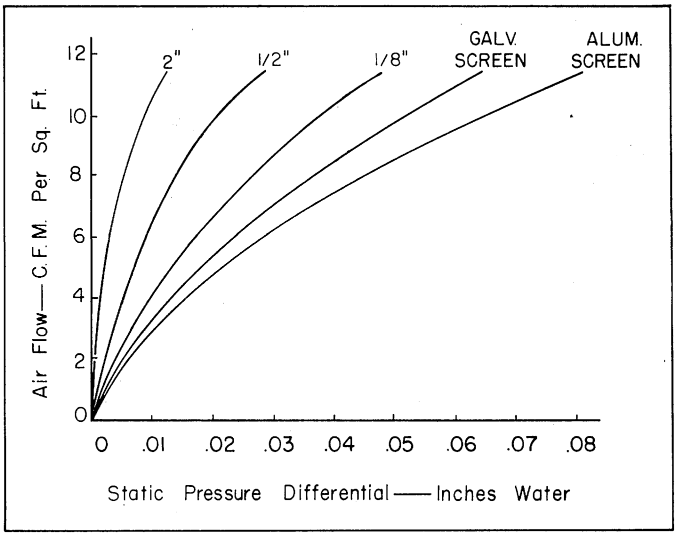

FIG. 3. Air flow through metallic screening materials in hundreds of C.F.M.

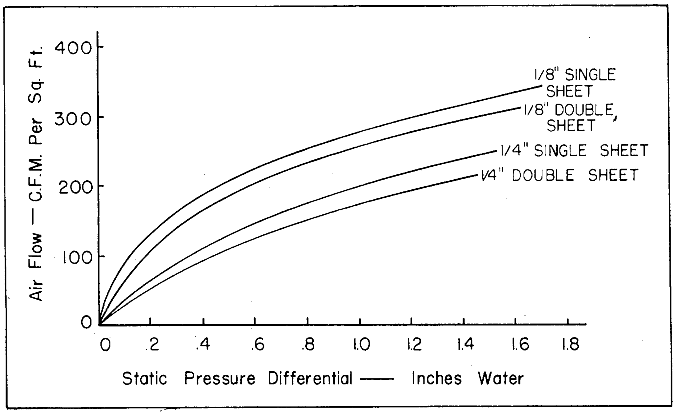

FIG. 4. Air flow through single and double thickness peg board. Double sheets separated 1 in. with holes in line.

Static pressure per unit air flow rate was determined also with the 1-inch air space between the two sheets filled with 1-inch thick fiberglass batt. Little difference was noted in the static pressure at the same rate of air flow, Figure 5.

These tests all used new, clean, porous material. Tests conducted with material exposed to dusty and dirty conditions showed a considerable decrease in air flow. This air flow decrease was a result of plugging of holes in the material.

Analysis of these data presents definite possibilities when applied to specific practical design problems. In the case of a hypothetical laying house 40 feet wide with a bird density of 2 square feet per bird, an arbitrary ventilation rate of 2 c.f.m. per bird would only require a 6½-inch wide strip of woven plastic or perforated board if a pressure differential of ⅛-inch static pressure were maintained across both faces of the material. If the static pressure were increased to ¼ inch of water, only a 4-inch strip of woven plastic or perforated hardboard would be required.

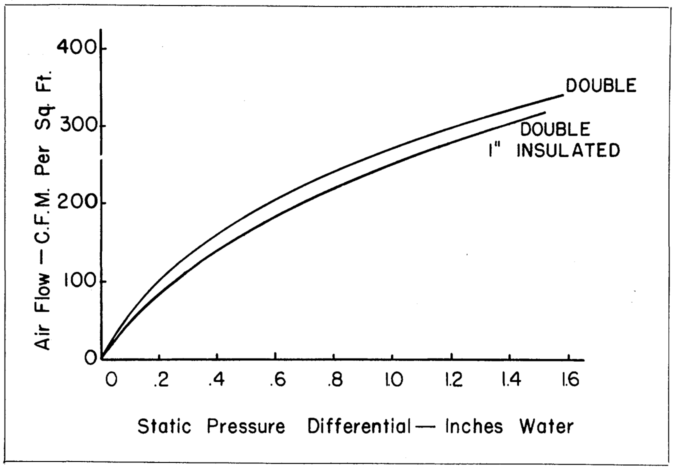

FIG. 5. Air flow through double sheets of ⅛-in. peg board. Insulation 1 in. thick used between sheets in one test and no insulation used in other.

In the case of a typical broiler house with a bird density of ¾ square foot per bird, an arbitrary ventilation rate of 1 c.f.m. per bird would require only an 8½-inch wide strip of woven plastic if the fan system provided a differential static pressure of ⅛ inch of water. If the static pressure were increased to ¼ inch of water, the width of the continuous porous strip could be reduced to 5 inches.

These arbitrary ventilation designs may be of interest because the continuous strip of porous material on a typical commercial house is at least 36 inches wide. This information is presented as a possible application of porous wall material. The design might be a tight building lined with a porous wall material and with a wall cavity to serve as an air duct system. This system would be of significance for reasons other than utilizing porous materials for the wall and ceiling surfaces. It would allow ventilation without concentrated air streams and accompanying cold areas. The air would be heated as it passed through the wall and ceiling cavities. Heat loss from the structure would be at a minimum because incoming air would return most of the radiated heat to the living area.

Porous wall materials have an important place in the construction and ventilation of animal structures, especially where there is a need for continuous ventilation. Although these porous materials are widely accepted in the poultry industry, these research findings indicate the large surface areas now being used must be questioned. Further study is to be conducted in the use of these materials.

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