Poultry Housing Cooling

*by W. T. Welchert, P.E. and Frank Wiersma, P.E.**

For most of the year, climatic conditions in southern Arizona are ideal for poultry production. However, during about 100 days, peak temperatures may reach 100F or more. Relative humidity is normally below 30% and day to night temperature differential usually exceeds 30F. Wind velocities average less than 6 mph. During the summer, reduction in high temperatures is necessary to maintain optimum production. The existing ambient conditions make evaporative cooling a suitable means of environmental control.

Field tests from 1964 to 1967 in cooperation with southern Arizona producers demonstrated the economic feasibility of evaporative cooling for poultry production. Significant improvements in feed efficiency, egg production, egg size distribution, and other quality indices were documented. In addition, evaporatively cooled environments offer better control of flies and of pollutants, such as odor, dust, feathers and noise.

Poultry house systems in Arizona are of four types and are referred to as: (1) conventional, (2) package cooled, (3) tower and plenum, and (4) pad and fan. The latter two may have either vertical or horizontal pad arrangements. There are other variations, but this discussion is confined to the prevailing characteristics of each type.

Conventional House. This structure is simply a solid shade with lath side walls. High temperatures are moderated by fog nozzles located above the cage rows. The foggers are set to operate about 1.5 minutes during each 15-minute period when temperatures exceed 90F. Extreme temperatures are moderated only slightly in conventional houses, and environmental control is inadequate both in summer and winter.

Package Cooled. The package cooler is a manufactured unit commonly used for home cooling in the Southwest. When applied to poultry housing, package coolers are normally mounted on the ridge line (Figure 1). Evaporatively cooled air is supplied to the building at a positive pressure. Total pressure differential is about 0.1 inch water gauge (W. G.). Continuous cavity wall outlets on both sides of the building are sized to permit an exit velocity of 600 feet per minute (about .04" W.G.) at maximum air flow. The cooler supply duct is usually equipped with a diffuser plate to improve air distribution and a back draft shutter to prevent escape of air during periods of low ventilation requirements when only a few coolers are operating. Variable ventilation rates are provided by two speed motors and/or thermostat and time clock switching combinations. Air flow distribution patterns are reasonably uniform at the maximum ventilation rate. To minimize wind effects, an adjustable slot outlet is desirable for the lower ventilation rates but can hardly be justified for the low wind conditions that prevail in Arizona.

The greatest disadvantage of this system is the high maintenance requirement of the coolers. The water distribution system must be checked daily to assure complete pad wetting. The cooler pads need to be rinsed weekly with a hose to remove accumulated dusts. Fan belts should be checked monthly. Performing these tasks on top of a hot roof is an undesirable chore. Some poultrymen have replaced the individual water circulation pumps with a central pump and reservoir to reduce the frequency of pump failure and improve service access.

Tower and Plenum. The tower cooler (Figure 2) is simply a large custom-designed version of the package evaporative cooler. Because the large volume of air flow is generated at a central location, the air must be distributed through a plenum or duct system. The exhaust is controlled through continuous cavity wall outlets or through exhaust chimneys. The system pressure differential is .25 to .50 inches W.G., requiring fans with good performance characteristics in this higher range. The distribution of cool air flow is usually excellent and, when the plenum is properly slotted, distribution is reasonably uniform even at the lower ventilation rates. This system is particularly well adapted to the deep pit laying house.

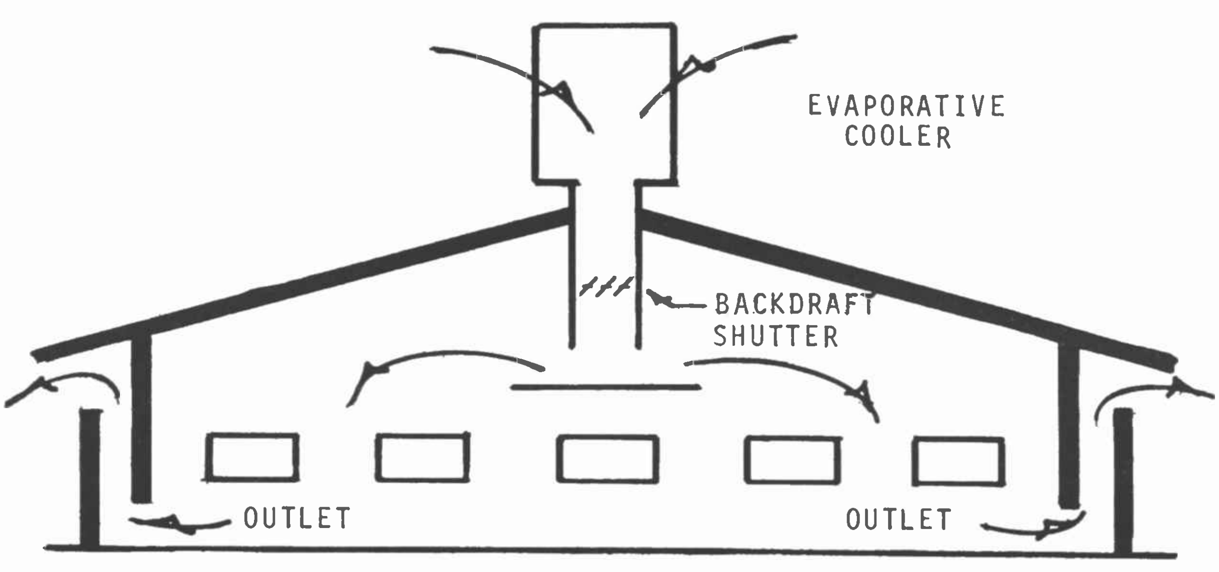

Figure 1. Package Cooled - Cavity Wall System

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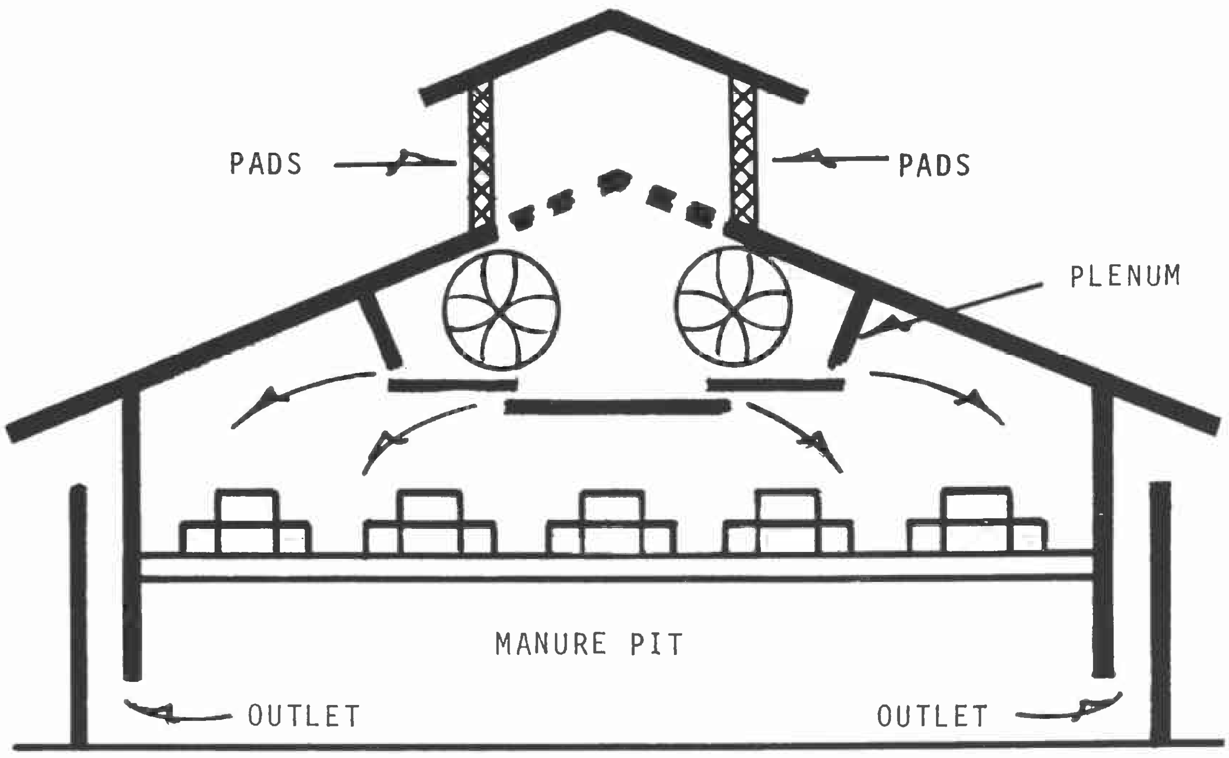

Figure 2 Schematic Tower and Plenum System with Deep Pit

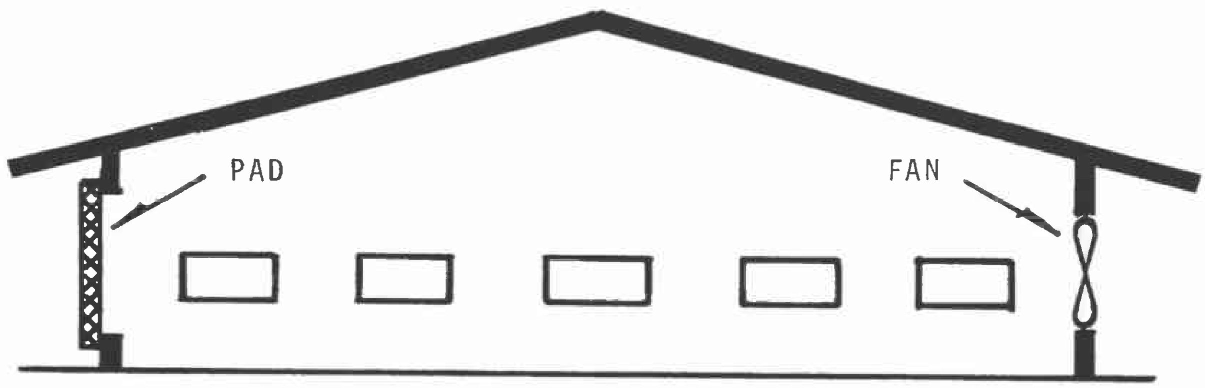

Figure 3 Schematic Pad and Fan System

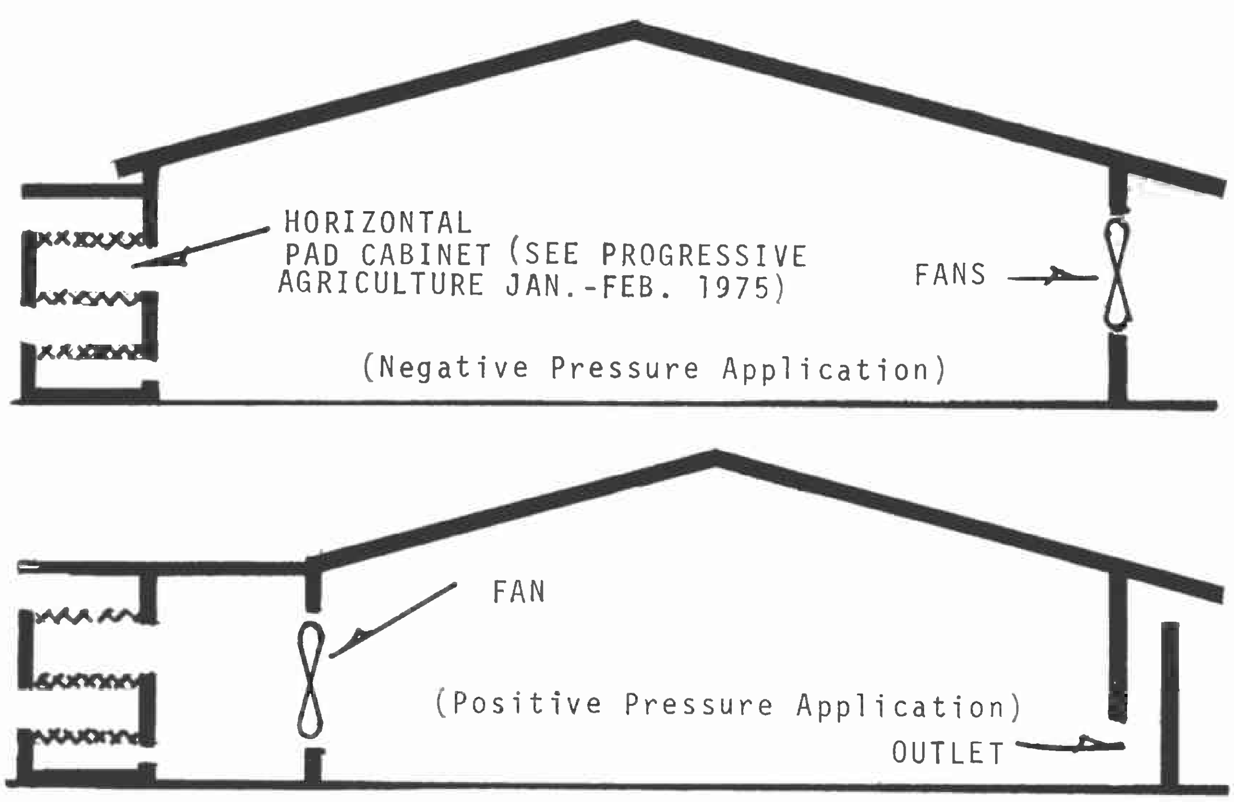

Figure 4. Schematic Horizontal Pad Cabinet Applications.

The plenum system is expensive and requires care in design. The maintenance procedure is about the same as for package cooler, but because it is a single large unit, the time required is reduced.

Pad and Fan. In the pad and fan system, fans are mounted at one end or side of the building to draw air through a wet pad located on another well (Figure 3). This system is economical to build, maintain and operrate. The exhaust system normally operates at negative static pressures of .03 to .08 inches W.G. Variation in ventilation rates is provided by using a number of fans controlled by a thermostat or time clock.

In the pad and fan system, cool air sinks to the floor, making it especially suitable for floor flock management. However, the air flow pattern is influenced by relatively low outdoor wind velocities. Adjustable pad covers can be used to improve ventilation control. Locating the evaporative cooling pad on the side of the building facing the prevailing wind will also help maintain adequate ventilation.

The power requirements for the pad fan system are only about $\frac{1}{3}$ to $\frac{1}{2}$ that of a tower and plenum system. Maintenance procedure and requirements are about the same as for tower and plenum.

Horizonal Pad System. The horizontal pad system (Figure 4) is an important improvement over vertical pad systems for both positive and negative pressure systems. Field observations comparing vertical pad applications to single, three-level and five-level horizontal pad applications indicate that dust accumulation in the horizontal pad is greatly reduced, pad life is substantially prolonged, maintenance is simplified, initial pad cost is reduced, and light control and wall closing systems are simplified.

Disadvantages observed are that the low volume nozzles require better filtration of water than drip pipes and multi-level systems may require additional baffling on the downwind side of the pad cabinet to prevent the pick-up of free water in the air above those pads through which the air flows upward.

System Design Recommendations

Air Exchange Specifications. For all systems, the air flow rate should be based on total volume of the building and provide one complete air exchange per minute at the following static pressure differential ranges.

Pad and Fan	.05 to .10" W.G.
Package Cooled	.10 to .125" W.G.
Tower and Plenum	.25 to .375" W.G.

Ventilation. Windowless houses (Figures 1, 2, 3, and 4) require continuous ventilation even during the coldest weather to provide oxygen, remove moisture and reduce odors. A minimum continuous ventilation rate of one CFM per bird is needed. This rate is about 1/6 the recommended air flow for evaporative cooling.

Insulation. No special insulation is recommended for the walls, but a maximum roof insulation resistance value of eight (R = 8) is recommended.

Evap-Pad Cabinet. For a detailed description of horizontal pad cabinet design procedures see plan A-186, Progressive Agriculture, January-February 1975.

Standby Emergency Power

The confinement of poultry in windowless shelters with mechanically controlled environments involves considerable financial risk in the event of a power or equipment failure. On a hot summer day, birds will start dying after about two hours following a power failure. An adequate alarm system to indicate failure of ventilation equipment and an automatic standby electric generator are highly recommended.

There are many types of alarm systems for detecting failure of the ventilation system ranging from inexpensive 'power off' alarms to more extensive systems for sensing interruption of air flow, temperature extreme and certain gases. Automatic telephone dialing systems are also available for alerting personnel at distant locations.

Power sufficient to operate at least half the lights and fans plus the feed and water supply system should be available on a standby basis. Both stationary engine and tractor driven generators are available. At least 2 kilowatts (kw) of standby generating capacity should be provided for each horsepower essential for emergency operation. A tractor should be capable of developing two horsepower for each kw of generating capacity required. Stationary units should be operated for a few minutes every two weeks to assure its immediate availability in an emergency.

Increasing the Leaf Area of Alfalfa

*by M. A. Brick, A. K. Dobrenz and M. H. Schonhorst**

Leafiness of alfalfa is an important factor for quality and maximum light interception. Alfalfa plants which have leaves with more than the normal three leaflet complement have been called multifoliolate by Bingham (1964). The size, shape and number of leaflets comprising one leaf vary considerable on a single multifoliolate plant. Leaves which display the variation in the multifoliolate characteristic are shown in Figure 1.

New alfalfa varieties have increased yield due in part to protection of the crop from insect and disease damage. Other factors which have contributed to the increased yields of alfalfa include improved management practices such as high fertility and appropriate harvest intervals (Thompson and Schonhorst, 1971).

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Variation in leaf morphology has received comparatively little attention among researchers despite the importance of the leaf in photosynthesis and nutritive value of the plant. It is important for alfalfa breeders to seek new ways to more fully utilize the potential of alfalfa. Leaf area and canopy design present a potential mechanism whereby the plant breeder can improve body yield and quality of alfalfa.

This study was designed to determine if the multifoliolate characteristic could be transmitted and expressed in the progeny of a cross between a normal Mesa-Sirsa and multifoliolate plants. Other objectives were to evaluate the effect this trait had on leaflet-to-stem-petiole ratio, internode length, and specific leaf weight (SLW-mg leaflet dry wt/cm[2] leaf area).

Four multifoliolate plants were selected from the progeny of a cross be-