# Keep your eggs cool

By Ron Meijerhof

For optimal incubation results, it is important that the heat production of the embryo is in balance with the heat loss of the eggs, resulting in a constant temperature of the egg shell of approximately 100-100.5oF. As the heat production of the embryos increases dramatically over the period of incubation, for optimal results the heat loss needs to increase as well.

In a practical situation we have a number of methods that we can use to increase heat loss. First of all we can decrease the temperature of the air towards the end of incubation, as a lower temperature of the air will increase the rate at which the eggs will lose heat. Of course this is only possible with single stage machines, as in multi-stage machines all stadia of egg setting are in the same machine.

But not only temperature influences heat loss, also evaporation of water and air velocity do. If we bring water in the air, this water needs to be evaporated, which costs a lot of energy, 2.26 kJ for each gram. This evaporative cooling effect can be used to support the cooling system of the machine, although it is difficult to distribute this cooling evenly throughout the machine. That is why with the increased cooling capacity in modern single stage machines, we try to avoid the spraying in the machine as much as possible, to get a more uniform temperature distribution. In some multi stage machines (tunnel types) the evaporation is used specifically to cool the older eggs in the machine, but in most multi stage machines it is difficult to use the cooling effect of evaporation exactly for these eggs that need it most, the eggs in the later stages of incubation.

Air velocity has also an influence on the heat loss of the eggs, as it increases the rate at which heat is transferred between two bodies with different temperature. So if air and egg are at the same temperature, a difference in air velocity will not have an effect. But as soon as there is a difference in temperature between air and egg shell, an increase in air velocity will increase the heat transfer, and the resulting difference in temperature will be less.

This means that in the second half of incubation, when the embryo starts to produce significant amounts of heat, a high air velocity will decrease the difference between air temperature and egg shell temperature, and therefore stimulates the cooling effect. But also at the start of incubation or at the pre-warming phase, when the eggs are not yet on temperature, an increase in air velocity will increase the speed at which eggs are warmed up.

As air velocity has an influence on the warming and cooling of the eggs, it is obvious that we should try to get air velocity over all the eggs in the machine as uniform as possible. When there is a difference, preferably the warming eggs and the eggs in the later stages of development experience the highest air velocity. When we look into a machine, it is obvious that this is not always easy to achieve. As air takes the way of the least resistance, a block of eggs in a trolley in a turned position will not easily let the air pass over the eggs, especially not when the eggs are bigger and the space between the trays is limited.

In single stage machines we should try to get the bigger eggs (older breeder flocks) in as much air velocity as possible, so close to the ventilator. In some multi stage machine we can move these eggs

at the later stages of incubation closer to the ventilator, but this is a lot of labor, and in many types of machines it is not possible.

Another way of increasing the air flow over the eggs and therefore removing more heat is leveling the trays to a horizontal position at the end of incubation, thus creating more openings between the trays. This doesn't work for all machines, as in some situations the air passes as a layer over the eggs and doesn't circulate over the surface of the eggs. Also some machines do not allow to stop turning before 18 days or allow to stop turning part of the eggs in a multi stage situation. However, if it is possible, stopping to turn earlier than 18 days can sometimes help to increase the air flow over the eggs and therefore control egg shell temperatures better.

Although many people believe that turning is necessary until 18 days, in reality it can be stopped after day 12-13. The embryo doesn't need turning in the second half of incubation anymore, but will benefit from an increase in air velocity and therefore an increase in cooling.