Cooling capacity is crucial for ventilation and humidity

By Ron Meijerhof

Sufficient moisture loss is important in incubation. Loss of moisture creates the air cell, and the size of the air cell is important for the embryo. During internal pipping, the embryos need to get enough air from the air cell to fill their lungs and get the energy to open the egg and escape from the egg shell. At the same time, too much moisture loss creates a too dry environment, which creates dehydration and makes it difficult for the embryo to hatch. The optimum moisture loss during the total incubation period is known to be approximately 12 to 14% on average, although individual eggs can differentiate substantially from this optimum.

The factor that drives moisture loss is relative humidity. The inside of the egg consists of basically 100% water, and because the outside of the egg is not fully saturated with water, the water vapor will be forced through the barrier of the eggs shell and leave the egg. To be more precise, moisture loss is caused by what is called the water vapor pressure deficit over the egg shell, so the difference in water vapor pressure inside and outside of the egg. Water vapor pressure is the result of temperature and humidity, and as the temperature of the egg and the air is almost identical and the humidity in the egg is practically 100%, the difference will indeed be caused by the relative humidity of the air. However, the control of relative humidity is related with the cooling capacity of the machine.

Older machines often have limited cooling capacity. To remove the heat produced by the eggs, these machines need to ventilate more than is strictly necessary for the exchange of oxygen and carbon dioxide. With this extra ventilation, also more water is removed from the machines, which means the sprayers have to come in to keep the relative humidity at level. This extra spraying functions as an extra cooling effect, which contributes to the temperature control in the machines.

Modern (single stage) machines usually have much more cooling capacity. As in these machines no extra ventilation for cooling is needed, the humidity in the machine comes mainly from the moisture that the eggs are losing, and the sprayers come in less often. As spraying gives a very local cooling effect, less spraying helps to keep a more uniform egg temperature throughout the machine, with a positive effect on hatch results. Therefore, we try to use the sprayers in single stage machines as little as possible. Because we increase the ventilation rate gradually during the incubation process, we bring an increasing amount of relative dry air in the machine. As a result the relative humidity will be lower at the end than at the start, and consequently the moisture loss will be higher at the end. This is no problem, as the goal is to get a specific amount of moisture loss at the moment of internal pipping. As it is not important when this moisture loss occurs, we can use a so-called non-linear moisture loss profile, which in practice means that we lose less moisture in the first days of incubation, and more towards the end. This is simply the result of adjusting the ventilation rate to the requirement of the embryos for oxygen and carbon dioxide, and at the same time trying to avoid using the sprayer in the machine.

It is important to understand that the goal of non-linear moisture loss is to minimize the use of the sprayer that is causing non-uniform embryo temperature distribution through its local cooling effect. But this is only possible if the cooling capacity of the machines is enough to actually avoid using the

sprayer. If the cooling capacity is not sufficient, the sprayer is needed to reduce the temperature, as evaporation of water requires a lot of heat.

Important in this system is the amount of air that is used for ventilation. If we ventilate more than we think, we replace more warm humid air with cold dry air, and the relative humidity in the machine will drop, or the sprayer will come in again. As the ventilation of the machine is not only dependent on the setting of the dampers but also for instance on pressure differences between inlet and outlet, a rigid control of the conditions in the setters and ventilating systems is crucial to get full benefits from modern single stage machines.