Egg Specific Gravity - Designing a Monitoring Program

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Simply speaking, eggshell damage is caused by contact either between eggs or between the egg and another object as the egg makes its way from the hen to the consumer. In most modern egg production facilities this breakage occurs at one of 4 major areas:

1. point of lay

2. transfer from point of lay to collection point

3. washing and packaging

4. transport

Shell damage is directly related to shell strength. Shell strength is determined by shell thickness (calcium carbonate content) and shell matrix organization. A number of techniques and instruments have been developed to measure eggshell strength. Specific gravity is an indirect non-destructive method. Determining an egg's specific gravity is accomplished by the flotation of the egg in various salt solutions.

What is specific gravity?

Specific gravity is the ratio of the weight of an object to the weight of an equal volume of water. In other words, weigh the egg and then divide the weight by the volume of the egg. Specific gravity of an egg indicates the quantity of shell relative to other components of the egg. Egg specific gravity usually declines as the hen ages. This is partly due to the size of the egg increasing more rapidly than shell weight. Therefore, differences in specific gravity among eggs of similar weights are mainly due to variations in the amount of shell. One could also break the egg, wash away excess albumin from the shell, let the shell dry and then weigh the eggshell. However, this is destructive, losses of small pieces of eggshell occur, and requires more space and time. Specific gravity measurements in field situations can provide accurate results more rapidly. Also, when the eggshell is dry, thickness can be determined and used as a measure of eggshell quality. However, specific gravity and eggshell thickness are highly positively correlated and specific gravity measurements are usually all that need to be taken.

What is the relationship between eggshell quality and specific gravity?

We know that specific gravity is highly correlated to eggshell thickness. As specific gravity goes down the number of cracks generally increase. Specific gravity gives the producer an idea of the probability of the eggs being cracked during handling.

What is needed to determine egg specific gravity?

1. This document is VM72, one of a series of the Veterinary Medicine-Large Animal Clinical Sciences Department, UF/IFAS Extension. Original publication date December, 1991. Reviewed April 2014. Visit the EDIS website at http://edis.ifas.ufl.edu.

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The necessary materials are:

1. five plastic garbage cans with covers (10 or 20 gallon capacity, NOTE: Using too small of a container will usually cause problems with maintaining the proper concentration of salt solutions)

2. salt (granulated-iodized is OK)

3. 1 hydrometer

4. 1 glass or plastic 250-milliliter cylinder (plastic is preferred)

5. water (tap water is OK)

6. scale for weighing the salt during the initial set-up of the various solutions (the scale is optional since the actual specific gravity of the solution is determined with the hydrometer)

7. 2 or 3 plastic coated wire or plastic baskets capable of holding about 20 eggs

8. 8 plastic egg trays (flats)

How many solutions of various specific gravities are needed to monitor commercial flocks?

No more than five solutions will be needed (three will usually be sufficient). These solutions should have specific gravities of 1.070, 1.075, 1.080, 1.085, and 1.090. The approximate amount of salt needed for these solutions is 1.070(0.8 pound per gallon of water), 1.075 (0.9 pound per gallon of water), 1.080 (1.0 pound per gallon of water), 1.085 (1.025 pounds per gallon of water), and 1.090(1.05 pounds per gallon of water). In most cases 85-90% of the eggs will fall into the 1.075, 1.080, and 1.085 categories. (NOTE: Research studies require as many as 18 solutions. The specific gravity of the solutions changes every 0.0025 units from 1.060 to 1.100. Eggshell quality studies require much more precision than field studies.)

What procedure should be followed when making the solutions?

In preparing the salt solutions the appropriate amount of salt needs to be dissolved in the appropriate amount of water. Keep in mind that the buckets need only be about two-thirds full thus leaving room for the eggs to float. The salt may be dissolved in warm water first. The solutions should be stirred thoroughly (a small plastic boat paddle works well). Periodically fill the 250-milliliter cylinder with the solution and carefully place the hydrometer in the cylinder. Determine the specific gravity. If the reading is too high, remove the hydrometer and pour the solution back into the bucket. Add a small amount of water to the bucket, restir and then recheck the specific gravity. Repeat until the desired specific gravity is reached. If the reading is too low, just add a small amount of highly concentrated salt solution or salt to the bucket, stir and then recheck the specific gravity. Repeat until the specific gravity of the solution is correct. Once completed place the solutions in a cooler overnight and place the lids on the cans (this minimizes contamination and evaporation).

How should the egg sample be taken?

The number of eggs to be sampled varies. How and where the egg samples are taken will depend on what is being evaluated in the operation. For instance, cage location in the house, feeder location, ventilation adequacy, strain of bird, feed additives and the influence of different dietary nutrient concentrations can all be evaluated. (NOTE: It must be kept in mind that positive changes in egg specific gravity, such as when some feed additives are used, may not be due to more calcium being deposited on the shell but simply a result of smaller egg size.) Samples can be taken at random and even egg handling can be monitored. Usually 100 eggs will constitute a good sample but the size of the sample can vary. (NOTE: After the eggs are collected they should be stored in the cooler and brought to about the same temperature as that of the salt solutions stored in the cooler. It is always best to determine the specific gravity within 24 hours after collection.)

Determining the specific gravity of the egg sample

The actual determination of specific gravity should be conducted in the egg cooler. Why? Pure water has its maximum density at 4°C. The density of pure water at this temperature is 0.999973 grams per cubic centimeter or 1 gram per ml. The egg cooler, however, is the ideal place to conduct specific gravity measurements because most hydrometers used in this particular measurement are calibrated at 60°F, which is close to that of coolers. Prior to placing the eggs in the solutions be sure to restir the salt solutions and recheck their specific gravity. This is very

important and should be done each time specific gravity measurements are taken. Take nothing for granted!

1. Carefully place 15-20 eggs into the basket and lower them into a bucket containing only water (no salt). This solution is often referred to as a pre-dip solution. Lift them up and let them drip into the bucket for about 10-15 seconds.

2. Carefully lower the eggs into the first (lowest) specific gravity solution for about 15-20 seconds. Remove any eggs that float (break the surface and remain there) and place them in a plastic egg tray with the particular specific gravity marked on the tray.

3. Carefully raise the basket with the remaining eggs out of the bucket and let them drip for 10-15 seconds. Then place them in the next higher specific gravity solution (never skip solutions or go from a higher to a lower solution). Continue this procedure until all the eggs have been placed in their appropriate egg flats.

4. Reload the basket and continue until all the eggs have been tested.

5. Calculate and record the percentage of eggs in each specific gravity category (tested eggs can be processed).

What are some factors that can influence the specific gravity results?

Many factors are known to influence specific gravity measurements. Some of these are:

1. Length of egg storage - It is known that egg specific gravity declines by an average of 0.001 units for each day the egg is stored in the cooler. Therefore, eggs should be measured within 24 hours after collection.

2. Temperature - The temperature of the specific gravity solutions should be kept relatively constant because the higher the solution temperature the higher will be the egg specific gravity.

3. Time of day - Eggs laid in the afternoon have higher specific gravity (thus, thicker shells) than eggs laid in the morning. When collecting eggs be sure that they are sampled at the same time period (best in the AM). (Note: When collecting morning eggs be sure the sample does not contain any of the previous day's evening eggs.) Always try to collect eggs for the sample at the same time of day.

Why monitor egg specific gravity?

The specific gravity of eggs is correlated with the probability that eggs will crack during processing. Monitoring the egg specific gravity of a flock should be just as routine as keeping records on egg production and feed consumption. However, often no egg specific gravity determinations are made until a problem arises. Many times, after the fact is too late. Problems can be solved more easily if flock histories have been kept. Otherwise, each problem is a problem in itself with no assurance of ever being totally solved. Isolating the problem is easier if comprehensive case histories of other egg problems are available for comparison. An eggshell quality problem can often be identified and corrected before it becomes serious enough to bring in outside assistance. If a company has a consistent eggshell quality monitoring program then the company has some indication (1) about the exact time a particular problem began as related to the age of the flock, ingredient changes, nutritional changes, temperature changes, vaccinations, etc., (2) if it is chronic or acute in nature, (3) how long is it taking to alleviate the problem, (4) if certain management decisions are better than others in alleviating the problem, and 5) where the problem is occurring. For example, your specific gravity monitoring program may not indicate a problem with eggs sampled directly from the hens. IF there is a high incidence of cracks, however, this means that the problem occurs after the egg leaves the point of lay. Thus tracking the source of the breakage along the line is made easier and disease and nutritional problems need not necessarily enter into the picture as possible causes of the problem. Many factors other than nutrition and disease can influence egg breakage.