INSTRUMENTED EGG UTILITY

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This Thesis has been further condensed for the purpose of marketing.

The Thesis in its entirety can be requested from Sensor Wireless Inc.

Full disclosure Thesis of 261 pages is available as well as another condensed version totaling 28 pages.

Threshold levels are to be noted. Previous testing has determined damage to occur at 85 G's for a cracked egg and 45 G's for a damaged egg. 3 impacts of 45 G's cause a crack.

Please contact Sensor Wireless Inc. for further information.

ABSTRACT

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This study examined the utility of a Sensor Wireless Agent QC instrumented Crackless Egg in mapping the distribution environment of an egg packaging facility. The research portion of this report highlights the US egg industry and describes packaging distribution environments. The analysis revealed areas in the packaging line that were inflicting the most shock. Recommendations for improvement are included. Also included are a review of the Crackless Egg, and a detailed photo gallery.

Photo 1: Crackless Egg at the farm packer transition (Karl Dierdorf)

Overview of Cal Poly Eggs
Flock age: 60 weeks
Flock Strain: Hy Line W-36
Flock Breed: White Leghorn
Feed: Standard Layer Mash
Packaging: Molded wood pulp flats stacked 5 high in B-Flute RSC cases
Holding Temperature: 44.8 Degrees F
Holding Humidity: 99% Relative Humidity
Holding time: 1 to 2 weeks
Production Volume: 1.2 million eggs per year
Sales breakdown: Currently 98% of eggs are sold in flats to restaurants

Cal Poly Eggs Production and Breakage Quantities

At the time of this study, Cal Poly Eggs, the laying operation examined, was producing about 1.2 million eggs per year or 100,000 dozen eggs. The unit was averaging 50 to 70 dozen checks per week at a loss off about $4,200 annually. A one percent decrease in checks could have increased annual profits by $600, while a shift from 10% breakage to 2% could have increased profits by $4,800.

While the figures for Cal Poly Eggs are modest compared to massive commercial producers, the operations are similar. The same test methods employed using the Sensor Wireless Agent QC Crackless Egg to map shock in the distribution environment could be applied to larger facilities. Considering that college students worked at Cal Poly Eggs as part of a profit-sharing enterprise project, the potential for each student to earn a few hundred dollars extra per year by decreasing breakage is more meaningful.

Sensor Wireless Agent QC Crackless Egg

The instrumented Agent QC Crackless egg is a battery powered replica of a Large Grade 'A' egg that is equipped with tri-axial accelerometers that measure shock, in G's, and transmit the measurements via radio frequency to a handheld device. Once events have been recorded, the handheld is hooked up to the serial port on a computer and the files are imported to the Agent QC software that is included with the kit. A customizable chart is made available for each file as well as the raw and combined event data.

It is suggested in the user's manual that damage to eggs is a cumulative process, which means that the more an egg is handled, the more likely a smaller impact will check it. The manual states that over the course of many studies Sensor Wireless has found that a shock of 85 G's will check an egg and that 4 shocks at 45 G's will have the same effect. Meaning that an egg that has experienced 3 shocks at 45 G's may not be checked, but a fourth shock of 45 G's will check it.

Feedback on the Sensor Wireless Agent QC Crackless Egg

The Crackless Egg system is a tool. As with any tool, the operator becomes more skilled with practice. This study was performed by a first time user. Some functions proved to be limited, others useful. Below is a piece-by-piece analysis of the system.

The Crackless Egg

The instrumented egg proved to be robust, having withstood drops from three feet onto concrete. It proved to be water proof, having made several trips through the washer. The Crackless Egg was also easily visible among other eggs due in part to its flashing LED lights. All of the testing for this study was completed without having to change the battery in the egg. While the sorter identified the egg as Grade "A" Large 100 percent of the time based on weight, the egg appeared to be an Extra Large by volume compared to the other eggs from the Cal Poly flock [10].

The Receiver

The receiver or 'sled' had a built-in belt clip and LED indicator light. Like the egg, the receiver also survived all of the testing on a single battery. The toggle switch used to turn the receiver on and off had the potential to be bumped during testing, but this user never encountered such trouble. The only thing that went wrong with the receiver is that the decal started to peel up on one corner. (Note: Since this study the labels and the position of the toggle switch have been changed on the Communications Box.)

The transmitting range was about 10 to 15 feet. (Note: Since this study the Signal strength has been improved and should be of at least 50 feet.) This required some brisk walking tokeep up with the egg during its trips through the sorting equipment. The handheld was attached to the sled with a sturdy connector cable that was screwed in place. The length of the cable seemed well thought out, not too long, not too short.

The Handheld

The handheld was convenient to carry and the connection to the receiver was solid. The screen could be tapped to "flag" events in real time. Large shocks could be seen as they occurred. There was about a 1 to 2 second delay between and event occurring on the egg and the data showing up on screen. The handheld could hold about one hundred files between downloads to the computer.

The facility run time was limited so I didn't have time to use the touchpad to carefully name the files and flagged events in the field. Instead, I carried a paper notepad to keep track of the files. It turned out that a ball-point pen worked just as well as the stylus that came with the handheld for tapping the screen. I ended up using only the pen to write in my notepad and to tap the screen in order to free up my hands. The ink from the pen on the screen wiped off with a rag sprayed with a little Simple Green.

Tech Support

Sensor Wireless was available during East Coast business hours to help me trouble shoot an issue I had getting the handheld to download to the computer. I didn't have to navigate through an automated phone menu and issue was solved, in one call, by a helpful engineer.

Cage to Empty Gathering Belt

This test simulated the laying of an egg. Performed inside an empty cage, the egg was dropped or placed onto the cage floor and allowed to roll down onto the gathering belt. In this situation, the gathering belt had no eggs on it for the Crackless Egg to collide with. Ten repetitions were performed.

Highest Shock 88 G's

Cage to Loaded Gathering Belt

This test simulated the laying of an egg. Performed inside an empty cage, the egg was dropped or placed onto the cage floor and allowed to roll down onto the gathering belt. In this situation, the gathering belt was loaded with eggs for the Crackless Egg to collide with. Ten repetitions were performed.

Highest Shock 108

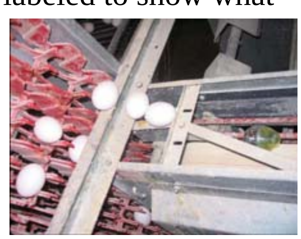
Cage into Metal Support

This experiment focused on rolling the Crackless Egg into the metal support deliberately. Ten tests were performed.

Highest Shock 106

Gathering Belt to Elevator to Rod Conveyor

The Crackless Egg was placed on the gathering belt just upstream from the transition to the elevator. The duration of the test was one minute and thirty seconds. The eggs moved from the gathering belt onto the elevator, over the top and down onto the rod conveyor. This test was repeated ten times and the charts were labeled to show what was happening to the test egg.



Highest Shock 120

Farm Packer
The Crackless Egg was placed onto the rod conveyor upstream from the farm packer and the test ran until the test egg dropped into a plastic farm packer tray. Critical events to be flagged included the transition from rod conveyor to the farm packer, the transition to the orienter, pickup, and drop. Each test took roughly one minute to complete and ten repetitions were performed.

Highest Shock 79

Palletizing from Farm Packer
The data egg measured the forces produced along the conveyor belt before being stacked six trays high and finally being loaded onto a pallet. Five tests were performed.

Highest Shock 2

Pallet Moving
Measure the shock experienced by an egg on a pallet as it is transferred from the farm packer to the holding cooler, by hand.

Highest Shock 0.0

Suction Loader
The Crackless Egg was substituted for a real egg on a tray staged on the timing conveyor before the loader. This test focused on the forces created by the loader pictured above in Photo 12 and the test period was stopped once the data egg was placed onto the conveyor belt just ahead of the washer. Fifteen repetitions were performed.

Highest Shock 40

Washer Transition

Focusing on the transition from the washer to the candler, this experiment spanned the distance seen in Photo 13. Trials were done for each of six lanes by replacing the Crackless Egg for a real one. The furthest lane pictured in Photo 13 was referred to as “Lane 1,” or “Far Lane, and the nearest lane as “Lane 6,” or “Near Lane.”

Washer Transition Lanes 1-5
Highest Shock 29

Washer Transition Lane 6
Highest Shock 48

Candler

Record the shock induced by transitioning into the candling area. Test each lane individually. Ten trials were performed.

Highest Shock 43

Sorter Shock Test

Each trial took about one minute to record. Two major events, the pickup and the drop were flagged. Occasionally, a third event was flagged if the tray advanced while the data egg was still transmitting. Thirteen trials were performed to measure shock.

Highest Shock 61

Case Loading by Hand

Ten trials were performed to test the handling environment during case packing. Cases were packed by hand and the placement of the egg was varied. The duration of the test included the loading of individual flats into cases and the folding of the case flaps.

Highest Shock 19

Palletizing

The Crackless Egg was incorporated into a full case of eggs and then moved from the packing platform to the pallet. The location of the test egg within the case was varied. The person handling the case was instructed to simulate a rough and rushed handling environment for some of the tests.

Highest Shock 29

Conclusion

Overview

In mapping the distribution environment at Cal Poly Eggs three methods were employed [6]. First literature was reviewed to learn more about the egg industry and distribution environments. Next, the Sensor Wireless Agent QC Crackless Egg was used to measure shock. Also, direct observation was used. The result of this comprehensive analysis is a complex set of recommendations.

When considering the data; maximum shock, quantity of shocks, average shock, percentile shock, and standard deviation all pointed to different areas that could be improved. These measurements were gathered using the Crackless Egg system.
The recommendations that follow are organized in order of perceived return on investment.

If the percentage of broken and checked eggs was reduced from ten percent to two percent, the recovered losses would equal $4,800 per year. This figure only takes into account the selling price of eggs. Additional savings would also be realized by increasing the ratio of sold eggs to feed consumed.

Final thoughts

The Sensor Wireless Agent QC Crackless Egg system was useful in mapping the distribution environment of Cal Poly Eggs. Reliable measurements were made. **As Morris E. Cohen, Wharton professor and Co-Director, Fishman-Davidson Center for Service and Operations Management said, “You can’t manage what you can’t measure.” With the data provided by the Crackless Egg, substantiated recommendations could be made that may save Cal Poly Eggs thousands of dollars per year.**