Rapid Lesson Sharing

Event Type: Plastic Aerial Ignition Sphere Potential Hazard

Date: October 5, 2023

Location: Quarry Fire
Stanislaus National Forest
California

An Important Heads-Up on Using 'Dragon Eggs'

The Story

While performing Unmanned Aircraft System (UAS) aerial ignition operations on the Quarry Fire, we began to encounter plastic aerial ignition spheres commercially known as "Dragon Eggs" that were incredibly volatile. All plastic aerial ignition spheres contain potassium permanganate and are injected with this ethylene glycol (antifreeze) before being discharged. Normally, a chemical reaction between the potassium permanganate and ethylene glycol causes the sphere to ignite approximately 20 to 30 seconds after injection.

We conducted bench testing on these volatile eggs with multiple configurations, including adding more glycol, less glycol, 50/50 mix, and with samples from multiple different boxes.

However, these plastic sphere eggs would start smoking at around 5-10 seconds, and the fire ignition would occur at approximately 15 seconds. When we would add between 0.3ml (milliliters) and 0.7ml of glycol, the average reaction would be for one egg to rocket into the air 25 feet or higher and the other egg would explode (no fire was present with an exploded egg)—sending one half of the shell flying. The sound was similar to a small caliber bullet.

Some eggs were tested with 50/50 mix and the others were tested using 100% glycol from two different brands.

The results were consistent with all the 2023 manufactured Dragon Eggs we tested on this incident: Volatility and exploding eggs, leaving only a separated shell behind.

We knew we needed to make initial notifications about our situation and gather information on how many eggs might have been manufactured on that date.

Next, we tested a batch of these eggs that were manufactured in 2022 and 2021. Both batches worked as they should with 0.3ml or 0.4ml of glycol injected, and a reaction-to-ignition time of approximately 30-40 seconds, with a longer duration flame and minimal movement from where the egg was dropped.

More than a total of 100 eggs were tested.

Based on this testing, we narrowed down the problematic eggs to those that were manufactured around June of 2023.

Considering the amount of eggs the wildland fire service has and uses, and not knowing how many pallets of Dragon Eggs are manufactured on a monthly basis, we may have just been unlucky in finding the only pallet that had this issue. Regardless, we knew we needed to make initial notifications about our situation and gather information on how many eggs might have been manufactured on that date.

Initial Actions

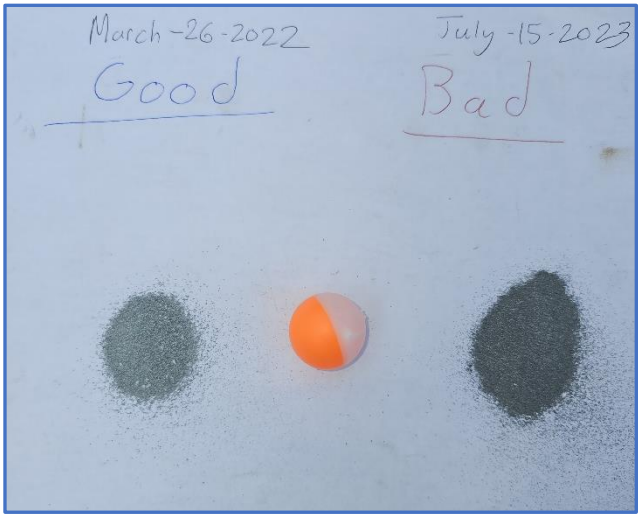
To alert others of our experience, we submitted a SAFECOM: https://www.safecom.gov/safecom/24-0012.

We informed the U.S. Forest Service Pacific Southwest Region UAS Specialist and the U.S. Forest Service National UAS Aerial Ignition Specialist of this situation.

We also contacted NWCG Interagency Aerial Ignition Unit and Project Lead with the National Technology and Development Program. We shared the testing parameters we had completed. We also provided him with a photo of a side-by-side comparison of the potassium found in an egg from a batch that was manufactured in 2022—that we know work as they should—with the potassium found in one of the eggs manufactured in July of 2023—that we know have been inconsistent and volatile. (See photo on right.)

The difference in the color of the eggs' contents is easily noticeable. The amount of the potassium is also different (which may not be that evident in the photos). In the 2023 eggs, there seems to be a lot more potassium permanganate than in the eggs manufactured in 2022.

It was later determined that an additive that the manufacturer puts into the eggs with the potassium to slow the reaction time, was inadvertently omitted causing the contents of the eggs to look and react differently.



Potassium found in a March 2022 manufactured Dragon Egg—that is from a batch that works properly—compared to a Dragon Egg manufactured in July 2023 from a batch that is volatile.

Follow-Up Actions

An Interagency Aviation Tech Bulletin was created and circulated related to this issue recommending that boxes of Dragon Eggs stamped July 14-17, 2023 be removed from service.

We also contacted the company that purchases the eggs from the manufacturer to inform about this situation. The company is working with the manufacturer and will be keeping us informed on the manufacture's findings—as well as next steps, if any need to be taken.

Lesson

Share your lessons.

Systems are in place such as the SAFECOM, Rapid Lesson Sharing (RLS), and bulletins to make others aware of actions and issues that are happening in daily operations which may affect safety, efficiency, and effectiveness. Sometimes what you have experienced might seem like an anomaly but sharing your story through formal systems can be the catalyst to initiate needed change or action.

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