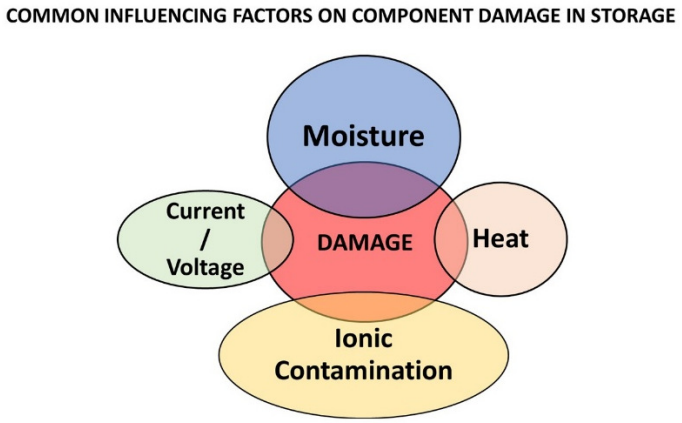
Condensate Observation Test

Comparing Different Types of Desiccant Technologies



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Introduction

Desiccants are used to absorb moisture to create and maintain a dry environment that prevents mold, mildew, and rust. They are especially useful in packaging of moisture sensitive devices in storage areas without temperature control as any water present will undergo thermal cycling. When the water vapor condenses it carries contaminants that contribute to corrosion.

This experiment directly compares two desiccant solutions: silica bead granules and Steel Camel Moisture Hog, a super absorbing polymer through a simulation of the desiccants in action. This experiment will show which desiccants used in a sealed environment will increase or decrease moisture levels.

Objective

Condensate Observation Test (COT) is a test designed to observe the effect of desiccant bags on condensation in a closed container subjected to thermal cycling.

Materials

- 3 wide mouth jars with lids that seal (28oz mason jars used here)
- Steel Camel Moisture Hog Desiccant Bag (2'' x 3'' size, 13g)
- Silica beads (fresh)
- Muslin tea bag
- String
- Water
- Govee Hygrometer Thermometer Sensor (H5100)

Methods

1. Collect materials.
2. Ensure glass jars are clean and wipe them clean of any contamination with a tack cloth or a lint free cloth.
3. Add 50mL of water to the bottom of all the jars.
4. Prepare the desiccants.
    a. Weigh SC packet. SC used below was 2 x 3in size and 13g.
    b. Cut a tea bag to the same dimensions as the SC bag.
    c. Fill the tea bag with silica beads till it weighs the same as the SC bag.
    d. Secure the desiccant bags on the lid so they are free hanging and do not touch the sides of the jar, or the water.
5. Place the jars outside next to each other with the sensor.

6. Observe jars in intervals to monitor the development of condensation and behavior of moisture.

Results

After setting up the desiccant bags in the jars, the jars were set out on a covered patio countertop. The jars were logged at approximately 12-hour intervals to observe the thermal cycling of water and the effect of the desiccants. The control jar had a consistently large amount of condensation and water at the bottom of the jar. There are also many water droplet tracks as the water condensed more and more. The Steel Camel jar remained dry the entire experiment. The water did not condense at all on the walls of the jar, only remained at the bottom, and eventually dried up completely. The water took longer to condense in the silica jar than in the control jar, but it did eventually mist over and form small drops. There also remained a small amount of water at the bottom of the silica jar, although less than the initial amount put in.

<u>Set Up</u>

The desiccants were set up to ensure that each are the same size and same weight:

Example of desiccant attached to lid:

Day 0:

The jar on the left is the control jar so we can observe the behavior of water without the effect of a desiccant bag. The jar in the middle contains the Steel Camel Moisture Hog. The jar on the right contains the silica beads.

After 13 hours:

The control jar has a lot of condensation on all walls of the jar, enough to leave some water droplet paths. The Steel Camel jar is completely dry and shows no change. The silica jar is also dry, although the silica is noticeably pink through the bag. Water level has decreased in both Steel Camel and silica jars.

After 25 hours:

The control jar continues to have a lot of condensation and more water droplet paths. The Steel Camel Jar remains dry and shows no signs of condensation. There is very little water at the bottom of the jar. The silica bead jar has developed a mist. The water at the bottom of the silica bead jar has not decreased further.

After 36 hours:

The control jar has many water droplet paths and still has a lot of condensation. The Steel Camel jar is completely dry, no water at the bottom of the jar. The silica bead jar is still misted; the water droplets are slightly larger. Some water remains at the bottom of the jar.

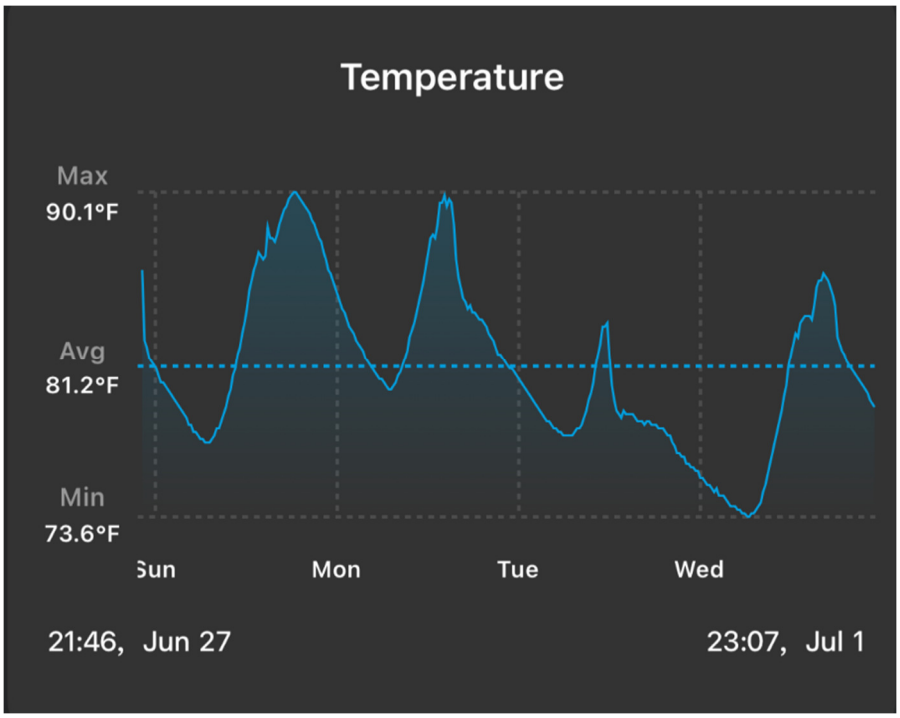
Measurements

Steel Camel had gained 4.8 g of water weight by the end of the experiment, so 96% of the water. The other 4% may have been absorbed by the string holding up the desiccant bag. Both desiccants were secured in the same manner, and approximately the same depth. The bag is not damp and the desiccant in the bag is puffed up / increased in size.

The jars were monitored for a couple of days further than the images included in this report to ensure there were no further major changes. In this time, the silica bag had completely molded. The silica absorbed 3.4 g of water and did not prevent mold. All the silica beads inside are bright pink, indicating a saturation point.

The relative humidity in the inside of the jars is the humidity at the time the jars were sealed, approximately 45.8%.

	Sunday (first 24-hour period)	Monday (second 24-hour period)	Tuesday (third 24-hour period)
Temperature High	90.1°F	89.6°F	83.3°F
Temperature Minimum	77.5°F	80.1°F	77.7°F



Discussion

At the start of the experiment both jars with the desiccants remained dry while the control jar immediately misted and was covered in condensation. While the silica beads seemed promising as a desiccant, but they underperformed as time went on. The Steel Camel held up better the entire duration of the experiment. The difference in behavior between the two desiccants are the way they actually interact with water. The silica beads are made to maximize surface area, and the water vapor attaches to the beads and can fill in some of the many pores in the bead structure. This means that the beads will only adsorb a certain amount of water and the water molecules will continue going through thermal cycling in the bead.

Steel Camel Moisture Hog on the other hand is a polymer type desiccant. The desiccant chemically binds to water, so the water is not free at all and unable to go through thermal cycling.

Contact Steel Camel for more information.