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ELE3387: Science Methods

11/11/15

Science Fair Project

Title:

• The effect of adding a dry towel to a dryer with a wet cotton t-shirt on the time it takes for the t-shirt to dry.

Question:

• How will adding a dry towel to dryer with a wet cotton t-shirt effect the time it takes for the t-shirt to dry?

Hypothesis:

• If a dry towel is thrown in a dryer with a wet cotton t-shirt, then it will take less time for the t-shirt to dry, because when the towel is added to the dryer it will cause the t-shirt to flip and spin through the dryer whereas if the t-shirt was drying alone it would remain on the edge of the dryer and would not rotate and separate as much. When the t-shirt moves around more the surface area of the t-shirt will increase causing the air to reach more sections of the shirt allowing it to dry faster. The dry towel will also absorb some of the water from the t-shirt which will cause the t-shirt to dry faster.

Background information:

Tumble dryers are used to dry clothes from a wet state after they come out of a washing machine. Tumble dryers work by sucking in air from their surrounding and passing them through a heating element and then carrying away the heated air through a ventilation system. The drum in the tumble dryer spins so that the clothes are rotated relatively equally so that the air is passing in between the clothing.

The process of drying clothes through the addition of heat is relying on the process of evaporation. Clothes that come out of the washer contain excess amounts of water that is trapped in the fabric in the liquid state. When heat is applied to the fabric the water goes through a physical change called evaporation where the liquid turns into a gas that is given off as steam.

Materials:

• Cotton T-Shirt
  o (Hanes, white, 100% Cotton Tag-less, Medium Size)
• Cotton Bath Towel
  o 68.5 cm X 132 cm
Investigative Design:

- **Independent Variable**
  - The addition of the dry towel to the dryer

- **Dependent Variable**
  - The time it takes for the t-shirt to dry

- **Constants**
  - Washer and Dryer Settings
    - Washer: Large Load, Wash Temperature Hot/Cold, Normal Cycle (Extra Heavy)
    - Dryer: empty lint trap, Setting (Automatic, High Heat, Very Dry)
  - Type and Amount of Landry Detergent
    - Tide Simply Clean & Fresh Daybreak Scent
    - 1/3 of a cup added to the water not placed directly on the t-shirt.
  - Time between measurements
    - T-shirt was weighed in 10 minute intervals for 40 minutes.
  - T-shirt and Towel
    - Same t-shirt and towel were used for each trial
  - How the t-shirt was handled
    - T-shirt was picked up using two fingers and placed on the scale to ensure that no water was lost.

- **Levels of Independent Variables**
  - Measurements were taken before the cotton t-shirt was washed and after it had been washed before being put in the dryer.
  - Measurements were taken after 10 min., 20 min., 30 min., and 40 min. in the dryer.

- **Number of repeated trials**
  - 3 trials without the towel
  - 3 trials with the towel

Procedure:
1. Make sure that all of the setting on the washing machine are set to the proper settings and record the settings in your observation notes so that you can make sure they are the same for each trial. (for this experiment they were Large Load, Wash Temperature Hot/Cold, Normal Cycle (Extra Heavy))

2. Turn on the kitchen scale and make sure it is balanced at zero.

3. Unfold the t-shirt and using two fingers pinch the t-shirt and gently place the entire t-shirt in the weighing container. Record the weight on the data table.

4. Take the t-shirt off of the scale and place it in the washer. Turn the washer on so that the water starts to fill the drum.

5. Using the Tide Fresh & Clean daybreak scent detergent for every trial measure out 1/3 cup detergent.

6. Place the measuring cup of detergent directly under the stream of water and leave it under the water until all of the detergent has been washed out of the measuring cup.

7. Let the washer go through the entire wash cycle without interruption.

8. While the washer is going make sure that the dryer settings are set to the proper setting and record the setting in your observation notes so that you can make sure they are the same for each trial, Empty the lint trap, and make sure that the kitchen timer is set for ten minutes. (for this experiment the settings for the dryer were Automatic, High Heat, Very Dry)

9. When the washer has went through the complete cycle, turn on the kitchen scale and make sure that it is at zero before removing the t-shirt from the washer.

10. Once the kitchen scale is ready remove the t-shirt by using two fingers and pinching the t-shirt and gently place the entire t-shirt in the weighing container. Record the weight on the data table.

11. Immediately after getting the weight of the t-shirt place the t-shirt into the dryer and start the timer while simultaneously starting the dryer.

12. Before the timer goes off make sure that the kitchen scale is on and calibrated to zero.

13. Immediately after the timer goes off remove the t-shirt from the dryer, weigh it, and record the weight on your data table.

14. Place the t-shirt back in the dryer as quickly as possible and restart the timer and the dryer simultaneously.

15. Repeat steps 12-14 for three more rounds (after 20,30, and 40 minutes in the dryer)

Standards:

The standards were found on the Pennsylvania Department of Education Standards Aligned System website.

- **Standard - 3.2.3.A3**
  - Demonstrate how heating and cooling may cause changes in the properties of materials including phase changes.

- **Standard - 3.2.3.A4**
  - Use basic reactions to demonstrate observable changes in properties of matter (e.g., burning, cooking).

- **Standard - 3.2.4.A5**
Use models to demonstrate the physical change as water goes from liquid to ice and from liquid to vapor.

- **Standard - 3.2.5.A1**
  - Describe how water can be changed from one state to another by adding or taking away heat.

- **Standard - 3.2.6.A4**
  - Differentiate between physical changes and chemical changes.

- **Standard - 3.2.6.B2**
  - Describe energy as a property of objects associated with heat, light, electricity, magnetism, mechanical motion, and sound.
  - Differentiate between potential and kinetic energy.

- **Standard - 3.2.6.B3**
  - Give examples of how heat moves in predictable ways, normally flowing from warmer objects to cooler ones until they reach the same temperature.
  - Explain the effect of heat on particle motion by describing what happens to particles during a phase change.

- **Standard - 3.2.7.A3**
  - Explain how energy transfer can effect the chemical and physical properties of matter.

- **Standard - 3.2.7.B6**
  - Demonstrate that heat is often produced as energy is transformed through a system.
  - Demonstrate how the transfer of heat energy causes temperature changes.

- **Standard - 3.2.8.A1**
  - Differentiate between mass and weight.

- **Standard - 3.2.8.A3**
  - Explain how changes in matter are accompanied by changes in energy.

- **Standard - 3.2.8.B3**
  - Explain how changes in temperature are accompanied by changes in kinetic energy.

**Citations:**


Data Analysis:

According to the data the hypothesis that the t-shirt will take less time to dry when a dry towel was added into the dryer was proven to be true. The t-shirt was weighed before it was washed and then it was also weighed after 40 minutes in the dryer. In trials 1-3 the t-shirt was dried without the towel. In trial 1 the t-shirt weighed 4.5 ounces before being washed and after being dried for 40 minutes it weighed 4.7 ounces, in trial 2 the t-shirt weighed 4.5 ounces before being washed and after being dried for 40 minutes it weighed 4.6 ounces, and in trial 3 it weighed 4.5 ounces before being washed and after being dried for 40 minutes it weighed 4.6 ounces. In trials 1-3 the t-shirt did not reach its starting weight after being dried for 40 minutes. In trials 4-6 a dry towel was added into the dryer with the wet t-shirt. In trial 4 the t-shirt weighed 4.5 ounces before being washed and reached the starting weight after only being in the dryer for 20 minutes, in trial 5 it weighed 4.4 ounces and it reached the starting weight after 30 minutes, and in trial 6 it weighed 4.3 ounces and it reached the starting weight after being in the dryer for 40 minutes. After all of the data was collected it was found that when a dry towel was added to the dryer with the wet t-shirt it decreased the time it took for the t-shirt to reach its starting weight.

Conclusion:

Placing a dry towel in with a wet t-shirt will cause the t-shirt to dry faster. After 3 trials without the addition of a dry towel and 3 trials with the addition of a dry towel it was found that when the t-shirt was dried with the dry towel it reached its starting weight faster than when it was dried without the towel. When the towel is added to the dryer it collides with the t-shirt and causes the t-shirt to unfold and flip throughout the drum. When the t-shirt is unfolded and is moving more freely throughout the drum the t-shirt is exhibiting more surface area. When the surface area is increased the heat that is produced by the dryer is able to heat up the water molecules faster. When the water molecules heat up faster they partake in evaporation and they move from the liquid state to the gaseous state quicker. Clothes are dry when the majority of the water particles have evaporated. Therefore by decreasing the time it takes for the water molecules to evaporate, it will also decrease the time it takes for the t-shirt to dry.

The data that was collected accurately measured the information that was needed to support the hypothesis. In order to determine if adding a dry towel to a dryer with a wet t-shirt would decrease the time it took for the t-shirt to dry the weight had to be measured at equal intervals among trials. In order to determine if the t-shirt was “dry” the t-shirt was weighed before it had ever been washed, the trials were also conducted on different days allowing the t-shirt to become completely dry. In order to keep the experiment as accurate as possible the weight of the t-shirt was taken before each trial to calculate the new weight that indicated that it was dry. The weight of the shirt was taken after it went through the complete wash cycle to ensure that there was no substantial differences in the cycles from trial to trial. The weight of the t-shirt was then taken in 10 minute intervals up to 40 minutes. The data that was collected accurately represents the hypothesis that was being tested because it tracked the weight of the t-shirt throughout the drying process. From the data it is easy to see how long it took for the t-shirt to become dry.
There are a few areas that could cause errors in this experiment. This experiment was conducted using a relatively old dryer and the results may have turned out differently if a newer dryer or an energy efficient dryer had been used. Another source of error could have been how the t-shirt was handled in between trials, in this experiment the t-shirt was hung over the back of a chair in the kitchen in between trials, but because cotton can absorb water from the air, the humidity and conditions of the air in the kitchen could have affected the absorption of the water during the washing cycle. Other possible sources of errors could have been fluctuating times in between when the washer finished its cycle and when the t-shirt was placed into the dryer, in this experiment the t-shirt was weighed and placed in the dryer as quickly as possible but there is no indicator for when the washer is complete therefore the times varied.

This experiment was done on a very small scale. The original thought was if the towel would be effective when added to a load of laundry, but for the sake of the experiment it was easier to do on a much smaller scale. In order to address the initial thought, the experiment would have to be replicated on a much larger scale using a full load of laundry. You could use this data with the data from the larger scale to see which situation would be more effective.

<table>
<thead>
<tr>
<th>Trial #</th>
<th>Weight before being washed (oz.)</th>
<th>Weight after being washed (oz.)</th>
<th>Weight after 10 minutes in dryer (oz.)</th>
<th>Weight after 20 minutes in dryer (oz.)</th>
<th>Weight after 30 minutes in dryer (oz.)</th>
<th>Weight after 40 minutes in dryer (oz.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.5 oz.</td>
<td>7.4 oz.</td>
<td>6.4 oz.</td>
<td>5.4 oz.</td>
<td>4.9 oz.</td>
<td>4.7 oz.</td>
</tr>
<tr>
<td>2</td>
<td>4.5 oz.</td>
<td>7.5 oz.</td>
<td>6.4 oz.</td>
<td>5.6 oz.</td>
<td>5.1 oz.</td>
<td>4.6 oz.</td>
</tr>
<tr>
<td>3</td>
<td>4.5 oz.</td>
<td>7.5 oz.</td>
<td>6.3 oz.</td>
<td>5.5 oz.</td>
<td>5.0 oz.</td>
<td>4.6 oz.</td>
</tr>
<tr>
<td>4</td>
<td>4.5 oz.</td>
<td>7.4 oz.</td>
<td>4.8 oz.</td>
<td>4.5 oz.</td>
<td>4.4 oz.</td>
<td>4.4 oz.</td>
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</tbody>
</table>
### Data results:

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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>4.4 oz.</td>
<td>7.5 oz.</td>
<td>6.2 oz.</td>
<td>4.9 oz.</td>
<td>4.4 oz.</td>
<td>4.3 oz.</td>
</tr>
<tr>
<td>6</td>
<td>4.3 oz.</td>
<td>7.3 oz.</td>
<td>6.2 oz.</td>
<td>5.2 oz.</td>
<td>4.6 oz.</td>
<td>4.3 oz.</td>
</tr>
</tbody>
</table>
Weight of a T-shirt Throughout the Washing and Drying Process

Time Weight was Taken

Weight of the T-shirt (oz)

Before being washed
After being washed
After 10 minutes in the dryer
After 20 minutes in the dryer
After 30 minutes in the dryer
After 40 minutes in the dryer

Trial #1
Trial #2
Trial #3
Trial #4
Trial #5
Trial #6