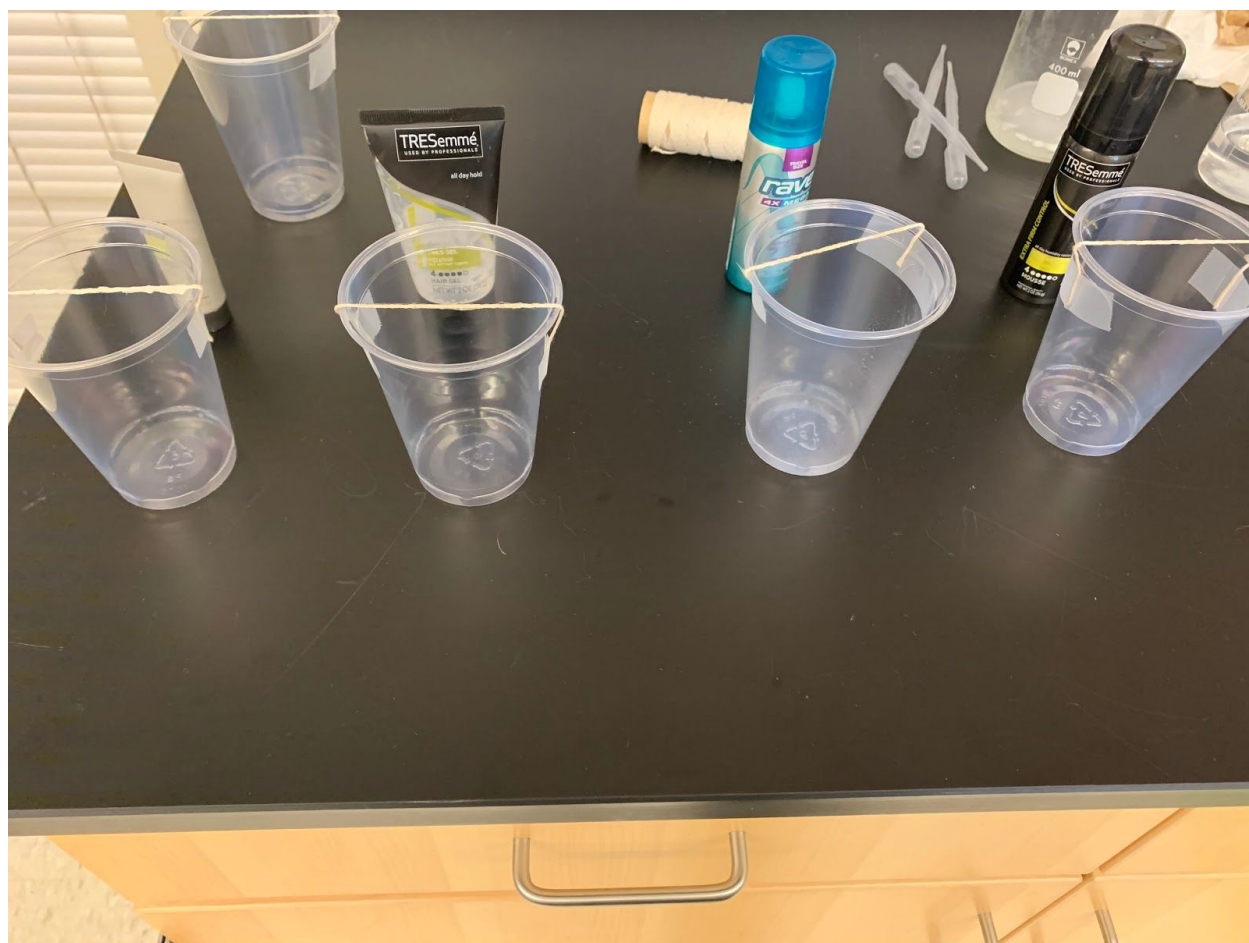


The Effect of Hydrogels on their Ability to Hold Water

IB Chemistry HL

By: Brendan Fitzgerald



Research Question:

How well do specific hydrogels hold water when attempting to simulate hair adhesion?

Introduction:

My topic for the Internal Assessment was to experiment how well hydrogels can hold water. I chose to experiment on this topic because I was curious about what I am really putting in my hair before school. Store brand hair products are what I looked at, all being relatively small size for possibly traveling individuals. It would always mess with my mind that this little amount of gel or spray can make your hair really shape up and stay in place until it is washed out. During my days at middle school, I would sometimes go into the bathroom and see that an outlier hair would be sticking up and water would be my savior so to speak. Water would almost act as a reactant to the hair adhesive product I was using at the time.

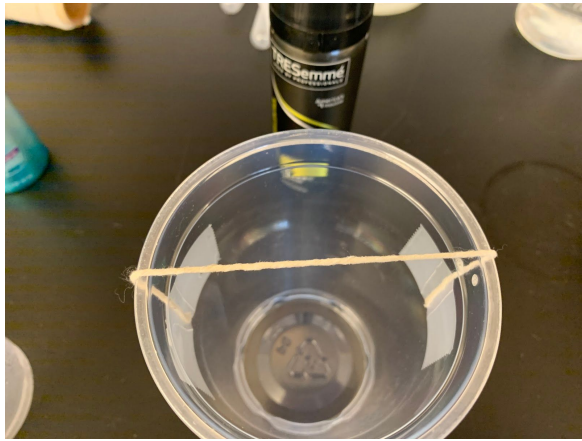
Scientifically speaking, many hydrogels are polymers of carboxylic acids, the acid groups stick off the main chain of the polymer.⁸ Then these polymers are put into water, the hydrogen atoms react and come off as positive ions which gives the sticky hold to hair.⁸ I decided to investigate how well hydrogels hold water when put on a strand of simulated hair? Just due to the fact that I was not going to go through plucking out my own hair for this experiment when there is string at my disposal.

I am fully aware of the safety and or environmental issues as there are very few of them. Individuals that use hair gel with the application of the product with their hands should wash their hands after dealing with the substance. You should also keep the hair products from your eyes, mouth and just face in general, no lathering on your skin of any sort. They will cause irritation if they are left on your body for prolonged periods of time³. There should be no consumption of the hair adhesive products. Specifically, each one of these hair products have material safety data sheets that go further into what to look out for when using these items. The

“TRES GEL” has a high flammability so it would be smart to keep away from other forces that may cause it to take up a flame⁷.

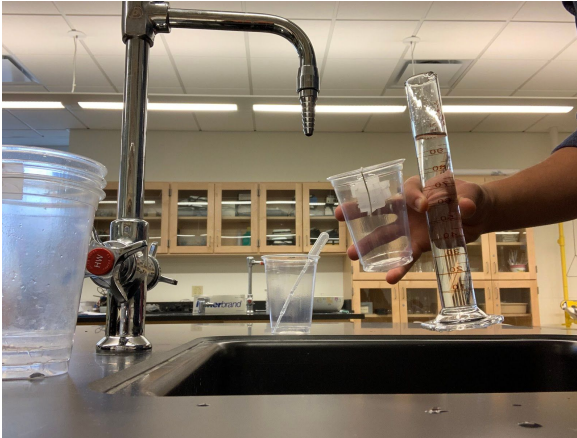
Methodology:

- Cut up 5 pieces of string at approximately 6 inches long
- Get 5 plastic cups
- Tape the strings across the middle of the cups

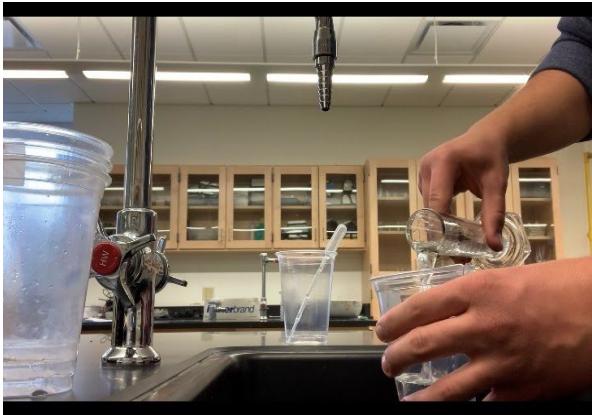


- Then apply a small amount of hair product to the simulated piece of hair (string)
- You can use a tissue/paper towel in order to smear the product over the string
- Knowing that the weight of the plastic up is 8.2 grams, weigh the cup with the hair product on the string to get the “before” weight

- After that, have a graduated cylinder filled with 100 m



- Over the sink pour the water slowly and steadily, going left to right over the string at a constant pace



- Then take the string off the cup and leave it hanging away from anything that can interfere with held water on the string with the tape still on it to dry for 1 minute
- When the one minute is up, rip off the tape, take the simulated piece of hair and put it onto the scale, zeroed out with a paper towel on top of it so nothing will make the scale more dirty
- Repeat these steps for all of your hair product stimulated pieces of hair and one without product on the string for a control group

This experiment obviously does not require an extreme amount of materials or money to purchase them. The simulation is helping us gather data to answer the question, which gel will help shape my hair after I get out of a shower/bath? Which product do I really want to use to make my image look better than others?

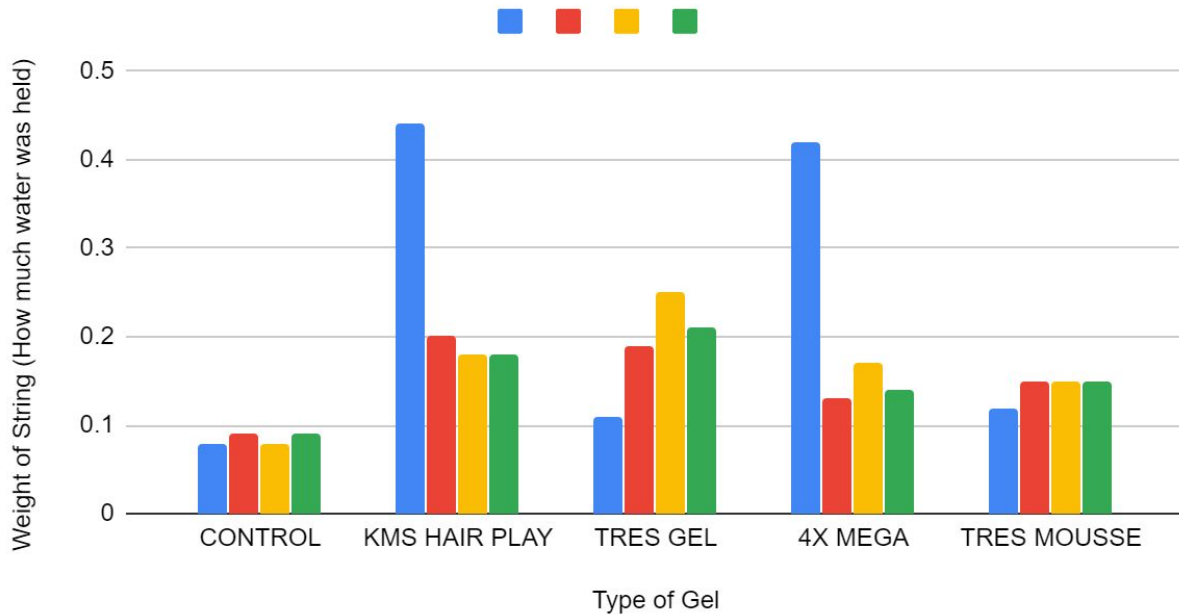
Statistics and Data Processing

A bit of information to take into account as well is that the 6 inch pieces of string each weigh around .08 grams. Also the cups with the string and tape all together weigh just about 8.2 grams.

Type of String	Before	After T1	T2	T3	After Avg.
CONTROL	.08g	.09g	.1g	.08g	.09g
KMS HAIR PLAY	.44g	.2g	.15g	.18g	.18g
TRES GEL	.11g	.19g	.19g	.25g	.21g
4X MEGA	.42g	.13g	.13g	.17g	.14g
TRES MOUSSE	.12g	.15g	.16g	.15g	.15g

Key: (Before, Trial 1 After, Trial 2, Trial 3)

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Observations

- “TRES” products hold H₂O the best
- “KMS” and “MEGA” products actually hindered the amount of H₂O able to be held
- No outliers that jump out at me
 - Trends are relatively the same throughout the three trials
- “TRES GEL” held the most water, avg: .21g
- “CONTROL” group held the least water, avg: .09g
- “TRES MOUSSE” showed the most consistent trend after water was added to the simulated piece of hair (the piece of string)

Data Uncertainty:

- Water could have been poured unevenly
 - Not at a constant rate for each trial
 - Same location of water being poured
 - Water missing the string due to my own pouring skills
 - Low amount of water poured on the string could lead to skewed data and vice versa for high amounts of water being poured in one area
- Hair product could have been dispersed onto the piece of hair unevenly

- A high mass of hair product on the string could have just made the string weigh more and not really measure how much water is being held at all
- Lots on one side, little on the other
- Some could have fell off during the experiment
- Some could have stuff to the tissue/paper towel used to get the product on the string, hindering the amount of hair products actually being used
- Time in between taking the sting of the cup and hanging it up
 - If I was off by a few seconds taking the string off, drops of water could have evaporated or just left the string entirely, skewing the data as a whole
 - Could have dried too quick because of the hair product
 - Water could have dropped a bit because it was hanging, making the piece of “hair” lighter
 - Keeping the “hair” hung too long, taking it off too early
 - Time in between taking the string off of the cup
- All and all, the data had a +/- 0.005 uncertainty

Conclusion:

At best, there were only two hair products that were able to hold 0.18 grams of water successively. That seems to be the maximum ranging from 0.18 to 0.25 grams of water held for “KMS HAIR PLAY” and “TRES GEL,” the two most successful adhesive items. The other products just let the water get past the hair without even sticking for at least one minute. Consequently, it must take a very thick gel or a foamy substance in order to maximize your hair’s moldability. Both physical characteristics of the solutions were found in the “TRES GEL” and the “TRES MOUSSE.” This also makes clear sense because they held the most water, shown in the data table and the graph. Coincidentally, they are both made from the same company which may lead us to think that this company has so much success with sales to the public because they actually have good results. If you have a product that helps and doesn’t harm people like “TRES” hair items, you are bound to have a successful company.

I managed to open ideas for other scientists to start experiments based off of this one. An individual could study how much gel you put on your hair really affects your moldability and is more gel really the “sticky solution” to your hair shaping problem? Can you really conclude a study with just experimenting on a single piece of hair? How about a few, a bunch, a straight up wig may do the trick for my study to be proven entirely.

While there may have been more than enough room for error, I found a repeatable procedure that can be done with ease. Scientists in middle school, high school and beyond

could test my ideas regarding hydrogels and their ability to hold water. The adhesion process developed in the sticky gels that numerous amounts of people use to shape their hair.

My study is important because it reveals some products you see on the shelf may not actually be what they seem. Some may say “highly ranked” or “best at...” just to be an eye grabber to get your money and purchase their products. Not caring whether or not the product works, it gets your wallet’s attention before it hits your ability to think and process the practicality of an off brand, store bought hair gel. Some hair gels just want to help and some just want you to be bald by 35. With studies like mine and more to come, people will be able to know what they are really putting in their hair.

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