The effect of the different pH levels on the tensile strength of a piece of cardstock

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Why I chose this area of science

I first thought of doing a project about the effects of different liquids with different pH levels on plant growth but the plants weren't growing even though I was using pea seeds which grows very fast. Then I decided to a project on the effects different liquids with different pH levels has on the time it would take for a piece of cardstock to disintegrate. I chose to use different pH levels for my project because I already had pH strips which would be very useful to make a good scientific experiment. It was hard to find different liquids with different pH levels which was the part I wasn't expecting. This experiment only took 11 hours so it was the easiest experiment I could think of that didn't include plants.

Scientific Question

How does the different pH levels affect the tensile strength* of the cardstock?

*tensile strength is the resistance of paper or any material to breaking under tension.

My Hypothesis

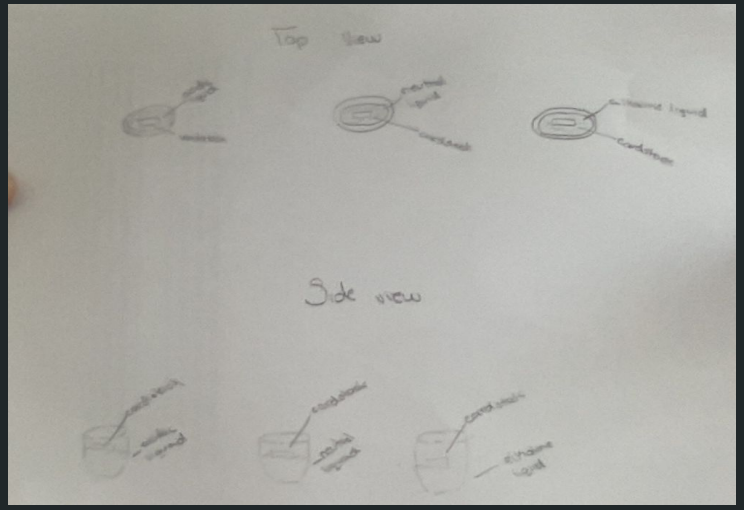
I predict that it would be easier to break the fiber of cardstock with acidic pH because alkaline pH could help with many diseases for people while acidic pH is sour and won't help. I know that both acidic and alkaline can cause chemical burns but only if the acidic pH levels are at 1 or 0 and alkaline pH is at 13 or 14 or the highest pH level. If alkaline could help with diseases I think it could also be easier to take more longer to break the fiber but if it is acidic I think it would be quicker. Neutral would be in between both times because neutral is both at a pH level that is between the acidic and alkaline so neutral pH could take longer than alkaline but not as long as acidic.

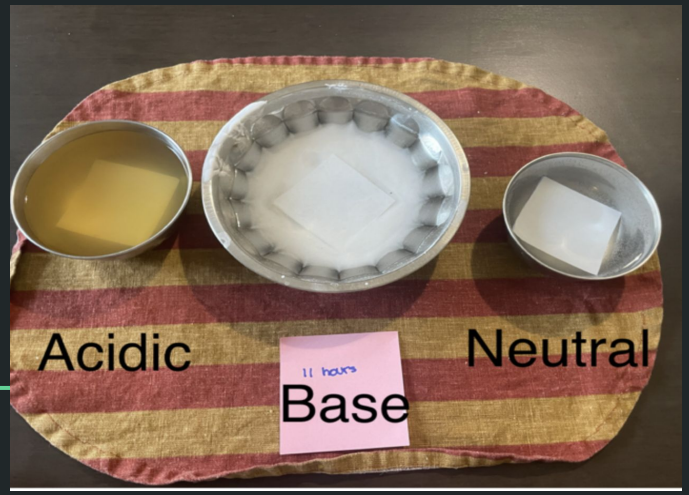
How I did my research

I have did my research by looking in some websites and I did a scientific experiment that partly helps me understand the part of the answer to the scientific question. The goal of my research was to understand what pH levels help disintegrate cardstock the fastest. My mom helped me find the websites and the websites told me about cellulose and the H+ions which explained a lot to me why cardstock in neutral pH doesn't disintegrate faster than cardstock in acidic and alkaline pH.

Procedure

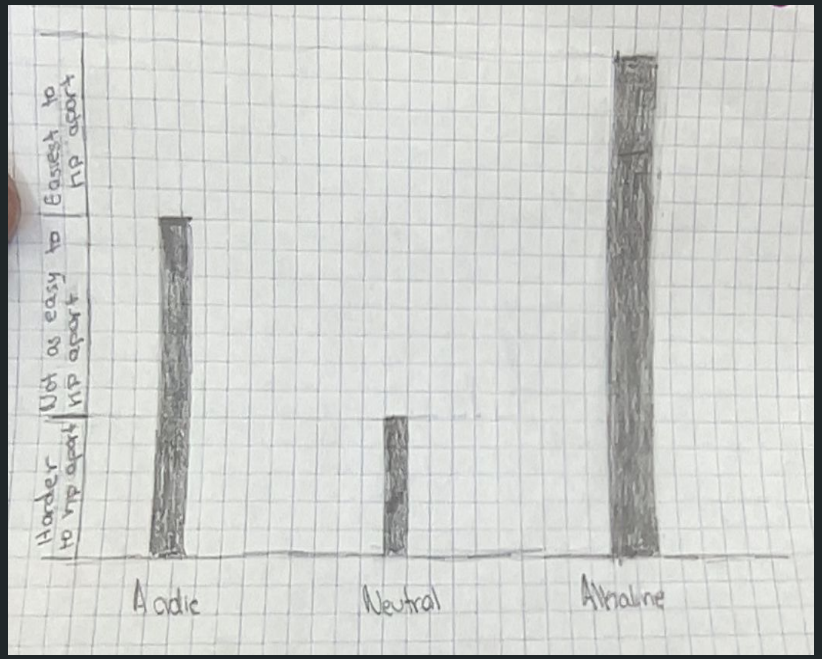
1. Put the three cups for your liquid out in front of you.
2. Then pour each liquid into each cup. One cup has just 1 cup of water because of the neutral pH. Another cup has 7 teaspoons of baking soda mixed in with 1 cup of water which is alkaline pH. (Make sure to really mix the baking soda and water and try your best to dissolve it.) The last cup is just one cup of vinegar which is acidic pH.
3. Once you finish pouring each liquid into each cup, take three pieces of cardstock that are the same size and place one into each cup. (Make sure the cardstock fits perfectly into each cup).
4. Check on the cups in 9 hours then try to slowly rip each sheet of cardstock and observe which piece of cardstock is easier to rip in what liquid.





Experiment data

This graph presents my findings. If I place a piece of cardstock in alkaline pH for 11 hours a piece of cardstock would be easy to rip a part. If I place a piece of cardstock in acidic pH it won't be as easy to rip apart and if I place a piece of cardstock in neutral pH it would be hard to rip apart.



Results

Usually Alkaline doesn’t have that much H+ion so when it is with cellulose it would take the H+ion from it breaking the cellulose bond. Acidic has more H+ions that also disrupts the bond. Because both Alkaline and Acidic disrupts the cellulose bond, then neutral which does not disrupt the bond takes the longest time to disintegrate. My prediction was not valid. Even though acidic could still disintegrate the fastest I never knew that cardstock in neutral pH disintegrates the fastest. I may be right about acidic pH but my hypothesis was still way off then my actual results.

Neutral pH isn’t as harmful as acidic and alkaline. The most dangerous alkaline and acidic is when the pH levels are under 3 or above 10 or 11. Alkaline and acidic is more dangerous than neutral because alkaline takes H+ions and acidic gives H+ions and both alkaline and acidic disrupts things like cardstock and other things. This could also cause chemical reactions which isn’t good for our body and this is why both the cardstocks in the alkaline and acidic pH liquid disintegrates faster than the cardstock in the neutral pH liquid.

Conclusion

From doing this experiment I learned that adding more cups of water to one or all of my liquids would not just increase the amount of liquid in that cup but also change the pH level. It doesn't matter if I add 1 more cup of water to my liquid because water has a totally different pH level than vinegar. If I had 1 more cup of water in my vinegar than the pH level won't be that low anymore, it would probably be a 5 or a 6. Adding different pH levels into different pH levels is a totally different experiment which does not fit in with my scientific experiment. Another extension that would benefit my experiment is if I dissolve the baking soda into my water more for a different liquid. Dissolving baking soda into water could also cause the pH levels to rise more so if I did that the results of my experiment could be different.

What will I do next?

Next I will redo my whole experiment to compare my data from now to my future data and figure out what results are the most efficient for this experiment.

Sources:

1. Alkali Burns vs. Acidic burns, study.com
2. Tensile properties of wet cellulose, nature.com
3. Relationship between wettability of pulp fibers and tensile strength of paper during recycling, scientific reports