Slime design lab

Sodium Borate, also known as borax, is commonly used In household products such as creams, bath and skin products. It affects the molecules In the formula and makes them work better together. Introduction: The borate Ions In sodium borate can form cross-links between poly(ethanol) chains. The water from the two solutions Is trapped between the polymer chains. The cross- links can be broken easily and this gives rise to a ‘ slime’ – possessing some properties that resemble those of a solid and others which resemble those of a liquid.

Different amounts of reactants will lead to the formation of different types of slime having efferent physical properties. What you do: You need to determine how changing the composition of the slime will affect the properties of the slime made. You can only use the materials provided. You need to develop a valid lab that enables you to collect enough data to have reliable results. Cases, E. Z. “ Chemistry Outreach Program: Florida State University. ” Chemistry Outreach Program:. Florida State University, n. D. Web. 28 Feb.. 2013.

Aspect 1- Defining the Problem and Selecting Variables Research Question: How will changing the concentration of sodium borate solution from 1% to 2%, 3%, 4% and 5% change the viscosity of slime? Hypothesis: If the concentration of sodium borate is increased, the stiffer the slime would become and the longer it would take for the marble to hit the bottom of the beaker. This is because there would be more sodium borate ions to form cross-links with the polyethylene chains meaning that there would be less cross links broken leaving a more solid slime. Defining Variables: Independent Variable: Changing the concentration of sodium borate.

There was 50 cam of 1% and 50 cam of 5% given. 15 cam of the 5% sodium borate solution was placed aside. Water was added to the rest of the 5% sodium borate solution to dilute it and make it 4% odium borate solution. This was done by deducing how much water would be needed to change the solution from 5% to 4% etc, from the formula below. Concentration (start) x Volume (start) = Concentration (total) x Volume (total) Sample Calculation: Volume (total) = 43. 75 The total volume of the 4% sodium borate solution should be 43. 75 cam 43. 75 – 35 = 8. 75 One must add 8. 75 cam of water to the 35 cam of the 5% sodium borate solution to create 43. 5 cam of 4% sodium borate solution. From 5% to 4%, from 4% to 3% and from 3% to 2%. Volume (cam) of water to add To change 5% sodium borate solution to 4% sodium borate solution 8. 5 To change 4% sodium borate solution to 3% sodium borate solution 9. 55 To change 3% sodium borate solution to 2% sodium borate solution 1 1. 65 Dependent Variable: The dependent variable is the stiffness of the slime. For each trial the stiffness of the slime would be determined by dropping a marble into the slime, which was placed in a ml beaker, and timing how long it would take for the marble to reach the bottom of the beaker.

For each concentration of sodium borate solution in the slime the marble is dropped 3 times and an average time is recorded. Controlled Variables: Volume of the polyethylene Volume of the sodium borate Temperature of the poly ethanol Temperature of the sodium borate The same marble Same food coloring Time kneaded for Aspect 2: Controlling Variables Independent Variable Control: To change the concentration of the sodium borate, a CACM of 1% and 5% sodium borate solution are given. 15 cam of and 5% must be kept aside in test tubes.

To change the concentration, the 5% sodium borate solution must be diluted with a volume of water. (Volumes are given in the table 1). Then that solution is now 4% sodium borate solution and CACM must be kept aside on a labeled test tube. Then his Just repeats until 15 cam all concentrations from 1% to 5% are in labeled test tubes on a test tube rack. Variable Effect Method of Control This may have affected the viscosity of the slime. If there were an increased volume able to make a longer chain and expand. The same volume of poly ethanol was used throughout the experiment.

Volume of the sodium borate The volume of the sodium borate may have also affected the viscosity of the slime. The more sodium borate the thicker the slime because this would also lengthen the chain and cause the slime to expand. The same volume of sodium borate was used wrought the experiment. Temperature of the poly ethanol Under pressure slime expands and becomes thicker. Perhaps it too, expands and thickens when under heat. The temperature of the polyethylene and sodium borate solution was kept constant by completing the procedure on the same day at room temperature.

Temperature of the sodium borate It is important to use the same marble because this is what determines the viscosity of the slime. If the marble increased in mass, then it would hit the bottom of the beaker faster altering the overall results. The same marble was used through out the experiment. It may be unknown but perhaps chemicals in the different colors of food coloring altered the viscosity of the slime. The same food coloring was used throughout the Method: Creating the different concentrations of sodium borate solution 1 .

Using a CACM measuring cylinder, measure out 1 5 cam of 5% sodium borate solution 2. Set aside on a test tube labeled 5%, on a test tube rack 3. Using a CACM measuring cylinder, measure out 8. 75 cam of water and add it to the beaker with the 5% sodium borate solution. (This creates 4% sodium borate solution). 4. Using a CACM measuring cylinder, measure out 1 5 cam of 4% sodium borate solution 5. Set aside on a test tube labeled 4%, on a test tube rack 6. Repeat steps 3-5; changing 4% to 3% and 3% to 2% using the given volumes of table 1. . Using a CACM measuring cylinder, measure out 15 cam of 1% sodium borate solution. 8. Set aside on a test tube labeled 1%, on a test tube rack Method: Creating the slime 1 . Add 30 cam of polyethylene to paper cup. 2. Stir in 3-4 drops of food coloring 3. Add 15 ml of 1% sodium borate solution – stirring quickly making sure to scrape the sides and bottom using the wooden craft stick. 4. Pour entire contents of the cup into a plastic baggy. 5. Knead the slime. Topnotch, time how long it takes for the marble to hit the bottom of the beaker.

Make sure the marble is dropped from the same height each time. 8. Repeat these steps with the 2%, 3%, 4% and 5% sodium borate solution. Materials: 50 cam measuring cylinder Sodium borate solutions, at 1% and 5% (50 cam of each) 5 test tubes 1 test tube rack Pencil Disposable paper cup Poly (ethanol) solution, 4% (1 50 cam) Protective gloves Wooden sticks for stirring (ice lowly sticks) 100 ml beaker Food coloring (optional) Marbles Plastic sandwich bags Stopwatch Aspect 3: Developing a method for collection of data Diagram of apparatus:

How to measure the viscosity of the slime: Table 2: Relationship between the viscosity of slime (measured by timing how long it takes for a marble to hit the bottom of a slime filled beaker thrice) and the concentration of sodium borate solution. Concentration of the sodium borax solution 1% 2% 3% 4% 5% Time 1 taken for the marble to hit the bottom of the beaker (B± 0. Sass) 6. 11 7. 55 8. 81 7. 75 8. 46 Time 2 taken for the marble to hit the bottom of the beaker (B± 0. Sass) 3. 66 5. 94 6. 47 8. 87 11. 3 Time 3 taken for the marble to hit the bottom of the beaker (B± 0. Sass) 4. 32 6. 10 7. 13 8. 95 8. 55 Observations The higher the concentration the longer it took for the marble to hit the bottom of the beaker. Aspect 5 & 6: Processing Raw Data and Presenting Processed Data Table 3: Processed data table showing the relationship between the viscosity of slime (measured by taking an average of how long it takes for a marble to hit the bottom of a slime filled beaker thrice) and the concentration of sodium borate solution.

Average time taken for the marble to hit the bottom of the beaker (B± 0. Sass) 4. 70 6. 53 7. 47 8. 52 9. 38 Sample Calculation to find the average time for the marble to hit the bottom of the eager at 1% concentration of sodium borax: Average time = 4. 70 seconds Average time = (Time 1 + Time 2+ Time 3 +3. 66+4. 32)/3 Aspect 7: Concluding The data from this experiment does support the hypothesis that, if the concentration of sodium borate is increased, the stiffer the slime would become and the longer it would take for the marble to hit the bottom of the beaker.

This is because the more diluted the sodium borate solution was the weaker the bonds between the sodium borate and the polyethylene. This is because there are less sodium borate ions to create chains with. The smaller the chain the thinner the slime is and vice versa. This is evident in the graph 1, the trend shows a positive gradient thus meaning if the concentration of the sodium borate increases so does the time it takes for the marble to hit the bottom of the beaker. Therefore supporting the fact that the higher the concentration of the sodium borate the more stiff and viscous it is.

Apparatus Errors: 100 x (Uncertainty/Quantity Measured) Uncertainty of Apparatus (half of smallest unit) Timer: B± 0. 05 seconds Beaker: B± 5 cam Measuring Cylinder: B± 0. 5 cam Total Amount of Solutions each Apparatus measured Timer: 6. 11 +7. 55 + 8. 81 +7. 75+8. 46+ 3. 66+ 5. 94 + 6. 47 + 8. 87+ 11. 13 + 4. 32+6. 10+ 7. 13 + 8. 95 + 8. 55= 109. 6 seconds Beaker: polyethylene 0 CACM; sodium borate solution 0 100 cam = 130 cam Measuring Cylinder: sodium borate solution 15+1 5+1 5+15+15 water 8. 75 + 9. 55 + 11. 65= 104. 95 corn Timer: 100 x (0. 5/109. 60) = 0. 05% Beaker: 100 x (5/130) = 3. 85% Measuring cylinder: 100 x (0. 5/104. 95) Total Apparatus Error = 4. 38% = 0. 48% Aspect 8 & 9: Evaluating and improving the investigation Errors: Improvements: Systematic error: During the experiment the time the slime was kneaded varied. This s important because the slime is dilating, which means that under pressure it will expand and thicken. If the slime was kneaded longer than another slime sample it could have caused it to be thicker altering the overall results. This is a significant weakness.

In future experiments time the kneading process and keep it at a constant time throughout the experiment. For example kneading the slime for only one minute. Systematic error: When adding water to dilute the sodium borate solution, the formula produced very precise numbers to two decimal places. These were impossible to measure accurately on a 50 cam measuring cylinder. This is an insignificant weakness. In future experiments providing more precise equipment. For example using a 1 cam-measuring cylinder, which has markings of decimal places.

Or simply being provided with 5 different concentrations of the sodium borate solution, so there would be less chance of error or weakness in general. Systematic error: It was difficult to see when the marble had reached the bottom of the beaker. This is an insignificant weakness. In future experiments use something longer and slimmer than a beaker, perhaps a CACM-measuring cylinder or a large test tube. So that it sakes longer for the marble to touch the bottom and it is clearer when to stop the timer.

As well as this, not putting food coloring may help the visibility of the marble in the slime. 0 To reduce the amount of random error in the experiment, using equipment, which has more recurrent markings. For example replacing the 100-cam beakers with a 1 Come-measuring cylinder. 0 To reduce the amount of systematic error in the experiment, going through the experiment once as a practice. Then take notes of what worked well and what didn't work well, make changes and perform the experiment for the second time for the report.