

Name _____
Date _____ Block _____

HYDROGELS

PHYSICAL SCIENCE

PROBLEM:

The biomedical company AnthroMed has developed a chemotherapy medication to treat a specific kind of cancer. While the drug has proven very effective, it is difficult to administer. It cannot be taken orally, because the molecules cannot survive the digestive process. Injections of the medication are too concentrated and it is too quickly broken down. Intravenous (IV) administration of the medication is effective, but the side effects are significant and severely affect the patient's quality of life. AnthroMed is seeking an alternative means of administering this effective drug to patients.

The company is aware of using hydrogels as an effective way to store the medication and release it to a targeted area over a long period of time. Hydrogels are polymers that swell in water, and can have a medication "loaded" into it. A patch of gel is then placed on the skin, in the mouth, or embedded directly into the body, where the medication is released slowly as the hydrogel breaks down. They can also be used in wound healing, tissue growth scaffolds, and many other applications outside of medicine.

PURPOSE:

This is a very active area of medical research, and you are among the first students to test these materials (seriously!). The goal is to produce a hydrogel from Xanthan gum and Glycerol, two naturally occurring materials that are biocompatible.

The ideal hydrogel must...

- Be biocompatible.
- Absorb a maximum amount of water while maintaining its structural integrity.
- Use no more than a 1:1 ratio of Xanthan gum to glycerol. Testing by the company has shown ratios higher than this are not viable for medication swelling.

Testing Suggestions:

- To most easily identify the best performing ratios of X to G, all test samples will be made with 1g of Glycerol and less than 1g of Xanthan. Scaled up tests can be performed after the test samples are characterized.

FORMAL TESTING

Note- These tests can be performed in any order, it is up to YOU to plan and decide which ones to do in what order.

Properties to Describe that do not require alteration of sample.

Size of initial sample- Mass, Volume, Radius, profile view (From side and to scale as much as possible). Pictures are ok too, but you will HAVE to label them if they are included in your final write up.

Elasticity- Does your sample spring back when gently pulled? *About* how far can you stretch it and still have it spring back? This will be an approximation and you can describe and compare this qualitatively. DO NOT try to stretch test your sample.

Transparency- Place your sample over top of the word “GEL” below. How well can you read the letters? You may take a picture to include in a formal write up as well.

GEL

Conductivity. This is how well electricity can move through it. Turn the Probe to X1K setting. Cross the probe ends together and make sure the needle goes all the way to the right. Now place the probe tips .50cm apart on your sample. Does the needle move? The further it moves the more conductive it is. Rate it as none, low, medium, or high.

Swelling Test- Total Swelling time should be for 20 minutes. More data is ok if you have time.

- 1- Setup a data table in notebook that looks like this:

Table- Formal Test Sample

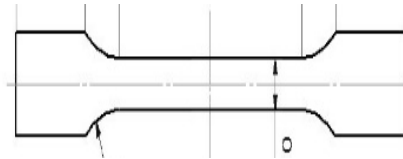
Time	Mass (g)	Qualitative Obs.
0s		
300s		
600s		
900s		
1200s		

- 2- Mass the sample of hydrogel you wish to use. Record in the 0s row.
- 3- Place water in a weigh boat or beaker. Temperature? Place one drop of food coloring (by microwave) in your water.
- 4- Soak in water for allotted time. Place on tissue or kimwipe, flip once to remove excess water. Remass at each 300s, 600s, 900s, and 1200s. Place back in the same water.
- 5- Find how much water was absorbed between 0s and 1200s by subtracting the mass at 0s from the mass at 1200s.
- 6- Calculate percent change by $\left(\frac{\text{Mass of water absorbed}}{\text{starting mass of gel sample}} \right) (100) = \text{percent change}$

Tensile Test

Reason- Not in terms of distance, but force! How much force can your sample withstand? Can it handle the rigors of use in the real world, whether on a device or in a body?

- 1- Using a marker, create a “dogbone” shape on your hydrogel and cut it out carefully with scissors. The dogbone should be approximately 2.00cm -2.50cm wide at its ends and the middle should be 1.00cm-1.50cm. The total length should be between 3.75cm-4.25cm.



- 2- Grip one end of the dogbone binder clip and 2 wood craft sticks. between the top sticks.
- 3- Grip the bottom end of the dogbone with the other binder clip and 2 wood craft sticks.
- 4- Use a Spring Scale hook placed over the bottom dowel rod to gently pull on your sample with increasing force. You should be looking at the Newtons (N) scale carefully as you are doing this.
- 5- Measure the force to the nearest Newton required to break the sample, and note any apparatus or human error that occurs. Record all measurements and observations in a data table.
- 6- Remove your sample from the device, clean your scissors and any other waste created.