# DIFFUSION RATE OF DIFFERENT SOLVENTS

## 1. Objective

The aim of this experiment is to find how different solvents with different molar mass affect the time taken for a substance to diffuse with the solvents.

## 2. Hypothesis

Different solvents have different molar mass. The lighter the particles in the solvent are, the faster it is to diffuse. Therefore, I hypothesize that different solvents will affect the time taken for the substance to diffuse with the solvents.

## 3. Variables

a. Independent Variables

1. Type of solvents

b. Dependent Variables

1. Time taken for food coloring to diffuse

c. Controlled Variables

1. Type of food coloring
2. Amount of solvent
3. Amount of food coloring poured into each solvent
4. Same person who times

## 4. Materials

Three 250 mL flask
150 mL hydrochloric acid (0,1 M)
150 mL distilled water
150 mL alcohol (97%)
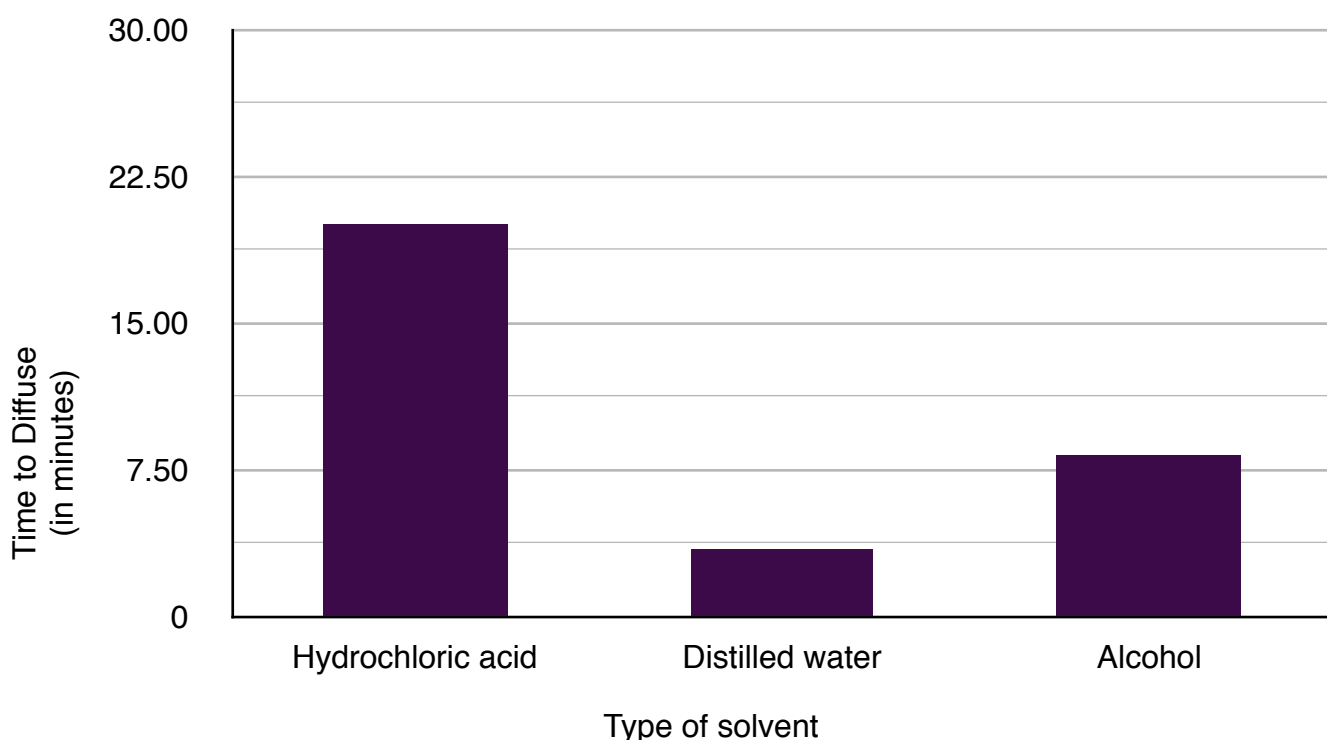Red food coloring
Stopwatch

## 5. Method

1. Prepare three 250 mL flasks.
2. Fill one flask with 150 mL hydrochloric acid (0,1 M).
3. Fill one flask with 150 mL distilled water.
4. Fill one flask with 150 mL alcohol (97%).
5. Drop one drop of red food coloring into one flask.
6. When the food coloring touches the solvent, start the stopwatch.
7. Wait until the food coloring diffuses with the solvent and stop the time. Do not shake or stir.
8. Collect the data.
9. Do steps 5-8 for the other two flasks.

# 6. Results

| Solvents | Time to Diffuse |
|---|---|
| Hydrochloric acid (0,1 M) | 20 minutes 10 seconds |
| Distilled water | 3 minutes 48 seconds |
| Alcohol (97%) | 8 minutes 27 seconds |



Diffusion refers to the process by which molecules intermingle as a result of their kinetic energy of random motion. The time taken for the food coloring to diffuse with the solvents depends on several factors. One of them is the mass of the molecule of the solvent. The lighter the particles are, the faster it is to diffuse. The molar mass (molecular weight) of hydrochloric acid is 36.46 g/mol, distilled water is 18.01 g/mol and alcohol is 32.04 g/mol.

From this experiment, we can see that lighter particles travel faster. Hydrochloric acid which is the heaviest among the other two solvents, takes the longest time to diffuse. Alcohol which is the second heaviest takes the second longest time to diffuse. Third is the distilled water which is the lightest of the other two solvents and takes the shortest time to diffuse.

Since I round the results (time) into the nearest second, the margin of error is +/- ½ seconds. The margin of error is mostly caused by a person's reflexes because different people have different reflexes. Some might press the start/stop button faster or slower depending on their reflex. Also, we judge whether the solvent and the food coloring diffused or not by only looking at it. So there are no specific things to know whether the

food coloring and the solvent had diffused precisely. Different people will have different assumptions on when the solvent and the food coloring has diffused or not, thus, it might create a huge margin of error. These two things could be considered as a weakness in this experiment too.

The data of this experiment is not reliable enough because only one trial was done. If the experiment was done twice (two trials), the data would be more reliable because we can check whether the data that we got is correct or not. Another weakness in this experiment is that the independent variables (types of solvent) are only three. If we could have at least five, it would strengthen the data that we have. However, we can't do this due to inaccessibility to two other solvents. The temperature of the solvents might also affect the results of the data. We should've maintain the temperature for each solvents and include it as our controlled variables.

## 7. Conclusion

Basically, this experiment is quite successful because we are able to answer our objective through this experiment. Throughout the experiment, we proved that different solvents with different molar mass affect the time taken for a substance to diffuse with the solvents. This is because, in our experiment, hydrochloric acid has a molar mass of 36.46 g/mol and is the heaviest among the two other substances which are distilled water and alcohol. In theory, the heavier the particle is, the longer it takes to diffuse. In the experiment, this theory is proven because hydrochloric acid has the biggest molar mass and it takes the longest time to diffuse.

The method itself is actually easy to be followed. The steps are clear and the materials are listed too. However, I think the problem is not in the method but about conducting the experiment again. We should at least did the experiment twice since we only have three factors that we change, the solvents. If we can add at least two more solvents and conduct the experiment twice, it would for sure strengthen the data that we got. In addition, maybe we could've actually changed the other two inaccessible solvents into something else rather than having nothing and becomes a weakness in the experiment that should be improved.

For further inquiry, maybe I can create an experiment to find the rate of diffusion as an extension to this experiment because this experiment is already about the time taken for the food coloring to diffuse with the solvents. However, I think that the method would be different since finding the rate requires more data other than just the time. The other data needed for this further inquiry are: quantity of solvent transported per time unit, permeability coefficient, the surface of contact where diffusion takes place and concentrations of the stuff on both sides. For this, I can use dialysis tubing in which I soak into different sucrose solutions or making jello mixed with sodium hydroxide and soak it into vinegar. After that, I take necessary measurements.

## 8. Resources

"Diffusion and Osmosis." Test Page for Apache Installation. Web. 10 Dec. 2010. <http://hyperphysics.phy-astr.gsu.edu/hbase/kinetic/diffus.html>.

"Rate of Diffusion - Biology-Online." Life Science Reference - Biology Online. Web. 10 Dec. 2010. <http://www.biology-online.org/biology-forum/about4775.html>.

YouTube - Diffusion. YouTube - Broadcast Yourself. Web. 10 Dec. 2010. <http://www.youtube.com/watch?v=H7QsDs8ZRMI&feature=related>.

# 9. Pictures