# Antibubbles: An Easy Effective Way to Make a More Stable Antibubble

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## ABSTRACT

Antibubbles, a type of bubble that is surrounded by air and contains water have a short life span and are difficult to form. Although scientists have discovered ways to expand an antibubbles life span there methods are complicated and can be costly.  This makes it difficult for scientist to test and make products utilizing antibubbles' properties. In this experiment different liquids, environments, and equipment were used to test the most effective way to produce stable antibubbles. Beer, carbonated water, distilled water, and corn oil were used as liquids. Clear dish soap was added to all liquids at room temperature, and a syringe and plastic pipette were used to make antibubbles in each liquid for 1 minute at a time. Then the number of antibubbles made in this time were counted. It was concluded that over all, a syringe would be most effective in creating antibubbles. In another experiment, antibubbles life span were timed in all liquids at different temperatures. It was concluded, that the cold distilled water would be the most effective in producing antibubbles with a prolonged life. Two more experiment were done, one where food coloring was added to room temperature distilled water, and another where only propylene glycol (an ingredient in the food coloring) was added. Both of these experiments were done to determine if either of these added substances extended antibubble's life span. After several tests it was determined that the addition of propylene glycol does extend the antibubble's life span significantly. Food coloring did extend antibubbles life greatly, but this was likely because of the propylene glycol contained in it.  Further study exploring the ratio of propylene glycol to the liquid might provide better results.

## BACKGROUND RESEARCH

A regular bubble is air or gas within a thin film of liquid, surrounded by gas, but an antibubble is the opposite, a thin gas or air coat containing liquid, and also surrounded by liquid (fig.1). Antibubbles form when a liquid droplet enters the surface of a liquid solution with a thin coat of gas, usually air (Nadovich 1998a).

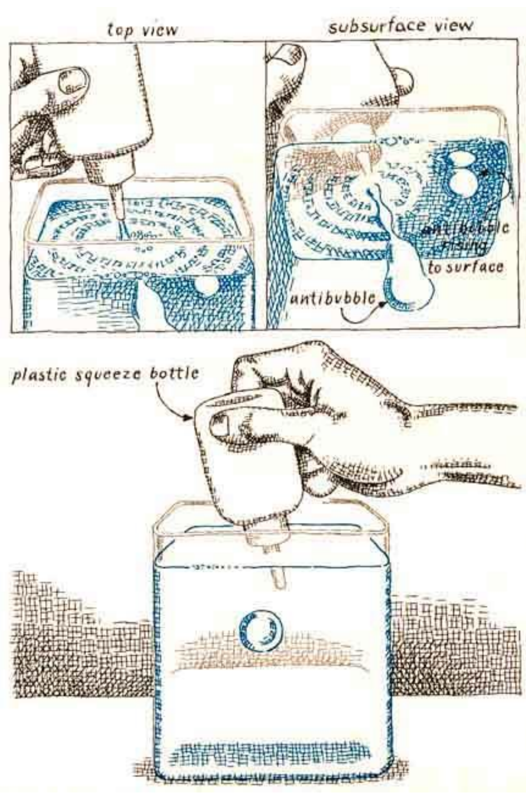
Over the years several different instruments have been used to create antibubbles.  In 1974 Kenneth C. Hickman made antibubbles using a variety of complex equipment (fig.2), whereas in J.E. Connett's experiment also in 1974, he only used a plastic squeeze bottle (fig.3), and produced the same results as Hickman.

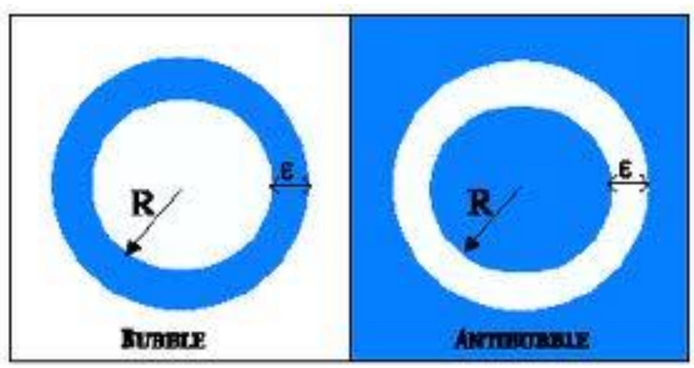
Unlike air bubbles, it is not known what cause antibubbles to form in some liquids and not others. A few liquids antibubbles have been formed in include beer, distilled water, tap water, and ginger ale. (Connett 1974b).

Another trait that separates antibubbles from air bubbles is their weight. This means antibubbles are mostly liquid, which makes them heavier and less buoyant than air bubbles, which cause antibubbles to rise much slower to the surface (Nadovich 1998b).

The life span of antibubbles are fairly short, usually only lasting a few seconds before popping which makes it challenging for scientist to study antibubbles or to test them. If antibubbles can be stabilized they can be used to remove pollutants, filter air, contribute to drug delivery, to name a few uses. Using the knowledge that antibubbles are heavier and less buoyant, Connett found a way to prolong the life of antibubbles to about two minutes. Salt was added to the core of an antibubble making it dense enough to sink, and when honey was added, it cushioned the fall of the antibubble. Later, Connett did several other experiments involving antibubble life, and was able to create one lasting seven minutes.

The purpose of this study was to determine the best liquid, temperature, and tools to form an antibubble. The main goal was to make an antibubble that is not only easy to form, but with a longer life then an average antibubble. To do this antibubble were tested in different liquids at three different temperatures using two different instruments, and two different substances to extend antibubble life span.



**HYPOTHESIS 1**

When the syringe and plastic pipette are used to form antibubbles in distilled water, $CO_2$ water, beer, and oil the syringe will form the most antibubbles in all liquids and out of the four liquids used, the most antibubbles will be made in distilled water, using the syringe.

**HYPOTHESIS 2**

Cooling distilled water, $CO_2$ water, beer, and oil will increase the life spans of antibubbles formed in these liquids, using the syringe. Antibubbles formed in cooled liquids compared to liquids heated or at room temperature, will last longer, especially in distilled water.

**HYPOTHESIS 3**

Distilled water at room temperature with food coloring added will form antibubbles with a longer life span compared to room temperature distilled water that does not contain food coloring.

**HYPOTHESIS 4**

Distilled water at room temperature with propylene glycol added will produce antibubbles that will last several minutes longer compared to antibubbles made in the room temperature distilled water without propylene glycol.

## MATERIAL AND METHODS

**EXPERIMENT 1**

Two hundred and fifty milliliters of carbonated water, distilled water, beer, and corn oil were each measured and put into four separate containers.  These containers were labeled with the name of the liquid.  For example above distilled water, a note read "distilled water."  Fifty milliliters of clear dish soap was added to each container. It should be noted all dish soap used in this study, was dye, fragrance, and phosphate free. A blunt knife was used to lightly stir the soap into the liquid. If a large amount of foam formed, a spoon was used to remove some of it. Then all liquids were tested using a thermometer to ensure they were at room temperature, which is around 20 degrees Celsius.

A plastic pipette and syringe were both used, each for 60 seconds to make antibubbles in all four liquids one at a time. The syringe and plastic pipette were first used to expel liquid from the solution being tested. Two methods were used to form antibubbles throughout this study, although antibubbles did not form on each try and only the "Water Globule Method" was used for this experiment. Water globules were formed by placing the instrument close to the surface of the liquid and expelling a small amount of the solution into the liquid. When the solution was forced out at the proper rate and the proper distance through the formed water globules antibubbles would be produced. (Beaty 1997).

Each time the syringe or plastic pipette was used for testing, it was washed using dish soap after to prevent contamination. The number of antibubbles formed in each liquid with the syringe or plastic pipette in 60 seconds was recorded in the lab notebook. After repeating this test several times, it would be determined which instrument (plastic pipette or syringe) was most effective at producing antibubbles.

**EXPERIMENT 2**

Two hundred fifty milliliters of carbonated water, distilled water, beer, and corn oil were each put into four separate containers and chilled until they reached 100 Celsius or below. This was tested using a thermometer. Fifty milliliters of clear dish soap was added to all liquids and then lightly stirred using a blunt knife. A syringe was then used to make an antibubble using the "Water Globule Method". Using a stopwatch, the life span of the antibubble was timed. This step was repeated in each liquid, more than once, until a desired amount of test results were gained. After each test, instruments were cleaned using dish soap to prevent contamination. The same test was done, but with heated liquids which is detailed in the paragraph below and in the lab notebook.

Two hundred fifty milliliters of carbonated water, distilled water, beer, were each put into separate pots on a stove top. They were then heated until they boiled. They were then cooled until then all reached 32o Celsius. Testing is detailed in the paragraph above and in the lab notebook, although a different method to form antibubble was used.

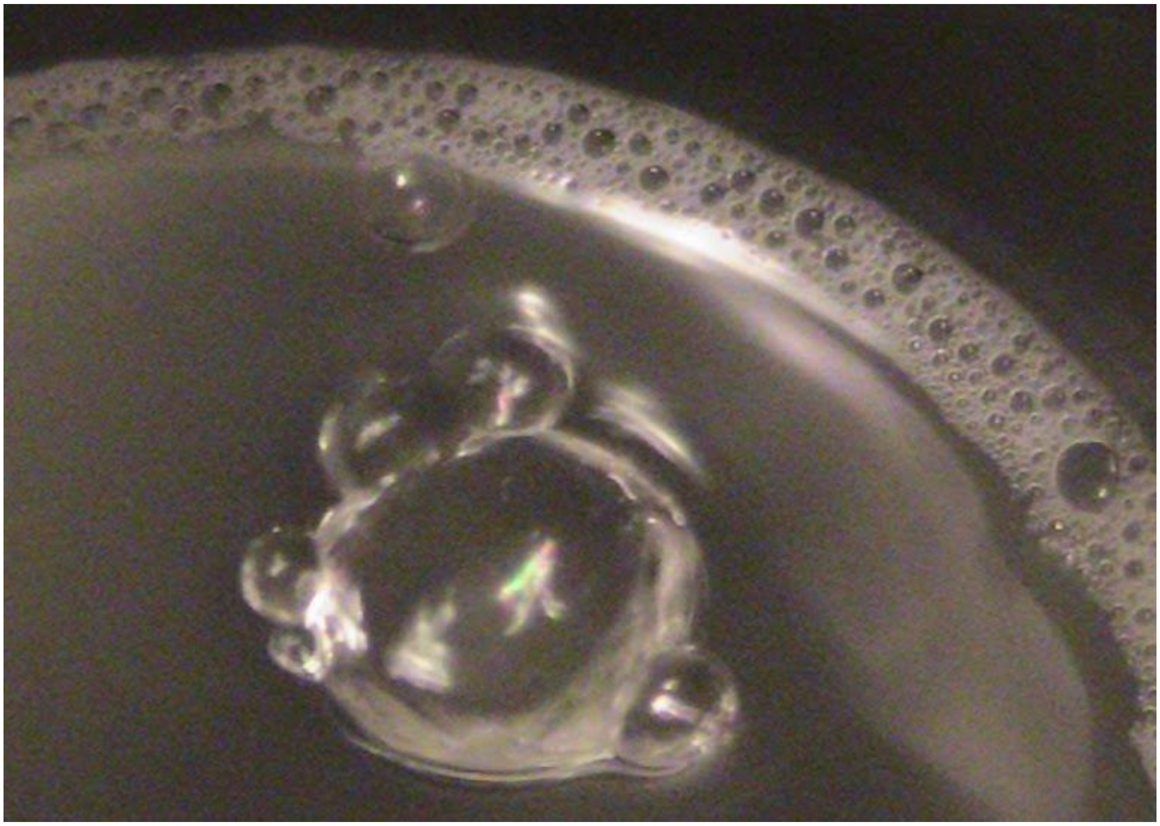
During this method the syringe was used to expel liquid from the solution. Then the instrument was slightly tilted to the side, and the solution was slowly expelled from the instrument to form antibubbles.

**EXPERIMENT 3**

Two hundred fifty milliliters of distilled water was placed in a container and 50mL of clear dish soap was stirred in slowly using a blunt knife. An antibubble was formed using a syringe and then the antibubble's life span was recorded using a stopwatch. Another container was also filled with 250mL of distilled water and 50mL of clear dish soap. Four drops of blue food coloring was added. Then, an antibubble was formed using the syringe. This antibubbles life span was recorded using the stopwatch. Results were recorded in the lab notebook, and testing continued until a desired amount of results was obtained. The "Water Globule Method" was used in both tests.

**EXPERIMENT 4**

Two hundred fifty milliliters of distilled water and 50mL of clear dish soap was placed in a container, then stirred with a blunt knife. Latex gloves were put on and, using a plastic pipette, propylene glycol was expelled from the propylene's container. Four drops of propylene was lightly stirred using a blunt knife into the distilled water/soap mixture. With the syringe, the "Water Globule Method" was used to produce an antibubble. The antibubble's life span was recorded using a stopwatch and repeated until a desired amount of test results was gained. Two other tests were done; one added 20 drops of propylene glycol to room temperature distilled water, another adding 4 drops to cold distilled water. This information, recorded in the lab notebook, was later compared to the distilled water antibubbles life span tested in previse experiments.

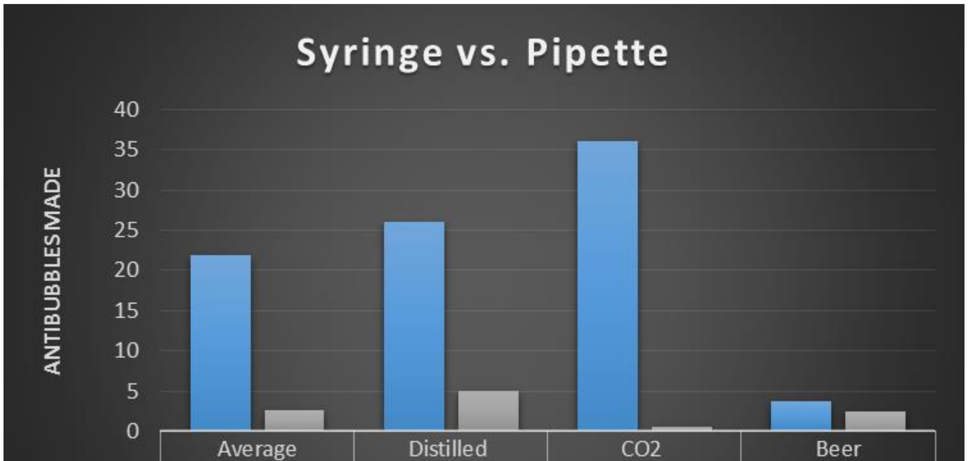


Water Globule

Antibubbbles w/Coloring

## RESULTS

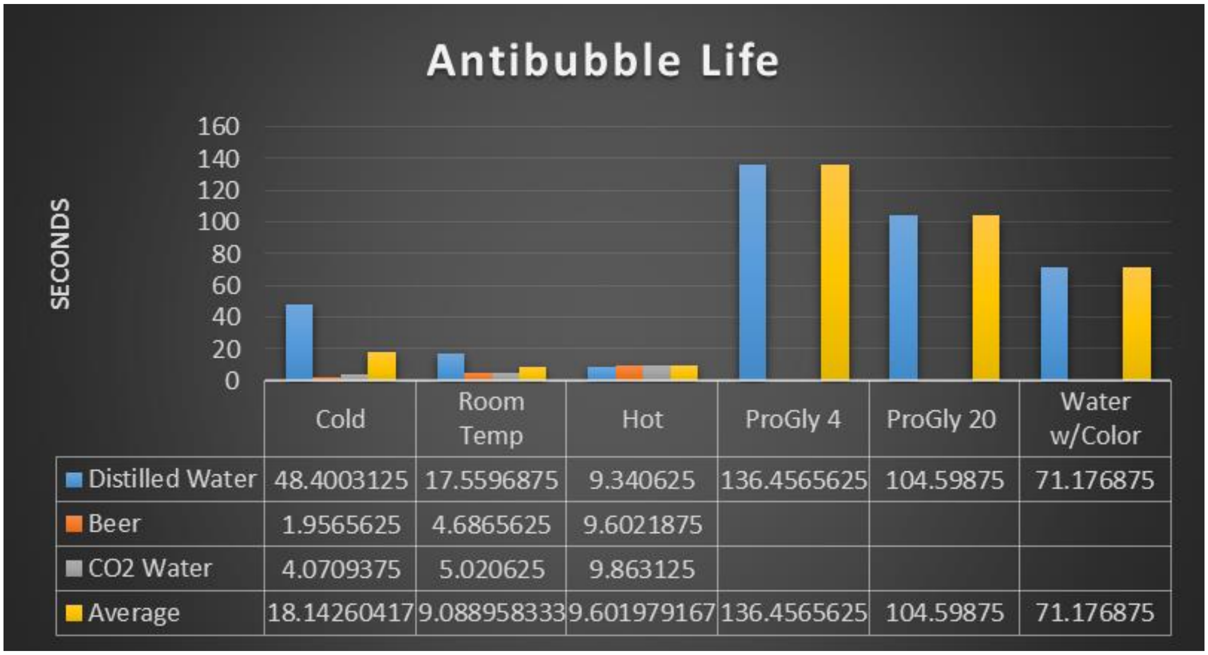
According to the syringe vs. plastic pipette experiment, the syringe formed 263 antibubbles total, which is 231 more antibubbles than the 32 antibubbles that were formed using the pipette. Also using the syringe, carbonated water is were the most antibubbles were formed, at a total of 144 antibubbles. The plastic pipette made two antibubbles in contrast. One hundred and four antibubbles were made in distilled water using the syringe; using the pipette 20 were made, forming 124 antibubbles in distilled water total. In beer only 15 antibubbles were formed using the syringe, and 10 using the dropper (25 total).

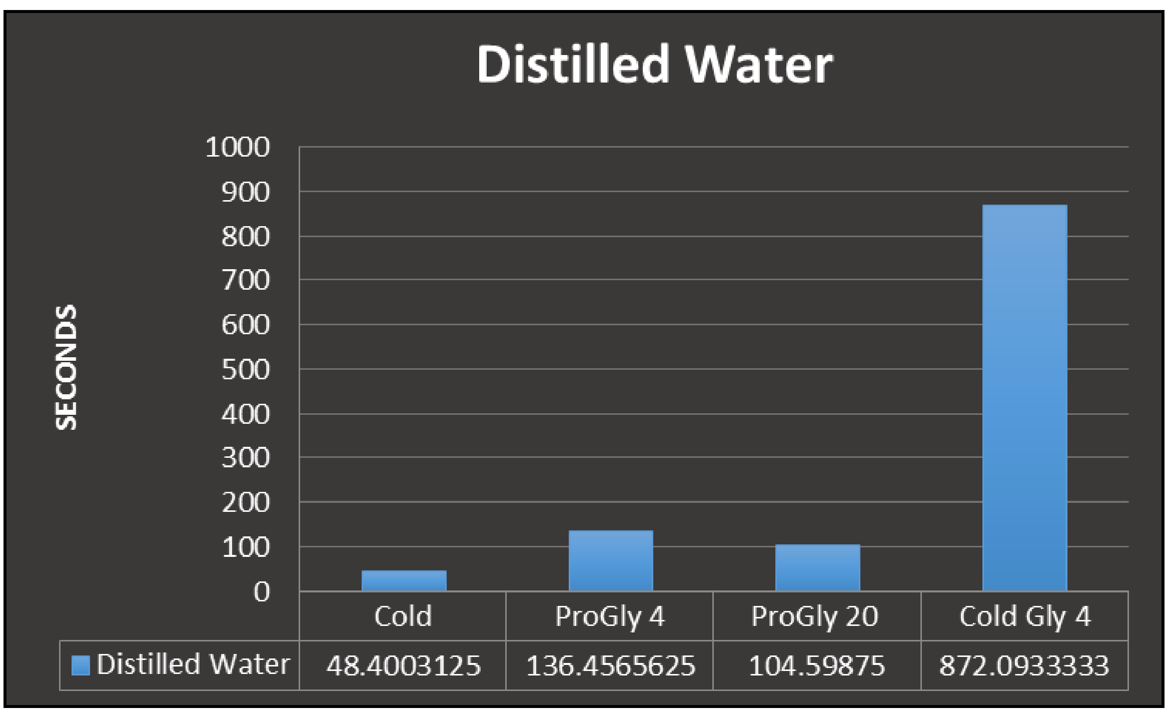



| | Average | Distilled | CO2 | Beer |
|---|---|---|---|---|
| Syringe | 21.91666667 | 26 | 36 | 3.75 |
| Pipette | 2.666666667 | 5 | 0.5 | 2.5 |

During experiment two, cold distilled water produced antibubbles that lasted 64% percent longer than antibubbles made in distilled water at room temperature and lasted 81% percent longer than antibubbles in hot distilled water. It also produced antibubbles that lasted 89% longer, significantly longer than antibubbles made in cold carbonated water and beer. Antibubbles at room temperature formed in beer life spans increased, but only about 3 seconds, from the 1 second antibubbles lasted in cold beer. In carbonated water, antibubbles lives only went up about 1 second at room temperature, from the 4 second antibubbles produced in cold carbonated water. Oddly, when heated, distilled water, beer, and carbonated water formed antibubbles that all lasted about 9 seconds. Although the distilled water's antibubbles life span decreased when heated, beer and carbonated water's antibubbles life span went up about 72%.

Experiment three and four involved adding food coloring and propylene glycol to distilled water to prolong antibubble's life span. Distilled water with added food coloring lasted 76% percent longer then uncolored distilled water at room temperate with 4 drops of propylene glycol antibubbles last 84% longer. In another test, 20 drops of propylene glycol was added, which compared to distilled water without propylene glycol lengthen antibubbles life span about 83%. When four drops of propylene was added to cold distilled water antibubbles life spans last about 94% longer than plain cold distilled water. The longest lasting antibubble in this experiment lasted about 30 minutes was formed in the cold distilled water solution with four drops of propylene glycol.



## CONCLUSION

The results of all four experiments both support and do not support my hypotheses. In experiment one; the syringe did in fact make the most antibubbles, although carbonated water produced more antibubbles than distilled water. Distilled water behaved exactly as I predicted in experiment two. The longest lasting antibubbles were formed when the water was cooled, but the life span decreased at room temperature, and even lower when heated. Both beer and carbonated water behaved actually the opposite, which I didn't expect. When heated, both liquids produced antibubbles that lasted about 10 seconds longer then when they were cooled. At room temperature they lasted less than when heated, but more than when cooled. All of my hypotheses for experiments three and four were correct. Antibubbles in distilled water with food coloring last much longer than antibubbles in the uncolored distilled water. Distilled water with the propylene glycol last minutes significantly longer, in fact the longest antibubble made in the study formed in the propylene glycol/cold distilled water. This antibubble lasted about thirty minutes. Although some of my hypotheses are correct, I do not believe I have found the easiest most effective way to make a stable (liquid – air) antibubble.e col d distilled water solution with four drops of propylene glycol.

## DISCUSSION

The data collected in these experiments has verify several notions about antibubbles. Experiment one eliminates the common belief that a dropper is best to use to create antibubbles. The syringe likely worked better because the rubber gasket allowed control of liquid flow making it easier to make more water globules and less foam. The experiment also suggests that carbonation can affect antibubble production although I do not have any ideas on why. Experiment two attests the theory that temperature affects antibubbles (Beaty 1997). Cold distilled water has less kinetic energy than hot distilled water, meaning molecules move slower in cold water. This makes cold water more stable; whereas hot water is the opposite with fast moving molecules that dissolve substance quicker. I infer this is why antibubbles life spans are longer, in cold water. Experiment three and four produced new information that has not yet been explored in antibubbles outside of this project.

Continuing this study using more controlled experiments would be beneficial. Additional trials would also provide more accurate results.

Further explorations could include:

1) testing antibubbles in different ph solutions

2) producing different sized antibubbles and exploring how that might affect their life span

3) exploring antibubbles filled with different solutions

5) testing how different carbonation levels effect antibubble life span

6) Determining the chemical reaction between created between propylene glycol and antibubble

Perhaps Connet's experiment with honey and salt prolonging antibubbles life span can be used in a propylene glycol solution in cold distilled water solution to expand their lives even more.

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