Cherry Coke Distillation Laboratory: Al DeGennaro

Teacher's Guide

Goals

- To use a new technique for separating mixtures
- To relate chemical principles to everyday life

The Laboratory

In this laboratory, Cherry Coke is distilled in order to learn about separation methods and food content. At least three components are identified: CO_2, food flavorings, and distilled water. The reaction of CO_2 with lime water is demonstrated before the experiment. This experiment should give the students the feeling of the chemistry of food.

Lecture Notes

Lime water is a chemical which is actually called $Ca(OH)_2$. The reason that it is called lime water is because the stuff that you put in your garden, which is called lime, is also $Ca(OH)_2$.

When you are distilling, you will have the tubing going into some lime water. Why are we doing it? Allow me to demonstrate.

Instructions

Put some lime water in a test tube. Immerse a drinking straw in it. Blow into the straw and watch the lime water become cloudy.

Discussion

In this demonstration, the teacher exhales air into a test tube which contains lime water, $Ca(OH)_2$. The following reaction takes place:

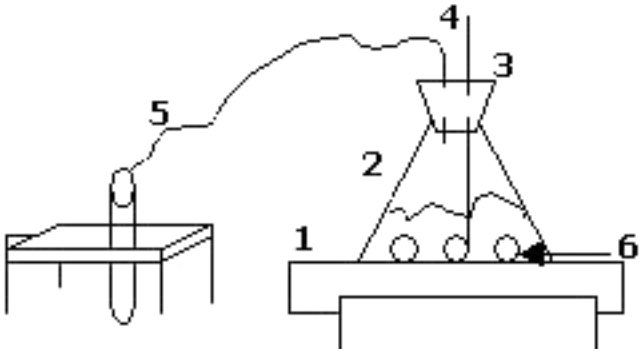
$$Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O_{(l)}$$

The solution turns cloudy due to the solid particles of $CaCO_3$ that are formed. This is a simulation of the same process of distilling CO_2 from soda pop.

Materials for Each Group

- Cherry Coke or grape soda
- Test tube rack
- Two 50 ml test tubes, one empty and one with lime water
- Ice bath
- Stopwatch
- Graduated cylinders: 100 ml and 5 ml

- Apparatus for distillation:
  1. Hot plate,
  2. 500 ml Erlenmeyer flask,
  3. A suitable rubber stopper for the flask with two holes,
  4. Thermometer in one hole,
  5. A tygon/plastic tubing connected to a short glass tube in the other hole,
  6. Boiling chips.



Note: professional distillation equipment can be used, if available.

SAFETY

Wear safety goggles at all times during the demonstration and laboratory.

Do not touch hot plate or hot vessels with bare hands.

Before heating, have your students show you their distillation apparatus: be sure they tighten all connections and open the tubing.

Lecture Notes

Lime water gets cloudy if you shake it, so don't shake it.

It's cloudy because little chunks of solid form in the water.

What is it in the exhaled air that reacted with $Ca(OH)_2$? CO_2, which forms $CaCO_3$.

What does this have to do with the soda pop lab? It is the same CO_2 that is in soda pop. It is one of the ingredients that we have to remove from the soda. And the way that we're going to test it is by bubbling it through lime water.

Lime water is not very dangerous and getting it on your fingers is no big deal. But try not to get it on your skin, if you can help it. You will collect it in the test tube during the experiment.

We're expecting to get flavorings out of the drinks. There should be at least one flavor, and there should be even two flavorings in the grape. So, what you are going to do while carrying out the experiment, is to waft the odors towards you from time to time and, if you smell something, record that.

You know that many of the food flavorings are artificial. The companies mix a chemical or two which only taste like it. These chemicals come out at different times (in distillation).

Instructions

You didn't check your apparatus before you started. The only reason I'm doing this is to make sure that nothing is wrong with your apparatus.

Keep the stopper in real tight.

Keep an eye on the thermometer. When it gets to about 30°C, you should keep it there for about 20 mins. You should see some action in your lime water.

If you don't get cloudy lime water, you should do the distillation over again.

Other groups have found that if the stopper is not really tight, the carbon dioxide squirts out of the tube. If you see bubbles coming through that's a good sign.

Did you smell the cherry? At what temperature was it noticeable, do you remember?

When the odor starts to fade and the temperature drops, heat it some more.

There's no way that you have so much grape flavor in it. If there were so much then it would probably have driven us all out of the room. There are probably about two drops of grape flavor in it.

You can unplug the heater and take off your goggles, and I will give you the closing questions.

Discussion Questions

Did you smell the flavoring? Did it come before or after the water?

How many people smelled the flavoring? Did you smell one or two?

Did the flavoring come out before or after the carbon dioxide or sort of in the middle?

What's the last thing you saw? There's still water in the test tube.

What would be left in the flask? Anything else in the soda (read the label).

Comment

Another fun lab to do without a formal write-up is to distill Cherry Coke. This is a simulation of the distillation of crude oil in the petroleum unit. The sweet smelling ester and carbon dioxide are similar to the more volatile fractions, which come off in the distillation of crude oil. The water fraction is a good contrast to the dark liquid left in the flask and points out distillation as a means of separating components with different boiling points in a mixture. This lab is simple but gives students a known mixture to work with in the lab. (By John R. Kirkau, taken from http://chem.lapeer.org/Chem1Docs/cherrycoke.html.)

Teaching Tips From Mr. DeGennaro

Separating mixtures is a very often misunderstood topic in chemistry. The idea of element, mixture and compound is very confusing to beginners. So, we will address that and we will have fun, too.

We are really at a disadvantage of a large class in a fairly small room. That's pretty much the trend…large classes. It puts a cramp on the kids. The tables are designed for four kids max and they're working five on each table.

You don't need a lot of equipment. The flasks and Erlenmeyers are everywhere, the tubing and thermometers are also pretty easy to get. This is very low tech, and this is the beauty of it.

They always show distillations on Frankenstein movies. That's expensive glassware. It's not practical to do seven stations on this, especially with kids who are pretty young and are likely to break things. So this is easy stuff.

The thing I like about it is the ingredients. These are things that they see all the time. So, instead of pulling chemicals off the shelf, deliberately mixing it and saying "now separate the 2-propanol from the 1-propanol," we can get their attention with something they are familiar with.

Except for the loose connections, everybody got successful results. There's always something you forget to tell the kids and that's to keep the stopper in, really tight.

I think the concept was driven across very well. I think they all understand it. And I'm going to drop in on some of the kids and see how they worked.

I would hope that they come out of this with a feeling that the products that they are using are understandable things. There is no such thing as a grape soda spring…that somebody blended this together with ingredients, which everybody knows about.

It's not just the food. I think that they should think the same about their medicine. If the doctor is telling them to take it they should ask: what is it doing to me?

I've seen chemicals that fizz violently when they touch water. I've seen chemicals, which burn up other chemicals. I've seen chemicals that do nothing. What exactly is this stuff doing to me?

That's a mindset that people should have all the time, that things are made from understandable things, and that they can do it.

Students' Comments

We want to see what makes the bubbles in Cherry Coke. By boiling it to evaporate, and putting it on ice, we get back whatever liquid there was in it.

I actually enjoy doing experiments, so I'm having a good time doing this stuff. In normal life I don't really care, I just like having things to drink and I don't really care what's in it. But knowing what's in it makes you actually aware of what sorts of chemicals are in objects these days.

I'm learning to do all kinds of things with heat that I didn't think that you could do before.

References: Links

http://www.pafko.com/history/h_distill.html
This site applies distillation to petroleum refining.

http://www.schoolscience.co.uk/content/3/chemistry/materials/index.html
A series of interactive pages that explain the composition of matter. Distillation and chromatography are highlighted.

References: Readings

Stanitski, C. (1999) "Molecules at an Exhibition: Portraits of Intriguing Molecules in Everyday Life (by John Emsley)," *Journal of Chemical Education,* Vol. 76, No. 8, pp: 1065-1066.

Rohrig, B. (2000) "Fizzy Drinks: Stoichiometry You Can Taste," *Journal of Chemical Education,* Vol. 77, No. 12, pp: 1608A-1608B.