Aluminum Recycling Laboratory: Al DeGennaro

Teacher's Guide

Goals

- To recycle aluminum cans and make a useful product, alum
- To understand the processes involved in recycling, their importance, and the difficulties in doing so

The Activity

This is a two-day activity, in which students are involved in a real-life chemical procedure and recycle old aluminum cans into solid alum. The students follow the whole process, do the reactions, learn about the hazards and difficulties involved in the process, and end up with a useful product. This experiment promotes the environmental consciousness of the students and educates for recycling.

Comment

Materials, SAFETY topics, and experimental procedures appear in the following sites:

http://sparkychem.wcu.edu/Alum.pdf

http://www.owlnet.rice.edu/~chem122/Lab122/Al/

or other sites, using the keywords aluminum, recycling, alum, experiment.

Lecture Notes—Day I

Today's class features an extremely cool lab with extremely nasty chemicals, and I hope no one gets injured.

In this particular lab, you are going to take a scrap piece of aluminum, and make it into a useful product.

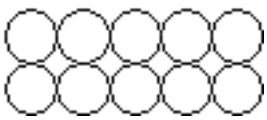
The best thing that you can do with old pieces of aluminum is to make new pieces of aluminum. That's why we recycle cans. It requires very low energy.

But the next best thing, if you can't completely manufacture a brand new chemical just like it, is to make something else that is useful. We are going to make something called alum.

When you want good quality printing paper, the gaps are filled in using alum. They make a very thick solution of alum, they smear it on, run it through rollers, and that fills in the gaps between the fibers of the paper.

Other things that they use it for is purifying water and making very tiny particles clump together. They then they sink to the bottom and the water comes out of the faucet looking good.

You should be able to make good alum crystals. We hope that in our solid alum we will have only alums, and they will be lined up, in nice rows, with no foreign atoms in between.



Now if there's dirt, or leftover chemicals on the outside of the crystals, that's not as bad as having them on the inside of the crystals, but still, it will make them stick to each other, and then they will not look as good.

One of the criteria that I will use to grade your crystals is how they avoid sticking together.

Alum crystal scoring: large amount, white colors, sparkles, uniform color, crunchy or fluffy (not sticky).

You should have the following: You should have lots of crystals, they should also be very white in color because alum is supposed to be white. If they are not white they must have some impurities in them. They should also sparkle: look like tiny ice particles, and they should be a uniform color and sometimes they will glob together, but if you tap them and they fall apart, they should not stick together again.

Lets talk about safety. Look at the bottom of the page where it says: this chemical [KOH] will dissolve skin. It really will. If you spill it on your hands, it will decompose your skin. Not instantly, though: it will actually take several seconds before it will start hurting.

Here's where the KOH is going to be. It is going to stay in the fume hood, you are not going to carry them to the table.

When you pour in your aluminum, it is going to react with KOH and start spattering. If that's the case, we wouldn't want to loose any of our product. First of all we don't want it to spatter out, because it might hurt somebody and also because it might be some of your aluminum atoms coming out—so you want to cover it with a watch glass.

Your starting chemical is a piece of an old soda can that was chopped off. It is painted on the outside, and you have to get the paint off of it

It also has a plastic coating on the inside, which most people don't know. The acids in soda pop will eventually react with aluminum, and if there weren't a coating on the inside, it would actually dissolve a hole in the aluminum can.

It's going to be your job to clean off the lacquer and the paint.

You can cut the aluminum anyway that you want, as long as there is no paint on it, and that it is in small pieces. Small pieces will react faster.

Tomorrow, we are doing day two, so if you want to go over what you are doing ahead of time, that will give you a head start.

Lecture Notes—Day II

In the second session, you will have to filter out the brown impurity, and that will be thrown away. Then you will add sulfuric acid, which will do two things. It will destroy the extra base, and it will add sulfate to the aluminum, which is part of the alum, and it will also make it turn into a solid.

As a result of that, we will get white crystals, which we will chill on ice, to make them dissolve as little as possible, and filter it.

There's going to be a lot of filtering and waiting for stuff to drip. We want to give you the longest time possible to do your filtration.

You are going to filter the liquid from that brown sludge. It has junk that we don't want, but also the chemicals that we do want.

Grab some goggles, start filtering. Once its dripping, I'm going to teach you a little bit, then you will go back, pour a little bit more, then I will teach you more, then you should be able to finish the entire experiment in time.

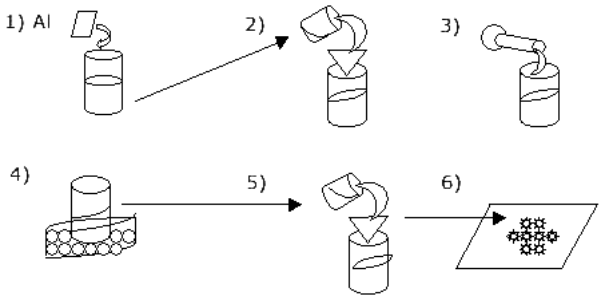
It's coming out clear, it's a good sign. Remember, don't throw away the wrong stuff.

This is going to be a suspense-filled one. You might do something wrong and not get any crystals. Or, sometimes crystals emerge all of a sudden.

Your closing activity, in addition to the questions in the procedure, will be to explain the two-day experimental procedure using the following diagram:

Here is a diagram of the procedure of recycling aluminum for making alum.

1. Explain what is done in each stage.
2. Where are the aluminum ions at each stage?



Teaching Tips From Mr. DeGennaro

Because it's a two-day lab, one group started it yesterday and the other group will start it today. Mod I will do one activity, and Mod 2 will be doing another activity, so it's going to be very confusing for me, but we will pull through somehow.

We hope that we get some beautiful crystals at the end of the mod that will sparkle in the sunlight.

First, I want to teach them the chemistry: that aluminum can react and eventually we end up talking about how most metals react with acid only, but that aluminum will also react with a base, because it is on the borderline between metals and non-metals.

Environmentally, the same old lesson that everybody drills in: When you throw something away, it doesn't disappear. It's got to go somewhere and you have to replace it with something else. The worse thing that could happen is that you throw away a soda can, it takes up space, and somebody has to dig out aluminum, and waste a tremendous amount of electricity and other resources, to make a new soda can, back where you started. If you can't make a loop, where you make exactly the same thing that you started with, then the next best thing is to do something useful, at least.

If you have kids that act responsibly, this is a nice activity. It reinforces the idea that we conserve resources. There's some lab techniques here, of working safely with dangerous things, and the idea that you put in two dangerous things, and you eventually end up with something's that safe, is an interesting concept. The down side of it is that it takes a long time.

References: Links

http://www.anchoragerecycling.com/alumfact.htm
Facts about recycling aluminum.

http://www.epa.gov/grtlakes/seahome/housewaste/src/alum.htm
Facts on aluminum recycling.

References: Readings

Orecchio, S. (2001) "Recovery and Reutilization of Waste Matter From Coffee Preparation. An Experiment for Environmental Science Courses," *Journal of Chemical Education,* Vol. 78, No.12, pp:1669-1671.