

CPIMA CLASSROOM LESSON/ACTIVITY: “WHAT’S THAT SMELL?”
(A Lesson on Polymer Out-gassing)

BACKGROUND: Many manufactured polymers, especially when new, give off distinctive odors. The smells of synthetic carpet, paints and finishes, and car interiors are familiar and easily identified by most people. These smells are caused by out-gassed volatile materials (usually volatile organic compounds--VOCs). In the case of plastics and synthetic fibers, much of the aroma can be attributed to “plasticizers” which increase the polymer material’s flexibility. However, there are other volatile chemicals which can be emitted by synthetic polymers, including solvents and chemicals intentionally introduced for the purpose of being out-gassed (such as scents). Sometimes these out-gassed materials are harmful (particularly in some hypersensitive individuals) and can be contributors, if not the sole causes, of indoor environmental air pollution leading to “sick building syndrome”. Northern Technologies International Corporation uses this out-gassing phenomenon to prevent corrosion of metal materials—especially during shipping—by having a somewhat volatile corrosion inhibitor out-gas from polymer material (wrapping material, capsules or plastic tabs) and adsorb onto the surface of metals, protecting them.

This activity follows a procedure used in Tom Karis’ lab at IBM Almaden. I am grateful to Jim Miller and Tom Karis for the time they took to explain the product and their procedures to me.

PURPOSE: The purpose of this lesson is make students more aware of polymers and the chemical make-up of polymers in our lives and to introduce them to the phenomenon of out-gassing and how that phenomenon can be both hazardous and helpful.

INTRODUCTION: I suggest passing around the room plastic film canisters containing cotton sprayed with a dose of ‘new car spray’. Ask them to try and identify the odor and ask them to come up with ideas as to what produces it in a real “new car”. You can also pass around new or freshly opened packages of some kind of new plastic objects and ask them to write down their best description of that smell. A variety of different kinds of organic synthetic polymer materials with different odors would, I think, be best.

Using a combination of lecture and discussion, introduce the concept and phenomenon of polymer out-gassing to your students and have them think of specific synthetic materials that you haven’t mentioned that day which have odors. Ask them to think of ways in which this phenomenon might be used in positive ways. Tell them that they will experiment with one product that uses polymer out-gassing in a positive way.

ACTIVITY: Polymer Out-gassing Used to Inhibit Corrosion

Objective: To compare the corrosion of various types of metals with and without the presence of ZERUST Plastabs.

Materials—For all classes you’ll need an oven which can be set for ~60°C and which will hold ~(18 X how many classes you have) 4-5 ounce jars.

Materials—Each group will need small (~1 cm²) pieces of metal (~3-4 types)

(2) 4-5 ounce jars with tight-fitting lids

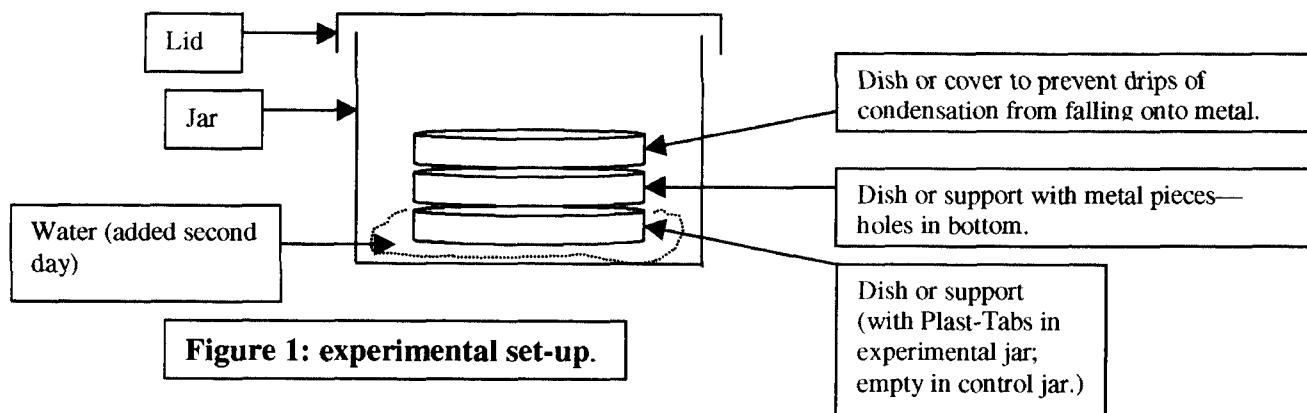
(1) ZERUST Plastab

Water

Plastic weigh boats or other cheap shallow container (in Tom Karis' lab at IBM they use small Fluoroware wafer caddies) to support the plastic tabs and metal pieces out of the water and to keep water from condensing directly onto the metals pieces.

Procedure:

1. Set up two jars, as shown in the diagram below (Figure 1), identical, except that one has the ZERUST Plastab and the other does not.
2. Place both completed jars (without water) in an oven set at 60°C overnight.
3. The next day, carefully add enough distilled water to get several mm of water on the bottom of the jar. Be careful not to get water on the metal samples.
4. Place the jars back in the oven for 5-7 days.
5. After the week, remove the jars from the oven and have students carefully compare and record the degree of corrosion found on each pair of metal pieces of the same type. Use of a microscope could enhance student assessments.



Conclusion Questions:

1. Which jar had less corrosion on its metal pieces? Is the answer the same for all metals?
2. Which metals show the most sign of corrosion in each jar?
3. What do ZERUST Plat-Tabs seem to be able to do? How, do you think, do they do it?
4. What could be some practical applications of these products?

FOLLOW-UP ACTIVITIES FOR STUDENTS:

1. Think up some additional useful products that would make use of this phenomenon of out-gassing. Describe them and their purpose.
2. Look up information on "Sick Building Syndrome" ("SBS"). A search of the web should bring up a number of references dealing with different aspects of the subject.

[I used Altavista and found useful information describing the symptoms, probable causes, analyses of suspect air, organic volatile compounds (OVC's) given off by common polymers and more.]

3. Use Material Safety Data Sheets (MSDS's) to look up possible health problems related to exposure to some of the identified OVC's.

DISCUSSION AND DISCLAIMERS:

1. I have not actually done this lab myself. It has been a routine in Tom Karis' lab, so I have no doubt it will work. It may be possible to do it in less time—the corrosion difference may become quite apparent in less than the 7 days used in Karis' Lab.
2. I have not purchased the ZERUST Plastabs, yet, so I do not know the cost. Northern Technologies International. does have a nice web site, which is somewhat informative.