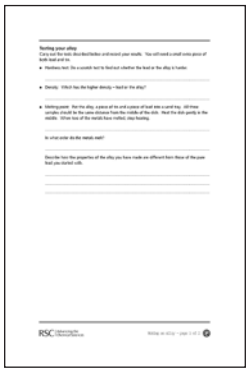
Alloys: making an alloy


Making an alloy



Index 2.3.1
2 sheets

In this experiment, students make an alloy (solder) from tin and lead and compare its properties to those of pure lead.

Equipment required

Per pair or group of students:

- About 2 g lead
- About 2 g tin
- Crucible
- Pipe clay triangle
- Bunsen, tripod and heatproof mat
- Spatula
- Carbon powder – 1 spatula per student
- Tongs
- 2 sand trays or sturdy metal lids
- Sand
- Access to a balance
- Eye protection.

Health and safety

The most likely incident in this experiment is a student burning themselves so warn them that the equipment will be hot.

Pouring molten metal can be hazardous if you are not sure how to use tongs correctly – it would be worth demonstrating how to use them safely. Some tongs in schools do not grip well. Every pair must be checked before the start of the experiment.

Eye protection should be worn.

Lead is a toxic metal. If it is heated for too long or too high above its melting point it could start to give off fumes. Ensure that the laboratory is well ventilated, warn students against breathing in the fumes given off by their sample during the experiment and tell them to heat the metals no longer than is necessary to get them to melt.

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Results

Hardness testing should show clearly that the alloy is harder than the pure lead. The alloy can be used to scratch the lead convincingly. The lead does not leave a mark on the alloy.

(Students may need to be reminded how to do this simple test – just try to scratch one metal with the other.)

The density of the alloy should be less than that of the lead, but this test is fairly subjective.

The lead melts first, followed by the tin, whilst the alloy has the highest melting point. This demonstrates that the alloy has very different properties from its constituent metals.

Extension

This experiment can stand alone as a demonstration of how the properties of a metal can be changed by alloying. Alternatively, you could follow it up with more able students by asking them to explain the results of the hardness testing in terms of the structure of the metals.

A good answer would include a reference to the layer structure of metals and describe how alloying can prevent the layers from sliding over each other, making it more difficult to change the shape of the metal. This makes the alloy harder than the pure metal as it is more difficult to change the shape of the alloy (which is necessary to scratch it).

Making an alloy

You are going to make an alloy of lead and tin and compare its properties to those of the metals it is made from.

You will need

- Lead
- Tin
- Crucible
- Pipe clay triangle
- Bunsen burner, tripod and heatproof mat
- Spatula
- Carbon powder
- Tongs
- 2 metal sand trays
- Sand
- Access to a balance
- Eye protection.

Health and safety

Wear eye protection at all times during this experiment.

Good ventilation is essential.

The equipment gets very hot so avoid touching it.

Lead is a toxic metal. Avoid breathing in fumes from above the heated crucible and wash your hands when you have finished the practical work.

What to do

- Weigh out 1 g lead and 1 g tin. Put the lead into the crucible but keep the tin to one side.
- Fill one of the sand trays with damp sand and push your finger into it to make an indent. This will be your cast.
- Put the crucible onto a pipe clay triangle, place the triangle on a tripod and mat and make sure the apparatus is stable.
- Heat the lead strongly with a Bunsen burner until it is molten. Add a spatula of carbon powder to the top of the lead to prevent a skin forming.
- Add the tin and stir with a spatula until the metals are both molten and thoroughly mixed.
- Move the Bunsen burner away from the apparatus and turn it to a yellow flame. Pick up the crucible using the tongs and pour the molten metal into the cast. Take great care to avoid splashing or dripping as you do this.
- Let the metal cool down completely before you touch it.

Testing your alloy

Carry out the tests described below and record your results. You will need a small extra piece of both lead and tin.

- Hardness test: Do a scratch test to find out whether the lead or the alloy is harder.

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- Density: Which has the higher density – lead or the alloy?

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- Melting point: Put the alloy, a piece of tin and a piece of lead into a sand tray. All three samples should be the same distance from the middle of the dish. Heat the dish gently in the middle. When two of the metals have melted, stop heating.
  In what order do the metals melt?

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  Describe how the properties of the alloy you have made are different from those of the pure lead you started with.

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