

AC1. The action of an anti-caking agent

Pupils are asked to design and carry out an investigation for a cocoa manufacturer who wishes to know whether the addition of an anti-caking agent to the cocoa will help the powder to flow more freely through the machinery. An additional question asks whether leaving the cocoa to stand further with the anti-caking agent added, affects the flow.

Hints

It should be noted that, without care, this has the potential to be a very messy investigation! The cocoa is most easily mixed with the anti-caking agent by putting the two together into a plastic bag or lidded container and shaking them. Make sure the bags are tied at the top or that the lids fit well! When transferring the cocoa from any container into another, there is a tendency for it to fly around.

Using either 100 g or 50 g of cocoa (the smaller of the two suggested funnels will not hold 100 g) it is possible to count the number of taps on the side of the funnel needed to make the cocoa pass through the funnel.

The process must be repeated a number of times to find a mean.

The maximum amount of anti-caking agent that can be used in food legally is 1% by mass in the final product. Pupils may design an experiment which covers a range of concentrations from 0.1 to 1%.

The addition of the anti-caking agent makes a significant difference to the flow of the cocoa above a certain concentration.

Leaving the mixture to stand *for any length of time* also makes a considerable difference. This is one factor which may not be immediately apparent. Making up all the concentrations together, but leaving them standing while testing one of them, may affect the results. However, it is advisable to leave the two powders together *for a short and standard period of time* before carrying out the test. Factors to keep constant include:

- how 'strong' the tap is on the side of the funnel
- how the anti-caking agent and cocoa are mixed before use
- size of funnel
- the length of time the anti-caking agent is left mixed with cocoa before use.

KS3 and 4 science

Timing - various

Pupil activity sheet AC1 accompanies this activity.

Requirements

- *balance accurate to 0.1 g*
 - *clamps and stands*
 - *powder funnels*
[Ordinary filter funnels are not suitable since the opening to the stem is too narrow; suitable funnels may be purchased from Philip Harris, Lynn Lane, Shenstone, Lichfield, Staffs, WS14 0EE; two sizes are appropriate and have code numbers R86432/6 and R86433/8]
 - *plastic bags approximately 25x25cm*
[It is essential that the bags do not have holes in them! The bags are used to mix the cocoa with the anti-caking agent; you could also use plastic containers with lids]
 - *cocoa*
[This must be 100% cocoa and not have an anti-caking agent already present (check the label!)]
 - *anti-caking agent**
This is supplied with the resource. Store this in a dry place; this additive is silicon dioxide, E551
 - *other simple equipment such as beakers, spatulas, spoons*
- * *Further supplies are available from the Chemical Industry Education Centre, University of York, Heslington, York, YO10 5DD, (tel 01904 432523)*

The problem with powders is that the particles in the powder have a tendency to stick together or cake. This is commonly seen with table salt which sticks in the salt cellar and refuses to be sprinkled over your chips! This is really only a minor inconvenience and the problem can often be solved by adding a few grains of rice. It may be interesting to consider how this works.

Manufacturers of food powders may experience real problems if the powder sticks together to form big lumps and clogs up the machinery.

Many production systems will use an anti-caking agent at some point in the production process.

You receive the following letter from the manufacturers of a cocoa powder:

Memo to: Research Director
from: Technical Manager

Chris,

As you know, we manufacture a high quality powdered cocoa which is used in cooking and for hot drinks.

We have found that particles of cocoa stick together and stop flowing through various parts of the machinery. This causes us to stop production in order to clear the blockages, which wastes a lot of time and is costing us a lot of money. The time taken to fill the containers is double what it should be.

If this situation continues we will be forced to pass this extra expense on to the consumer.

We have available to us an anti-caking agent which claims to help the cocoa powder to flow more freely and enable us to overcome this problem. We understand, by law, that the maximum permitted level of anti-caking agent is 1% of the mass of the final food.

We would like you to carry out an investigation using our cocoa and the anti-caking agent to find out:

- a Does the anti-caking agent really make the cocoa flow more freely?
- b Sometimes the machines are left full of cocoa overnight and so the agent would remain mixed in with the cocoa. Will this make further difference to how quickly it flows?

Thanks.

You are given the following:

- cocoa
- anti-caking agent
- clamps and stands
- a funnel - if cocoa is carefully placed in this funnel, the cocoa will not flow through the funnel unless the rim of the funnel is gently tapped
- a balance
- plastic bags or containers with lids in which you can mix cocoa with the anti-caking agent
- and other simple apparatus.

Task

Design and carry out an investigation which will attempt to answer the two questions asked in the letter.

Hints

- handle the powders **very carefully**; to avoid mess
- remember to carry out a **fair test**
- remember to write a **report** for the cocoa company.