

B3 Inclusion: How does waste separation work? – Separating materials by density and other properties

The amount of plastic waste is increasing worldwide. In an effort to reduce this flood of waste, in Germany, for example, disposable bottles are also returnable. These plastic bottles are partly fed back into the raw materials cycle, as is the case with returnable glass bottles. After the waste goes through a crude presorting process, it is delivered to companies that either produce new raw materials (for example, nearly 100 percent pure granulates) or directly manufacture new products (for example, cable ducts for railway track construction).

The topic of plastics recycling is dominated by ideology and conflicts of interest. Therefore, the students will come across some misleading or at least contradictory information when they do their research. (When this happens, my students always say, “But it says so on the Internet.”) Teachers should be able to bring clarity to this situation.

1 Main question

How can plastic waste be separated according to type?

Similar to what is done at recycling companies, samples of materials (or better yet, cleaned waste) of PE, PS, and PVC should be separated.

2 Integrating the experiment into the teaching context

2.1 Relevance to the curriculum and competences

Areas of expertise in selected curricula from Saxony-Anhalt

Chemistry in grade 9/10:

Investigating derivatives of hydrocarbons and evaluating their useful properties as well as properties that are harmful to health and the environment

The students should:

- apply knowledge – classify plastics according to their properties and the resulting possible uses.
- gain knowledge – plan, conduct, and log the experimental investigation of the properties of selected plastics.
- evaluate – discuss and assess the advantages and disadvantages of using plastic and possibilities for recycling plastics.

2.2 Explaining the experiment in the teaching context

2.2.1 Qualitative approach

This experiment shows the simple physical methods that can be used to sort plastic waste, at least crudely.

2.2.2 More detailed explanation of the phenomena

The addition of table salt increases the solution’s density and therefore polystyrene also begins to float as the solution’s saturation level increases.

2.3 Experimental variations

Variation 1 (for the students):

Fill a beaker halfway with tap water and add a drop of dish detergent. Then put in pieces of plastic. Observation? Add spoonfuls of table salt (from experience, approximately 6–7), stir well after every portion, and observe.

Variation 2 (for teachers):

Collect the groups' salt solutions in the graduated cylinder (approximately 550 ml). Pour the solutions carefully because the dish detergent will make suds. Then determine the density using the hydrometer.

Experimental variation:

Some of the groups add salt only until the PS rises; the other groups carry out the experiment fully. Then the density of the solutions is determined separately.

3 Notes on conducting the subexperiments

Subexperiment 1:

Fill the 600 ml beaker halfway with water and add a drop of dish detergent.

Then put in the samples of different plastics (three different plastics).

The students write down their observations.

The experiment is continued by having the students add table salt one spatula at a time while stirring constantly.

After every spatula of table salt is added, the students write down their observations.

Subexperiment 1 ends when a second sample of plastic rises.

Subexperiment 2:

All table salt solutions are collected from the students in a graduated cylinder and the solution's density is determined.

4 Additional information on the experiment

You will find additional media (B3 How does waste separation work?) for preparing or for further study of this experiment on the Media Portal of Siemens Stiftung:

<https://medienportal.siemens-stiftung.org>.

Source of the experiment: Borrowed from experiments for chemistry classes at the University of Bayreuth:

http://daten.didaktikchemie.uni-bayreuth.de/experimente/standard/0103_trennung_kunststoff.htm