# STUDENT WORKSHEET

## Phosphate Recovery

### Topics

Critical raw material, precipitation, recycling of chemicals, solubility, and wastewater treatment.

### Objectives

* Develop understanding of the interdependence of the structure, properties, and uses of chemical compounds.
* Observe systematically and use observations as a source of data.
* Develop experimental (research) skills.

### Introduction

To grow crops in the same place year after year, the soil must be nourished. You need to put back as much nourishment as is used in cultivation. In the past, stable manure was used, but nowadays manure has largely been replaced by industrially produced commercial fertilizers. Phosphorus is an element that plants need to grow well. Phosphorous minerals that are used to make commercial fertilizers are a finite resource. Just like in animal manure, phosphorus is found in the feces that we flush down the toilet and in other types of wastewaters. How can wastewater treatment plants of today be the resource plants of tomorrow? One way to make use of phosphorus from wastewater is to use sewage sludge from water treatment plants. In Sweden, about a third of sewage sludge is utilised. The remaining two thirds are too polluted to be used in agriculture, containing heavy metal ions such as cadmium, lead, and mercury.

### Lab equipment

* 3 small jars (approximately 100 mL, preferably plastic with a lid)
* (if no jar with lid, 1 spoon)
* 2 beakers (approximately 250 mL)
* 1 measuring cylinder, 100 mL
* 4 coffee filters
* 1 neodymium magnet

### Chemicals

* "Sludge ash"
* Calcium chloride, 0.8 mol/L

### Safety information

Mandatory personal protective equipment: goggles and lab coat. Calcium chloride, 0.8 mol/L, is not classified as a harmful mixture. The sludge ash is not classified as a harmful mixture. The waste is harmless.



### Procedure

1. Place the sludge ash into a plastic jar and examine it.
2. Use a magnet to separate the contents by holding it underneath the plastic jar and moving it around.
3. Keep the magnet underneath the jar and transfer the non-magnetic materials into a separate jar.
4. Repeat steps 2 and 3, about 5–8 times to remove as much of the black contamination as possible by. Collect the black contamination in a separate jar.
5. Add 100 mL of warm water to the purified sludge ash. Put the lid on and shake or stir gently.
6. Filter the mixture by placing a coffee filter over a large beaker and pouring the mixture into it, folding 3-4 cm of the filter over the edge to secure it in place.
7. Collect the filtered solution and repeat step 6 twice using a new filter each time.
8. Add 100 mL of calcium chloride solution to the filtered solution, stir, and observe what is happening.
9. Filter the solution from step 8 with the last coffee filter.
10. Allow the content in the last filter to dry until the next lesson or hand it to your teacher.
11. Dispose of the final filtered solution by pouring it into the sink.

### QUestions for discussion

1. What property is used to remove the black contamination?
2. Why do you need to repeat the filtering process?
3. How could the products of each step be used?
4. Discuss the potential benefits of scaling up this process.

### Results and discussion

Record your observations at each step in the procedure.

Answers to the questions above.

Discuss the advantages and disadvantages of using fertilizer originating from wastewater treatment compared to artificial fertilizers in terms of sustainability, cost, and other relevant considerations.