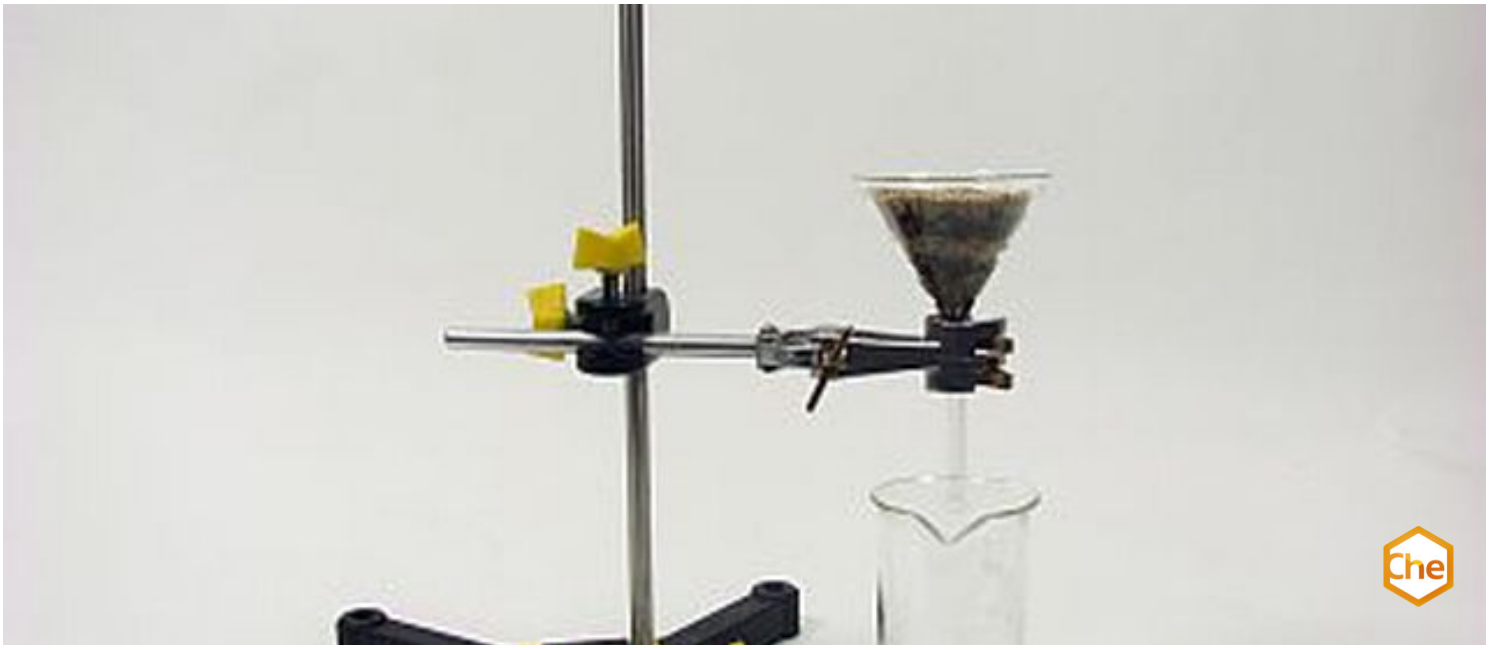
Water treatment in sewage treatment plants



Chemistry | Industrial Chemistry | Exhaust gas cleaning, environmental protection

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f566e3b742d0c00034be288

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Teacher information

Application

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Experiment set-up

A sewage treatment plant converts dirty wastewater into clean water by means of mechanical and chemical-biological processes. One of these purification stages are the gravel/sand filters.

For example, a combined system of gravel/sand filters and downstream activated carbon filters is used in the sewage treatment plants for water treatment. Gravel/sand filters "filter" a large proportion of the impurities, but cannot retain dissolved substances. The activated carbon filter is used to separate these substances.

In this experiment the students learn about the principle of a gravel/sand filter and how it works.

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Other teacher information (1/2)

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Prior knowledge

- Gravel filters are devices for the purification of water and waste water.
- A gravel filter is used to separate undissolved solids from water. This process is called filtration.
- An activated carbon filter contains activated carbon and is used to remove dust, heavy metals and toxic chemicals from liquids and gases.

Scientific principle

In this experiment, the students learn how a filter system of sand and gravel works by modelling such a filter.

Preparations

- Newly used methylene blue solution should be diluted 1:1.
- The clay solution from the experiment "Solutions, colloids, suspensions" can be used.

Other teacher information (2/2)

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Learning objective

- In sewage treatment plants, a combined system of gravel/sand filters and downstream activated carbon filters is used for water treatment.
- Gravel/sand filters separate a large part of the impurities, but cannot retain dissolved substances. The activated carbon filter serves to separate these substances.

Tasks

- The students build a model filter system from sand and gravel, which can be found (in a similar way) in the sewage treatment plants.
- They are investigating how the filter system works in the sewage treatment plants.

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Safety instructions

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- Do not swallow methylene blue!
- Use safety glasses/protective gloves!
- The general instructions for safe experimentation in science lessons apply to this experiment.
- For H- and P-phrases please consult the safety data sheet of the respective chemical.

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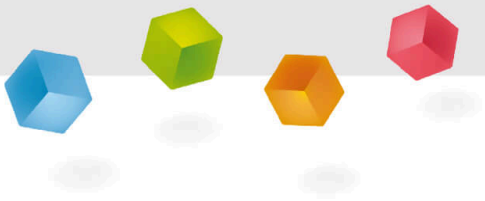

Student Information

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Motivation

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Activated carbon

Wastewater treatment in a sewage plant includes mechanical, biological and chemical wastewater treatment. In this experiment a combined system of gravel/sand filters and downstream activated carbon filters is investigated.

This system is the basis of a separation process with the aim of producing pure water with the lowest possible content of undissolved particles.

Gravel filters are used in water and waste water treatment. In contrast, activated carbon filters are also used in other areas such as respirator filters, in aquaristics (pollutants or drug residues are filtered out of the water) or in the ventilation systems of cars.

Tasks

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How does the filter system work in the sewage treatment plants?

- Build a filter system similar to the sewage treatment plants.
- Investigate its effects.
- Consider the advantages and disadvantages of using such filters.
- Write down your experimental observations and answer the questions in the protocol.

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Boss head	02043-00	1
4	Funnel, glass, top dia. 80 mm	34459-00	1
5	Beaker, Borosilicate, tall form, 250 ml	46027-00	1
6	Beaker, Borosilicate, low form, 250 ml	46054-00	1
7	Beaker, 250 ml, plastic (PP)	36013-01	1
8	Universal clamp	37715-01	1
9	Protecting glasses, clear glass	39316-00	1
10	Rubber gloves, size M (8), one pair	39323-00	1
11	Glass rod, boro 3.3, l=200mm, d=5mm	40485-03	1
12	Spatula, powder, steel, l=150mm	47560-00	1
13	Activated carbon, granular 250 g	30011-25	1
14	Methylene blue sol.,alkal. 250 ml	31568-25	1
15	Quartz sand, coarse, 1000 g	CHE-881318041	1
16	Cotton wool, white 200 g	31944-10	1

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Set-up (1/3)

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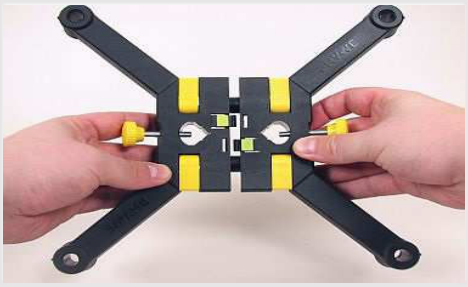
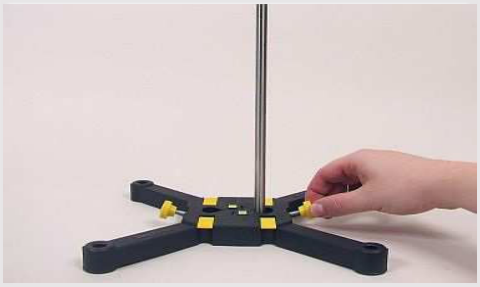
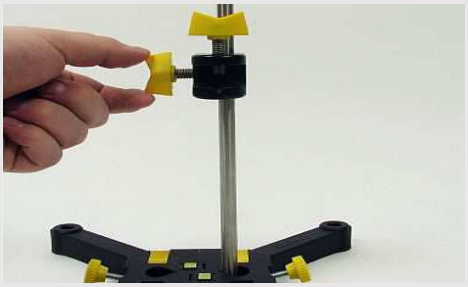
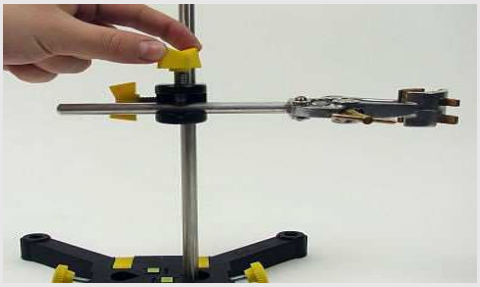
- Set up the tripod as shown in the pictures.
- Attach a stand rod in the stand flow (picture above right)
- Attach the clamp to the stand rod with a sleeve (pictures below)

Set-up (2/3)

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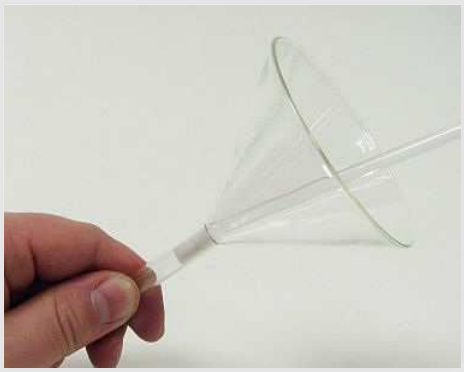
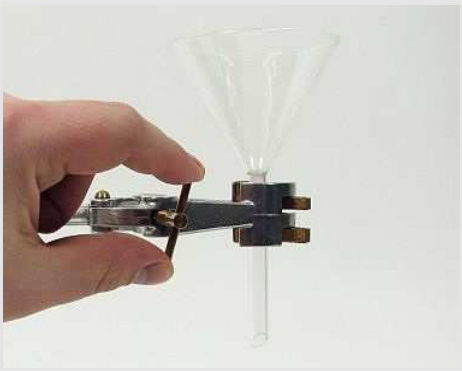
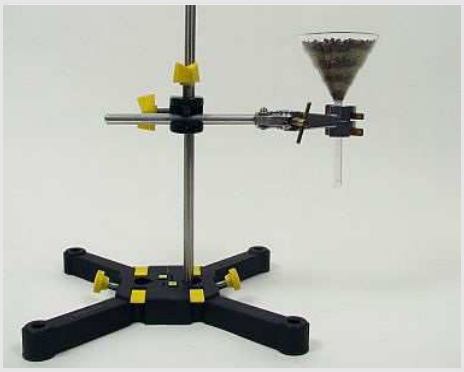
- Use the glass rod to stuff some cotton wool into the outlet tube of the funnel (do not stuff too tightly!) and clamp it into the stand (first two pictures below)
- Fill the funnel alternately with a 1 cm layer of gravel and sand to just below the upper edge.

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Set-up (3/3)

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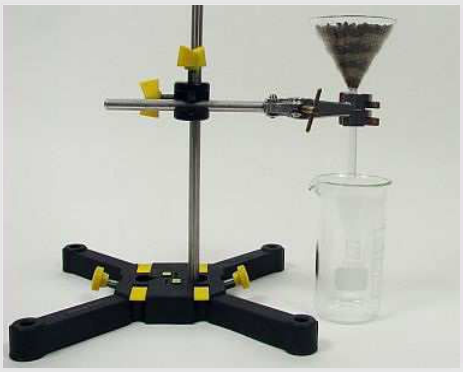
- Place a beaker under the funnel.
- Moisten the manufactured filter thoroughly with water.
- Half fill the second beaker with water and stir in clay to form a suspension.



Procedure (1/2)

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- Empty the beaker filled with water and place it under the funnel. Pour half of the clay water through the filter.
- Replace the filter, place an empty beaker underneath and pour about 20 ml methylene blue solution through it.
- Empty the hopper and clean it. Insert new cotton wool, place a 2 cm thick layer of activated carbon on top of it and like before, a layer of gravel/sand.

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Procedure (2/2)

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- Place an empty beaker underneath.
- Pour through the filter first another 20 ml methylene blue solution, then the remaining clay water.

Disposal

- Collect gravel/sand/activated carbon filter in a bag or similar and dispose of as solids.
- Pour filtrate into the spout.

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Report

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Monitoring

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Write down your observations.

(a) Gravel/sand filter

b) Gravel/ sand/ activated carbon filter

Task 1

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The gravel/sand filter is able to retain dirt particles so that the loam water is almost completely cleaned.

- correct
- wrong

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Task 2

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Complete the cloze !

Bank filtrate is [ ], which is taken from areas close to the bank. The [ ] and [ ] layers of the bank act like a [ ] on the

\contaminated river water and [ ] it of pollutants. Any dissolved odorous substances that may be present must be

[ ] must be separated.

Check

Task 3

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What additional steps could be taken to use the water produced so far as drinking water?

The water could still contain toxins that have not been removed by the [ ], and it could also contain [ ] (bacteria etc.). In any case, the water must still be [ ] if [ ] are contained.
Bacteria etc. are killed by [ ]. To improve the taste [ ] can be added.

activated carbon filter
mineral substances
pathogens
chlorine addition
poisons
analyzed

Check

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Slide	Score / Total
Slide 17: Filtrates	0/5
Slide 18: Bank filtrate	0/6
Slide 19: Water as drinking water	0/6

Total amount 0 / 17

Solutions | Repeat | Exporting text

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