The effects of acids and alkalis on natural and industrial indicators (Item No.: P7157400)

Curricular Relevance

Area of Expertise: Chemie

Education Level: Klasse 7-10

Topic: Anorganische Chemie

Subtopic: Säuren und Basen, Protonenübergänge

Experiment: Wirkung von Säuren und Laugen auf natürliche und technische Indikatoren

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Easy	10 Minutes	10 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

indicator, natural indicator, industrial indicator

Task and equipment

Information for teachers

Learning objectives

- Indicators are colorants indicating the presence of an acid or an alkali through a change in colour.
- There are naturally occuring colorants and technically produced colorants which might serve as indicators.

Notes on set-up and procedure

Preparations
Prepare a 5% hydrochloric acid and a 10% acetic acid (13 ml of concentrated hydrochloric acid and 100 ml of water/11 ml of glacial acetic acid and 100 ml of water).
Also prepare a 5% sodium hydroxide solution and a 5% potassium hydroxide solution (5 g of $NaOH_{(s)}$ / 6 g of $KOH_{(s)}$ and 100 ml of water each). However, it is not necessary to keep the exact concentration levels.

Preparation of the beetroot colorant
Pour hot water over small pieces of beetroot, allow it to stand for 10 minutes and filter it out.

Preparation of the red cabbage colorant and the flower colorant
Put some small pieces of red cabbage or some flower petals together with 4 spatulas of sand and 10 ml of raw alcohol into a mortar and grind them for about 5 minutes. Add another 5 ml of raw alcohol and continue grinding for 3 minutes. Filter everything out.

Remarks on the students' experiments
The pipettes must be rinsed between the individual experimental steps. In order to save time it is also possible to form several groups of students responsible for different tasks. When everything is finished, the students can exchange their results. Once more draw the students' attention to the safety precautions to be taken when handling acids.





Hazard and Precautionary statements

Hydrochloric acid:	
H314:	Causes severe skin burns and eye damage.
H335:	May cause respiratory irritation.
H290:	May be corrosive to metals.
P280:	Wear protective gloves and eye/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induse vomiting.
P309 + P310:	IF exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Acetic acid:	
H226:	Flammable liquid and vapour.
H314:	Causes severe skin burns and eye damage.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P307 + P310:	IF exposed: Immediately call a POISON CENTER or doctor/physician.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Sodium hydroxide:	
H314:	Causes severe skin burns and eye damage.
H290:	May be corrosive to metals.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P309 + P310:	IF exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Potassium hydroxide:	
H314:	Causes severe skin burns and eye damage.
H302:	Harmfull if swallowed.
H290:	May be corrosive to metals.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P309 + P310:	IF exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician.
Phenolphthalein:	
H226:	Flammable liquid and vapour.
P210:	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

Hazards

- Acids are highly corrosive. Put on protective glasses!

Notes

The colours of the flower indicator given in Table 1a refer to a cornflower extract which is very suitable as an indicator.

Remarks on the method

This experiment can either be carried out directly in conjunction with the preceding experiment or independently when the concept of alkalis is introduced, for instance. Question numer 3 requires a deeper insight into the topic since in this case quantitative considerations are in the foreground. The resulting solution can also be applied for introducing the polybasic character of acids (and as an equivalent also of alkalis).

Waste disposal

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- Put all the acids and alkalis used in this experiment into the collecting tank for acids and alkalis.

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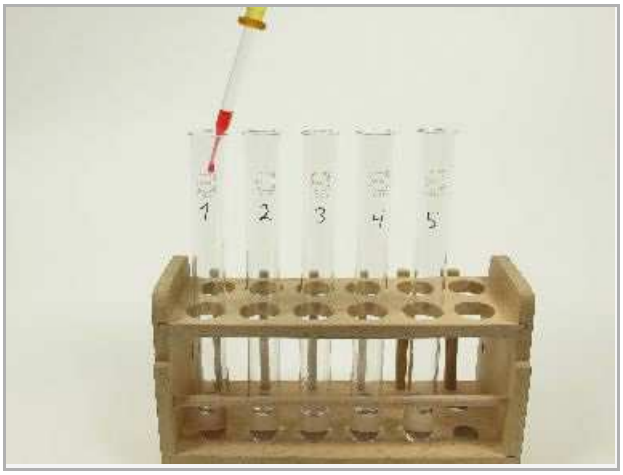
Task and equipment

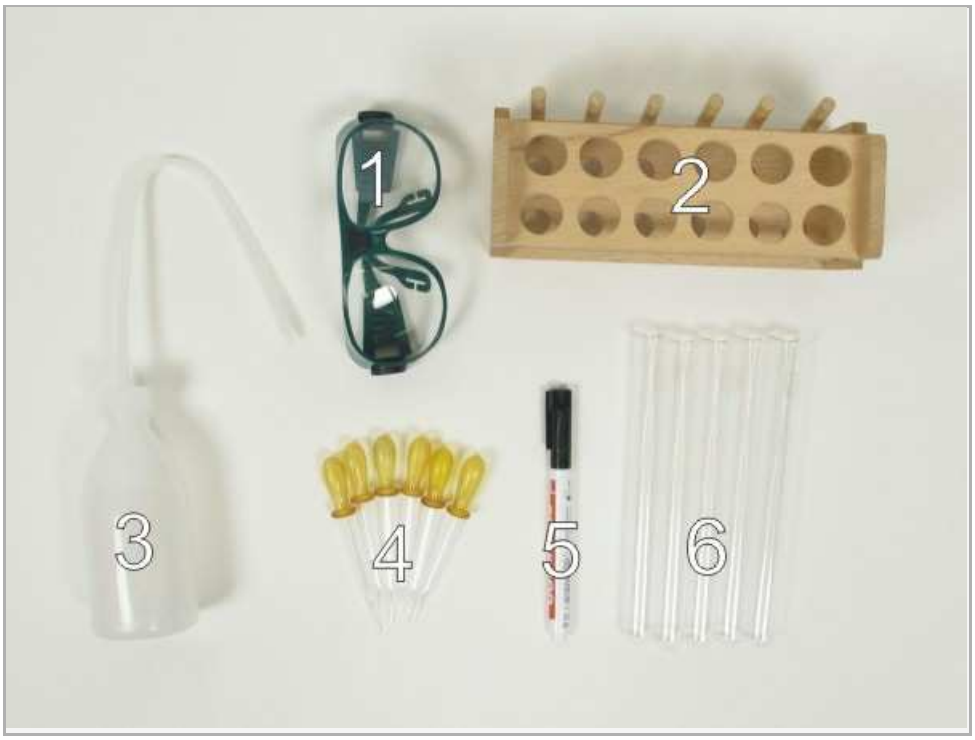
Task

How do acids and alkalis act on indicators?

Study the effects of several acids and bases on natural and industrial indicators.



Equipment



Position No.	Material	Order No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
3	Wash bottle, 250 ml, plastic	33930-00	1
4	Pipette with rubber bulb	64701-00	6
5	Labor pencil, waterproof	38711-00	1
6	Test tube, 18x188 mm, 10 pcs	37658-03	(5)
	Potassium hydroxide pellets,500 g	30103-50	1
	Litmus solution 100 ml	30127-10	1
	Sodium hydroxide, flakes, 500 g	30157-50	1
	Hydrochloric acid 37 %, 1000 ml	30214-70	1
	Water, distilled, 5 l	31246-81	1
	Acetic acid 99...100%, 500 ml	31301-50	1
	Methyl orange soln., 0.1% 250 ml	31573-25	1
	Phenolphthalein, 0,5% soution in ethanol, 100 ml	31715-10	1
Additional material			
	Beetroot colorant		
	Flower colorant		
	Red cabbage colorant		

Set-up and procedure

Set-up

Hazards

- Acids and alkalis are highly corrosive. Put on protective glasses!




Set-up

Number the test tubes from 1 to 5 (Fig. 1).

Fig. 1

Place the test tubes next to each other in the test tube rack (Fig. 2) and mark the pipettes (Fig. 3).

Fig. 2

Fig. 3

Procedure

Fill test tube 1 with distilled water (filling height approximately 2 cm) (Fig. 4). Take a pipette and fill the same quantity of hydrochloric acid into test tube 2, the same quantity of acetic acid into test tube 3, the same quantity of sodium hydroxide solution into test tube 4 and the same quantity of potassium hydroxide solution into test tube 5. Always use a new pipette for the different acids/alkalis (mark the pipettes correspondingly).

Fig. 4

Take a new pipette and let some of the beetroot colorant drop into the test tubes 1 to 5 (Fig. 5). Enter the colour into Table 1 in the report.

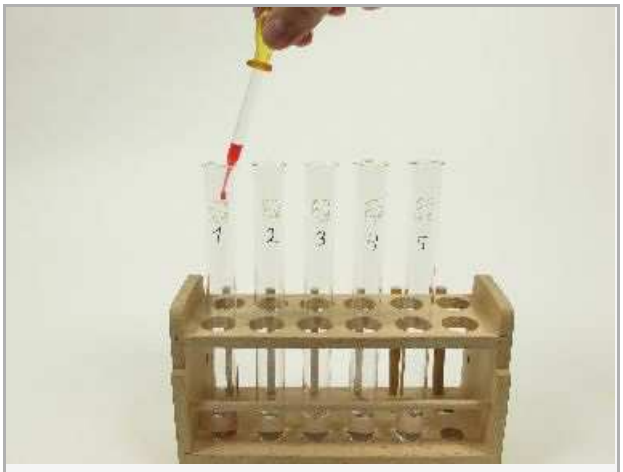


Fig. 5

Put the content of the test tubes into the collecting tank for acids and alkalis, rinse the test tubes by means of some distilled water and fill them as described under the first point. Now add a few drops of red cabbage colorant by means of the rinsed pipette.
Proceed in the same way with all the available indicators.

Waste disposal

- Put all acids and alkalis together with the indicators into the collecting tank for acids and alkalis.

Report: The effects of acids and alkalis on natural and industrial indicators

Result - Observations

write down your observations in a general form.

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Result - Table 1

Enter the change in colour into Table 1.

Indicator	Distilled water	Hydrochloric acid	Acetic acid	Sodium hydroxide solution	Potassium hydrox
Beetroot	1	1	1	1	
Red cabbage	1	1	1	1	
Flower colorant	1	1	1	1	
Litmus	1	1	1	1	
Methyl orange	1	1	1	1	
Phenolphthalein	1	1	1	1	

Evaluation - Question 1

Draw the conclusions from your observations.

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Evaluation - Question 2

Which of the indicators is less suitable for indicating the presence of an acid?

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Evaluation - Question 3

The indicator bromthymol blue has a yellow colour when an acid is present and a blue colour when an alkali is present. What conclusion can be drawn when a solution of bromthymol blue is green in colour?

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