

PROFILES IBSE Teaching/Learning Materials for Teachers

compiled by the PROFILES Working Group of the Maria Curie-Skłodowska University, Lublin - Poland



What is the safe way to use cleaning agents effectively?

A Module for Chemistry Instruction - for Grades 2nd to 3rd of junior secondary school.

Developed by: Ryszard M. Janiuk, Magdalena Słowik and Katarzyna Osińska

Institution: Department of Chemistry Education, Maria Curie-Skłodowska University, Lublin - Poland

Homepage: https://umcs.lublin.pl/zaklad_dydaktyki_chemii Mail: dydchem@poczta.umcs.lublin.pl

Module content.

During lessons pupils carry out studies of cleaning agents which provides a very good opportunity for getting familiar with properties of many substances which are their components. Based on this pupils will be able to point out to their activities which lead to their use in a given cleaning agent. This will require conducting many interesting experiments. As a result, besides consolidating and completing their chemistry knowledge, pupils will become convinced that it can be used in everyday life.

Course of lessons.

1. Looking for information about composition of cleaning agents, properties of their main components and methods to study them based on available materials (packages, journals, books, the Internet)
2. Planning techniques and procedures to study individual cleaning agents. Designing equipment and reagents.
3. Studies of properties of cleaning agents considering their assignment and function of the substances responsible for it:
 - Substances removing stone (CaCO_3) and result (e.g. Cilit)
 - Whitening agents (e.g. ACE, Vanish)
 - Substances to make sewage pipes permeable (e.g. Kret)
 - Detergents (shampoos, fluid soap, washing fluid, washing up fluid)
4. Presentation of results in the form of tables and diagrams. Working out a report to sum up the studies. Discussion with other groups.

The pupils achievements after successive lessons:

1. Will evidence for applicability of the knowledge about composition of cleaning agents, properties of their main components and the methods to study them.
2. They will suggest ways to study properties of some groups of cleaning agents. They will design proper equipment, reagents and procedure.
3. They will study properties of some groups of cleaning agents will describe properties of the substances included in the studied cleaning agents affecting their assignment and safe procedure. They will present



- the obtained results in the form of tables and diagrams as well as perform their critical analysis.
- They will present and discuss the results obtained by individual groups and prepare a final report.

Proposal of studies of individual groups of cleaning agents:

Substances removing stone (CaCO_3) and rust

- Studies of pH
- Comparison of the action of active components on stone and rust.
- Action on the base being cleaned – choice of a proper agent

Whitening agents

- Studies of pH
- Action on dyes
- Action on fabrics

Substances for sewage pipes permeability

- Studies of pH
- Pointing out to the way of action
- Action on fabrics

Detergents (shampoos, rinsing fluids, washing fluids, washing up fluids)

- Studies of pH
- Mechanism of dirt removal
- Effect of Ca and Mg ions presence (comparison with soap)

Among cleaning agents it is possible to distinguish those of disinfecting action. However, in school conditions it is not possible to conduct experiments on pointing out to and comparing this property.

Practical hints

Studies of pH of cleaning agent samples.

After dilution or dissolution in water it is possible to use universal indicator papers or decoction from red cabbage. The obtained information can be a starting point to show their actions and hazards resulting from their misuse.

- Substances removing rust and calcium carbonate (reaction of insoluble in water salts of weak acid and metal oxide with acids to form compounds soluble in water, strong corrosive properties depending on acid strength).
- Whitening agents (strongly basic reaction of whitening agents containing proper chlorine compounds which decompose into strong bases and are compounds of strong corrosive properties).
- Substance to make sewage pipes permeable (strongly basic reaction, compounds of strong, corrosive properties).
- Detergents (almost neutral reaction).

Other studies

Agents removing stone (CaCO_3) and rust

- Comparison of the action of active components on stone and rust.
In the experiment there can be used solutions of a few acids of different strengths: hydrochloric acid, phosphoric (V) acid, acetic acid with the addition of pieces of CaCO_3 (e.g. stone deposited in a kettle) and some object covered with rust (e.g. old nails). Pupils will have to compare rates of reactions.
- Action on the base being cleaned – selection of a proper agent.
In this case small amounts of quite active metals (e.g. magnesium) can be added to the acids used in the previous experiment. The effect of the experiment should make pupils aware why cleaning agents containing strong acids should not be used for cleaning metal objects (e.g. bath batteries) or other acid-sensitive surfaces.



Whitening agents.

- Action on dyes

A few drops of whitening agents should be added to samples containing coloured solutions (e.g. vegetable or fruit juices).

A similar effect can be observed studying the reaction of this group of cleaning agents as gradual decolourization can be observed after the change of indicator colouring.

- Action on fabrics.

On one piece of cotton cloth there should be spread a few drops of a whitening agent whose active component is H_2O_2 and on the other one the whitening agent whose active component are chlorine compounds. In the latter case the cloth should be damaged as these compounds decompose into strong bases.

To make pupils acquainted with the action whitening agents there can be conducted the following experiment. In the beaker with water there can be obtained a black deposit PbS by adding a few drops of suitable salts. Then there should be added scores of milliliters of a whitening agent containing H_2O_2 . Then a white deposit $PbSO_4$ is formed. The same rule is applied when active components of whitening agents react with coloured compounds making a stain which we want to “whiten”. This will take place when new compounds, not possessing colour, are formed.

Agents making sewage pipes permeable.

- Painting out to the way of action.

A drop of water should be placed on a glass plate whose bottom was smeared with grease and in another place a drop of water with the studied agent. A strong base, which is a component of an agent rendering a sewage pipe permeable reacts with grease converting it into compounds soluble in water which causes that the drop of water containing it will “propagate” more over the grease surface. This effect will be more visible on the screen if the plate is put on the panel of the projectoscope.

- Action on fabrics.

A pellet of a given agent should be put on a piece of cotton cloth and after some time it should be checked what changes it underwent. This experiment should be supervised by the teacher following the safety rules.

Detergents (shampoos, rinsing fluids washing fluids, washing up fluids)

- Mechanism of dirt removal.

A drop of water should be placed on a glass plate whose bottom was smeared with grease and in another place a drop of water with a detergent. The drop of water with a detergent will “propagate” over the oily surface which means that it can also enclose and remove dirt particles containing grease.

- Effect of the Ca and Mg ions presence (comparison with soap)

A solution of common soap and detergent should be added to two test-tubes with water containing calcium salt. The deposit of calcium salt of higher fatty acid should precipitate in the test-tube with soap.

Note: The suggestion presented above do not exclude carrying out other studies. In any case, due to the fact that cleaning agents chosen for studies by pupils can have different composition, it is not always possible to predict the effect of their reaction with a given substance (reagent). Therefore it is recommended for the teacher to check earlier the course of experiments proposed by pupils choosing reagents and reaction conditions.



After the lessons pupils:

- Search out and analyse the information about cleaning agents from packages, journals, books and the Internet.
- Point out to drawbacks and advantages of individual kinds of cleaning agents.
- Explain why proper and safe use of cleaning agents depends on knowledge about properties of substances contained in them.
- Take active part in the work of research team.
- Present and justify the decisions about choice and proper use of cleaning agents.

Acknowledgement:

These materials were adapted by the UMCS-PROFILES Working Group - Member of the PROFILES Consortium using the Teaching-Learning Materials Tool compiled by the PARSEL Consortium as part of the EC FP6 funded PARSEL Project (SAS6-CT-2006-042922-PARSEL)

For further information see: www.parsel.eu.

teacher training on inquiry based teaching methods on a large scale in Europe