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Alkaline salts of higher fatty acids (soaps) - science and attraction

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The chemical experiment with real application in practice is an opportunity to increase the interest of the students in chemical science. The synthesis of alkaline salts of higher fatty acids is a possibility of experimental work in a real environment. The ability of students to make glycerin soaps by themselves is an interesting challenge for them. By participating in experimental work, students develop chemical literacy, laboratory skills, teamwork skills, logical and critical thinking when dealing with concrete laboratory tasks. Students learn to link chemistry to real life by solving laboratory problems.

Keywords: chemistry, scientific literacy, students

INTRODUCTION

In recent years, the interest in the alkaline salts of higher fatty acids containing different types of plants and essential oils has increased. The reason for this is their softness and appealing appearance. Their production has been known for nearly 200 years. The making of alkaline salts of higher fatty acids is directly related to experimental work. It is that part of the chemistry that attracts the young people's attention to this difficult but interesting science - chemistry.

This is the reason to seek a connection with the curricula and to find the way to introduce the real chemical experiment as an innovative form of learning. It is believed that innovative forms of education are a prerequisite for increasing pupils' interest in learning activities. Innovative learning methods contribute to the diversification of the learning process. They stimulate the students' creative thinking with the transfer of knowledge. This leads to the formation and development of skills to work with a real chemical experiment and increases learners' self-esteem that they can reach an end product through the acquired knowledge.

The aim of the present study is to highlight the possibility of applying a real chemical experiment in chemistry training to increase the motivation of learning and to develop the natural sciences literacy of students.

A connection is sought with curricula and with a chemical experiment that is actually applicable, i.e. the synthesis of alkaline salts of higher fatty acids (soaps). The analysis shows that the synthesis of alkaline salts of higher fatty acids could be introduced as a classroom form in the training. This is because the curriculum, as expected results, includes knowledge, skills and competencies relating to soap and a real chemical experiment. The student should be able to:

- verbally describe important chemical properties of fats - hydrolysis, saponification, hydrogenation;
- describe soaps as salts of higher fatty acids;
- experimentally distinguish soaps from synthetic detergents by their characteristic properties (pH, their reference to water and acids);
- comment on the advantages and disadvantages of soaps and synthetic detergents in their use in households and in terms of environmental protection;
- plan and conduct a chemical experiment by observing the safety rules;
- present oral and written results of a chemical experiment and draw conclusions;
- use all possibilities to represent the experimental nature of chemistry through a demonstration, laboratory, and home experiment (file: /// C: /Users/Megi/AppData/Local/Temp/UP_HIM_9kl_pril14_90_sintez.pdf).

By improving the skills related to the realization of a real chemical experiment, students acquire and develop skills and competences of different types. Students learn skills for designing the equipment and performing experiments. These skills include both the construction of simpler devices for known processes and the schematic representation and understanding of the principle of operation of more sophisticated devices for chemical processes in the household. Students are given the ability to perform observations and to record, analyze and present in different forms the results obtained.

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They draw conclusions and are able to comply with rules for safe laboratory work to protect their own health and the health of others. Students acquire teamwork skills. The complexity of the acquired knowledge, skills and competences formed for self-realization of a chemical experiment develops students' skills leading to natural sciences literacy.

Numerous studies of this concept and the proposed definitions [1-15] make it possible to summarize that a person who has acquired the natural sciences literacy is the one who understands the scientific concepts, principles and processes, which helps in the understanding of scientific and technological achievements, as well as the phenomena in living and inanimate nature. An educated society must be able to assess the impact of science and technology on people's lives and the environment.

Natural sciences literacy is undoubtedly related to the acquisition of knowledge, skills and competencies that enable real life situations to be dealt with [16].

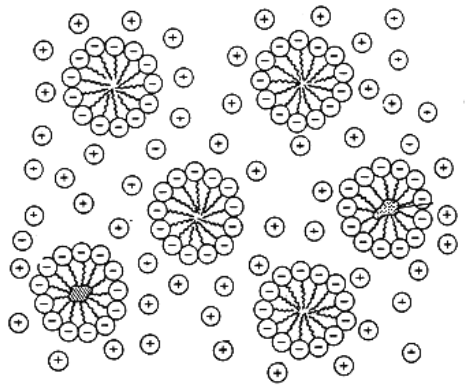

Fig. 1. Operating principle.

EXPERIMENTAL

The making of alkaline salts of higher fatty acids can be defined as a real life situation. Through a practical chemical experiment, students obtain a product and enrich their knowledge and skills. Students synthesize independently colored and aromatic alkaline salts of higher fatty acids. The time required for synthesis is two laboratory hours (90 minutes). Starting materials for the production of soaps are sodium hydroxide, glycerine base, natural fats (olive oil, coconut oil), distilled water, essential oils, seeds and herbs.

In order to make glycerin soap in school conditions, besides the above mentioned materials, the following items are needed: a round-bottomed flask, a beaker, silicone molds that withstand high temperature, filter paper, gloves, glasses and a hob.

The procedure is as follows:

1. Cut the soapy base into small pieces and place them in a round-bottomed flask with water;
2. Heat the flask using a hot plate;
3. Pour the achieved consistency into silicone molds;
4. Optionally add herbs and colorants to the mixture (chamomile, lavender, etc.);
5. The product - glycerin soap is ready in about 40 minutes.

The resulting product has a crystalline structure. Alkaline salts of higher fatty acids contain in their structure a hydrocarbon part (non-polar) called a tail and a polar residue. The hydrocarbon moiety is soluble in oil (impurities), i.e. it is oil-based. The second, salt part, also called the head, is water-soluble, i.e. water-based. Both in households and in industry, pollution is almost always oiled. When a contaminated object is placed in a solution of a higher fatty acid alkaline salt, the hydrocarbon portion is directed to the impurities and the polar moiety remains in the aqueous solution according to the rule: 'Similar ones dissolve in like'. In this way, the solution "wets" the impurity and penetrates between it and the contaminated object that is being cleaned. Upon stirring, air bubbles penetrate into the solution and foam is formed which covers impurities and extracts them as microparticles from the surface of the object.

Alkaline salts of higher fatty acids do not pollute the environment after being used because they are biodegradable, i.e. they are completely absorbed by the bacteria in the soil and in the natural water basins.

In conclusion, it can be summarized that by organizing a laboratory lesson with real application in practice (e.g. in households), the teacher helps the students in an interesting, entertaining and accessible way to:

- increase interest in chemistry;
- form skills for experimental work;
- develop skills for teamwork;
- develop assessment and self-assessment skills;
- develop skills for analysis and selection of information.

CONCLUSIONS

As a result of the preparation and implementation of a real chemistry experiment in chemistry classes for the development of natural sciences literacy, the following conclusions can be drawn:

- In order to be in line with the set educational requirements, the actual chemical experiment must

be compiled in accordance with the normative documents;

- The development of pupils' natural sciences literacy should be achieved by gradual formation and improvement of the individual competencies;
- It is appropriate to develop a methodology for a real chemical experiment for different purposes: for partial individual work in class; for individual work outside the classroom; for entirely individual work in class;
- The real chemical experiment can be used in combined lessons.

REFERENCES

1. AAAS [American Association for the Advancement of Science], Science for all Americans: a project 2061 report on literacy goals in science, mathematics and technology, Washington, AAAS, 1989.
2. R. W. Bybee, Achieving scientific literacy: from purposes to practices, Portsmouth, Heinemann, 1997.
3. G. E. DeBoer, *J. Res. Sci. Teach*., **37**, 582 (2000).
4. R. M. Hazen, J. Trefil, Science matters. Achieving scientific literacy, New York, Anchor Books, Doubleday, 1991.
5. J. D. Miller, *Daedalus*, **112** (2), 29 (1983).
6. J. D. Miller, Civic scientific literacy in Europe and the United States, Annual Meeting of the World Association for Public Opinion Research, 2006, p. 1.
7. NGSS Lead States, The next generation science standards: for states, by states. Washington, National Academies Press, 2013.
8. NRC [National Research Council], National science education standards, Washington, National Academies Press, 1996.
9. OECD [Organization for Economic Co-operation and Development], The PISA 2003 assessment framework: mathematics, reading, science and problem solving knowledge and skills, Paris, OECD Publishing, 2003.
10. OECD [Organization for Economic Co-operation and Development], Assessing scientific, reading and mathematical literacy: a framework for PISA, Paris, OECD Publishing 2006.
11. OECD [Organization for Economic Co-operation and Development], Assessing scientific, reading and mathematical literacy: a framework for PISA, Paris, OECD Publishing, 2009.
12. OECD [Organization for Economic Co-operation and Development], PISA 2015 draft science framework. Paris, OECD Publishing, 2013.
13. M. O. Pella, G. T. O'hearn, C. W. Gale, *J. Res. Sci. Teach.*, **4**, 199 (1966).
14. T. Kolarova, M. Dokova, I. Hadjiali, V. Alexandrov, *Chemistry, Bulgarian Journal of Science Education*, **26(**2), 171 (2017).
15. A. Tafrova-Grigorova, M. Kirova, E. Boyadzhieva, *Chemistry, Bulgarian Journal of Science Education*, **20**(6), 507 (2011).
16. V. Dimitrova, M. Shekerliyska, *Bulgarian Chemical Communications*, **50**(B), 75 (2018).