



Research Paper

Formation of the ecological culture of learners as an important way of solving the environmental problems

Accepted 29th June, 2018

ABSTRACT

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This article considers the possibility of poisoning the environment with dioxin and products such as dioxin. Our goal is to inform as many people as possible the dangers of burning waste, the formation of dioxin and products such as dioxin, as well as the toxicity of these substances. We want to contribute to the education of the human ecological culture in Armenia, to prove that the solution of environmental problems can be achieved through proper environmental activities and environmental policy.

Key words: Dioxin, environmental problems, anthropogenic pollution, dangers of burning garbage, environmental policy, education, ecological culture.

INTRODUCTION

In the autumn of 2017, the mass media of Armenia announced that in Yerevan the refuse is being removed from one site to another but the problem is yet to be solved. According to the mass media, the garbage is generally removed to the refuse tipping site of Nubarashen where it is not sorted and processed but burned up. As a result of incineration, a huge amount of smoke was produced (Figure 1) which spread over the surrounding settlements and the population made a protest.

The population filled the streets complaining of smoke, women were crying out that they were being suffocated by smoke. These poor people knew that it was not ordinary smoke. The smoke contained dioxin - the most poisonous product synthesized by humans. In this article, it is considered one of the dangers threatening our civilization - the possibility of poisoning the environment of the planet with dioxin and products similar to dioxin.

In order to achieve our goal, the level of awareness of the lecturers, teachers and students about dioxins was studied. The level of knowledge of the lecturers and students about dioxins was found to be interesting. As a result, we conducted a survey in which 150 lecturers and students were meant to answer the following questions (Figure 2):

1. Do you have any information about "chlorakn" disease?
A) yes-15 %
B) I heard, but I do not know the details-30 %
B) I have not heard -55%
2. What do you know about the "dioxin" organic matter?
A) I am familiar with the structure and the mechanism of receiving -15%
B) I know that it is a chloro-organic material -30%
C. I know nothing -55%
3. What kind of changes can dioxins cause in the living organism?
A. Known as "Chemical Spider" - 70%
B.causes cancer - 20%
C. I know nothing -10 %
4. What other toxins do you know?
A. Cyanide,90%
B.Anticholinesterase toxins-0%
C. Food poison -10%

The results are disturbing. It turns out that the environmental crisis in the Republic of Armenia is largely



Figure 1: Burning of waste in Nubarashen.

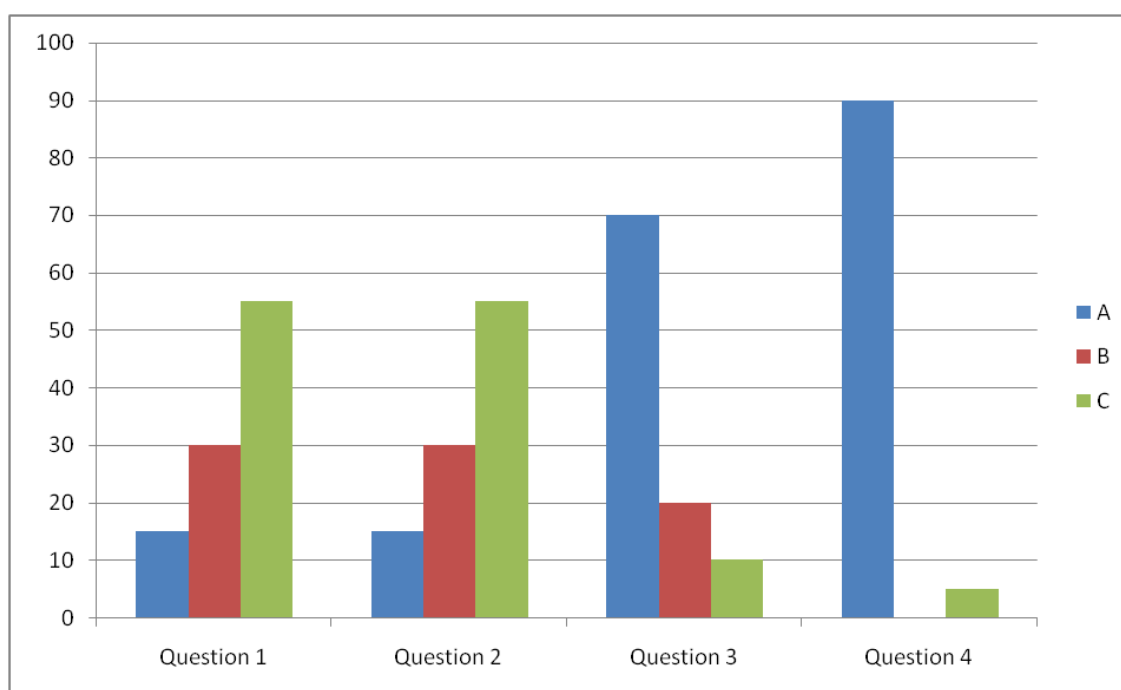


Figure 2: Awareness of students and faculty about dioxin.

the as result of ecological illiteracy of the general public. It is logical that one of the most important ways to solve this critical problem is to carry into effect the ecological education among broad layers of population (Nazarenko, 1990; Oganova and Kornienkov, 2012).

It means finding effective ways and methods to influence consciousness, behavior and lifestyle of a person in

harmony with the contemporary level of interaction between society and nature (Yagodin, 1988).

Creating an ecological culture in the process of learning is the most optimal form of ecological education. An important component of ecological culture is the personal relationship with nature which helps to realize that one is a part of nature and have an environmental responsibility for

the consequences that arise after dialogue with it. There are different ways to realize the goals of ecological education. They are:

1. Ecologization of the educational courses,
2. Integrated training courses,
3. Inclusion of a special subject revealing the problems associated with protecting the ecology and environment from pollution.

The process of implementation of the last two points is complicated and demands a long period of time, the path to reach the goal is very difficult, and the leading role for the ecology training courses belongs to the teacher.

In the initial process of chemistry teaching, it is important to focus the attention of the learners on the environmental protection problems, the development of the conceptual content of the materials, the mutual relations between biological functions, the biosynthetic role of biological agents, and the reasons of biological cycles.

When speaking about ecological orientation of the chemical education, it is necessary to understand the following (Asatryan et al., 2003; Petrosyan, 1991):

- 1). Change in the learning orientation and learning content orientation on the formation of the environmental outlook (environmental image of Armenia). Moreover, this world outlook will adequately reflect the state of the outer environment and its proper deployment in a human's requirements and activities,
- 2). A process of continuous, consistent development and introduction of environmental content, teaching methods and resources which is a complex of environmental upbringing coverage, education and advocacy campaign.

The level of environmental education is determined by the degree of understanding the role of the environmental factors in nature and in the life of the society, by the depth of the knowledge which is provided through the special courses of the subject, by capacity for taking appropriate judgments in the given situation and by the ability of solving the problems in accordance with development of the contemporary science. Creation of the system of chemistry-ecological conceptions is placed in the base of ecologization of the educational subject of chemistry (Ecological Chemistry, 1997; Nazarenko and Malykhina, 1993).

Taking into consideration the special aspects of the contemporary educational process, chemistry courses at schools and universities should be considered from the point of ecological education. Ecological problems should be discussed through the whole course of the chemistry program. For example, it is reasonable to emphasize the issues of chlor-organic compounds, pesticides (herbicides) and insecticides (insecticides) when speaking about hydrocarbon compounds.

The methods of ecological education are as follows:

1. Lectures,
2. Workshops,
3. Experiments.

Approaches to the ecological education involves advocacy of moral behavior norms which do not do much harm to nature (saving water supplies, reuse of natural resources, etc).

LECTURE

This lecture was given to the second-year students of the Pharmacy Faculty of Yerevan Medical University after M. Heratsy and to the group of chemistry teachers of the secondary schools in Yerevan (lecture was delivered by Prof. Sahakyan).

The reasons of the pollution of the environment are both artificial and natural. Usually, we do not pay attention to the pollution caused by natural process - volcanic eruptions, earthquakes, floods, and so on, particularly, for the reason that at the present stage of development, humanity is not capable of affecting them. Besides, nature has the ability to self-control and adapt to changes. Fauna and flora products are completely incorporated into the natural cycle of materials. Depending on the nature of human activity on the Earth, the process of natural processes has undergone some changes. These changes largely depend on the use of natural resources (Miller, 1994; Nebel, 1993).

From mass media, we occasionally observed various break-downs on industrial enterprises, resulting in a large amount of toxic substances emitted into the environment (Chemistry and Society, 1995; Asatryan et al., 2003). Soil, water and air get polluted. People die, animals and plants disappear from their habitats. Thus, the leakage of methyl isocyanate gas from the industrial plant in Bhopal (India) caused the death of 2500 people and more than 100000 people were poisoned. Human also knows the terrible story of the medicine thalidomide. This drug was widely produced in Great Britain in 1960s, but without proper control. As a result of the mass use of this medicine by pregnant women, many abnormal infants were born (Beloborodov et al., 2008).

The terrible disasters that occurred on planet earth should not be forgotten, such as the disaster in Chernobyl, destruction of the Aral Sea, numerous damages of oil tankers on the seas, and pollution of the rivers with waste water pouring into them from industrial plants. It is especially worth mentioning the massive destruction of the Debed River fish in the Republic of Armenia in 2001 and fadeaway of forests.

It is rather complicated to solve the problem of environmental pollution. It may seem that it is a very

common problem to eliminate the cause of each specific case of contamination - simply eliminate the source of pollution. But such an action can have a serious impact on the social and economic wellbeing of the particular region or even the whole country. For example, one of the main reasons for environmental pollution is the use of huge quantities of oil. It is impossible to imagine what kind of monstrous economic consequences would cause the complete termination of oil extraction on the modern lifestyle. That is why, when addressing the problem of environmental pollution, one should pay attention to a large number of factors, including the expediency for those whose interests relate to the problem (Sahakyan, 2006).

In 1988, the Republic of Armenia was famous for its advanced chemical industry. Taking into consideration the environmental problems, some giant plants such as Nairit, Polyvinylacetate and Kanaz plants in Yerevan, Alaverdi Copper Smelting plant, Ghapan (now Kapan) Copper-Molybdenum Combine, Kirovakan (now Vanadzor) Chemical Combination, etc, were brought to stop in one or two years. In the Republic of Armenia which gained independence, inactivation of those factories was against the interests of our country and people. Actually, it was the beginning of the process of cutting Armenia's "live veins" and seriously damaged the socioeconomic wellbeing of the people.

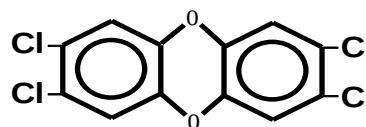
The geography of toxic dissemination from chlor-organic compounds expanded through 1940-1950s, as many countries produced 2,4,5-trichlorophenol and its pesticides, a large number of 2,4,5-trichlorophenoxyacetic acid, as well as hexachlorophene anti-bacterial preparations. The reason for the disease was initially attributed to chlorine. Dioxins could still remain unknown if there was no line of human sufferings. In the last two decades, the issue of contaminating the biosphere with dioxins became a subject of public debate in the press, public and political circles. This was contributed by two major events that took place in 1960-1970s.

The first was the US war in Vietnam, throughout the Southern region. With the aim of fighting guerrillas, in order to destroy vegetation, the American airplanes dropped about 57,000 tons of defoliant - "Agent Orange", which according to the official data contained 170 kg of dioxin. Many reports appeared about mass poisoning, progress of malignant tumors, abnormal born infants and break out of other diseases among both the native population and participants in the war including the US soldiers. It caused panic as this substance was widely used in agriculture to control weeds.

The second was an incident occurred in Seveso, Italy in 1976. Hundreds of tons of 2,4,5-trichlorophenol were drained out of the plants. More than 500 people were poisoned, thousands of domestic animals were killed.

The first report about dioxins was given in 1957. Several groups of scientists in France, USA and Germany

simultaneously started researches on the disease chlorakn. It turned out that the reason for the infection was not chlorine. One of the groups in Germany managed to synthesize a new substance, but the employees were taken ill with chlorakn. The other researchers also repeated the results of the Germans. This substance was 2,3,7,8-tetrachlorodibenzo-p-dioxin (Long et al., 1987), which originates in the process of getting 2,4,5-trichlorophenol as microalloy. After the detection of high toxicity of the compound, a large number of research works emerged on the study of toxicological activity of these substances. It turned out that the most toxic effect is that of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which is more toxic than cyanide, strychnine and in extreme cases, it is comparable to anticholinesterase toxins (tabun, sarin, zoman, etc.) (Feodorov and Myasoedov, 1990; Treger, 2003):



Thus, it was finally confirmed that dioxin is the most toxic and monstrous material that humans have ever synthesized.

Some dioxin such as polychlorodibenzo-p-dioxins, chlorinated dibenzofurans and diphenyls are highly similar, but provided with less biological activity. 2,3,7,8-tetrachlorodibenzofuran was also listed as a substance causing chloracne illness similar to the case of 2,3,7,8-tetrachlorodibenzo-p-dioxin. But this xenobiotic attracted attention when it was confirmed to be microalloy of polychlorodiphenyl. Moreover, polychlorodiphenyl is widely used as fluid dielectric, thermal, hydraulic fluid etc. Massive poisoning with this xenobiotics occurred in Japan (1968) and Taiwan (1979), which was associated with PCB being mixed with rice oil.

Poisoning cases with this xenobiotics were also reported in the tinplate production in Yerevan aluminum plant (1985-1987). The aluminum plate was rolled into a hot fluid polychlorodiphenyl material. The workers at that workshop were getting ill with chloracne disease, their legs and back were covered with typical, incurable furunculus. The health minister of RA assigned us to study the fluid used in tin rolling process. The cause of the disease, of course, was not known at that time, as the devices that revealed the microquantities of xenobiotics are yet exist all over the USSR. Numerous persons suffered from these very xenobiotics only at Kanaz factory in Yerevan (Sahakyan, 2001).

The question is what is the cause of such exceptional toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin? The simplest interpretation is that the shape of the dioxin molecule is rectangular with 3×10 dimension, allowing dioxin to fit right into the appropriate active centers of the

receptors of the living organism. The physiological activity of that "stranger" suppresses the vital activity of the "owners", making them act differently (Asatryan et al., 2003).

A number of dioxin like compounds, such as polychlorodibenzo-p-dioxins, chlorinated dibenzofurans and diphenyls, are similar in their quality but have less biological activity. 2,3,7,8-tetrachlorodibenzofuran was also mentioned as a substance causing illness of chlorakn in line with 2,3,7,8- tetrachlorodibenzo-p-dioxin (Feodorov and Myasoedov, 1990; The Circulation, 1990).

Dioxins are not so toxic in small amount, but they alter the living organism. The system of dioxin poisoning symptoms is extremely complicated. These substances can accumulate in the organism for years without being involved in any interactions, and then remind to cause the disease. The receptors suppress the immune system of the body by blocking the dioxine molecule –illness begins with irritation of the skin, incurable furunculus appear, abnormal infants are born, malignant tumors are developed, and mental agitation is produced.

The issue of lasting infection of the biosphere with dioxin and substances like dioxin is in the focus of attention of the researchers in many developed industrial countries. In number of countries, the problems related to dioxins are one of the most important issues in the ecological program.

It is important and urgent that the government of RA pays much attention on the problem of dioxins in Armenia. The urgency of this problem is conditioned by alarming ecotoxicological situation in Armenia.

The infection of people with xenobiotics in Armenia is connected with:

1. unreasonable utilization of chlorine industrial waste. Chlorine is received by electrolysis of thick salt solution through carbon electrodes. When baking residue of electrodes, a favorable condition is generated for getting dioxin. It should be mentioned that a large amount of bleaching liquid (bleach) is produced in Armenia,
2. fires broken out at power stations where there are large amount of polychlorophenyl insulators or condensers full of PCB,
3. destruction of industrial and residential waste. Numerous substances made of polyvinyl chloride are found in the residential waste. During the incineration, a temperature is established which is advantageous for the production of dioxins,
4. water chlorination. Water contains phenolic compounds and lignin, from which the appearance of xenobiotics is possible
5. Aluminum foil rolling,
6. Automobile-emitted gas, especially when chlor- or bromorganic burning lubricants are used, as well as leaded petrol and dichloroethyl.
7. Production and utilization of pesticides, herbicides

synthesis, for example, phenagon which is
8. the derivative of the above stated dichlorophenoxyacetic acid in the Republic of Armenia.

The evaluation of the risk of the dioxins' effect is possible only on the basis of profound knowledge, by deep understanding the features of their toxic kinetics and toxic dynamics, by shaping the whole variety of expected developments.

The toxicologic peculiarities of xenobiotics are first of all conditioned by their large lipophilic and exceptional stability. Lipophil properties favors the accumulation of dioxins in the organic fase of the biosphere and bioaccumulation in the living organism. They mainly accumulate in the adipose tissues, thymus, liver, haematopoietic organs and they drop out very slowly but they don't drop out of the human organism at all.

Bioaccumulation is realized not only through food chain but also through interphase flow from any environment including air, water and soil. Toxic kinetic researches have revealed that one half of the 2,3,7,8-tetrachlorbenzo-p-dioxin is out from the human organism in 6-7 years. High toxicity xenobiotics- besides being lipophil and stable, should also have relationship with their bioreceptors, the so-called dioxin receptors. All the isomers that comply with these terms, contain four atom chlorine in 2,3,7,8-position, which is accepted as a criterion. Researches on structure-activity coorelation and molecular mechanism impact are essential for understanding harmful effect of dioxins over the environment and on the health of humans. It is important to define the factors that determine toxicological effects of various chemical compounds (Long et al., 1987). Toxicity alarm is a cumulative indicator, depending on various factors, and theoretically it is difficult to estimate that indicator. However, structure-activity coorelation has been studied by many authers. As a trendy problem, this issue has been subject to comprehensive theoretical assessments since 1980s of the 20th century. In all studies, only compounds considerably different in their degree of toxicity and structure have been discussed and compared like TCDD, TCDF, polychlorinated diphenyl, polycyclic hydrocarbon etc.

The principal conclusion on "dioxins" - particularly 2,3,7,8-TCDD, is that toxicity is mainly conditioned by the presence of smooth structure and lateral chlorine substituents.

The peculiarity of the class of dioxins is that in definite positions, besides containing halogen atom, they have dislocated electronic cloud which is very moveable (Asatryan et al., 2002a). In all toxication mechanisms, the key role is given to complex formation with xenobiotics and this or that system of the organism, for example, receptors. Thus, it is natural to conclude that by estimating the mobility of the above mentioned cloud, the so-called "electronic elasticity", we can approximately assess

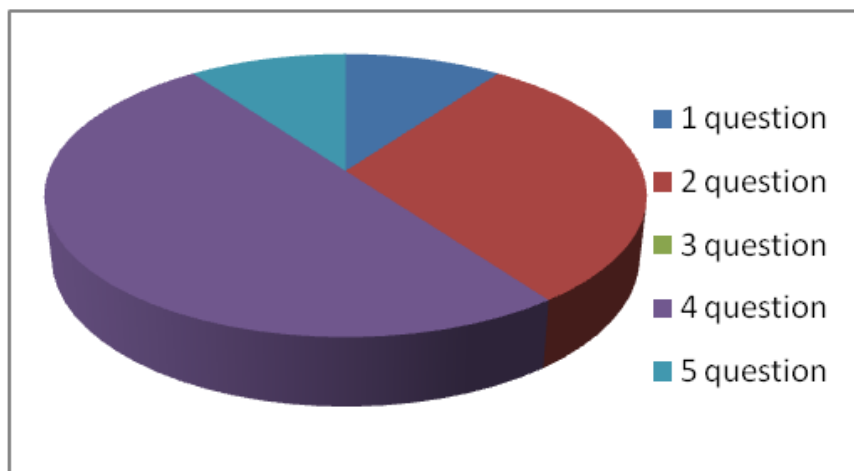


Figure 3: Method to choose based on the results of the survey.

coordination ability of the dioxins, that is the degree of toxicity (Asatryan et al., 2002b). It is impossible to solve humanistic-ecological problems without protecting peace and human rights all over the world.

At present, the main dioxin emitting sources are the waste burning plants, and therefore western countries, as well as the USA and Japan are the most polluted with dioxins. So it is logical that nowadays the governments of these countries implement a very strict policy against dioxin emission. In Japan, there was discovered an area with high mortality rate from cancer, not far from waste burning plant. Through 1985-1995, 42% of deaths were due to cancer in the location situated 1.1 km to the south of the plant (Serebryakova, 1990; Tsyrllov, 1990).

The percentage of cancer deaths in Armenia is high. According to official data, 70% of deaths in Armenia are caused by heart disease and cancer. One of the reasons is probably dioxin.

Chronic exposure of animals to dioxins has resulted in several types of cancer. TCDD was evaluated by the WHO's International Agency for Research on Cancer (IARC) in 1997 and 2012. Based on animal data and on human epidemiology data, TCDD was classified by IARC as a "known human carcinogen". However, TCDD does not affect genetic material and there is a level of exposure below which cancer risk would be negligible. 4 окт. 2016 г. - WHO report on dioxins and their effects on human health includes key facts, definition, sources, contamination incidents, and control.

According to the WHO fact sheet on dioxins in 2017, the World Health Assembly passed the resolution Cancer Prevention and Control through an Integrated Approach (WHA70.12) urging governments and WHO to accelerate action to achieve the targets specified in the Global Action Plan and 2030 UN Agenda for Sustainable Development to

reduce premature mortality from cancer ([www.who.int › News › Fact sheets](http://www.who.int/News/Fact_sheets)).

Two questionnaires were distributed to the students and teachers of chemistry, who had attended the lecture on xenobiotics, to test if the issue was delivered and comprehended effectively.

Dear teacher (student), we expect to get your sincere answer on the following questions-choose the right answer:

A). How is the problem of household waste solved in the Republic of Armenia?

1. In Armenia the household waste is dumped on numerous refuse tipping sites.
2. It is destructed in the garbage burning plants.
3. It is burnt just anywhere-in the refuse tipping sites, in the yards, gardens on the sidewalks.
4. It is sorted and processed.
5. I don't know.

All the respondents chose the first and the second points.

B). If you were elected as a mayor how would you solve the problem of waste destruction? To the question, which method you would use in Armenia - 10% of the respondents chose the first method, 30%-the second, nobody chose the third method, 50% of the respondents were for sorting and processing and 10% were indifferent (Figure 3).

The answers confirm that those who participated in the lecture understood the seriousness of the issue. This was a successful beginning of our struggle.

At the end of the study, the learner receives the final test tasks that must be of creative nature and of interest to learners.

Summarizing test

1. How can the problem of waste generation be solved?
2. Explain the term "Waste civilization".
3. Anthropogenic pollution of the environment:

- a) when is it considered to be quantitative?
- b) when is it considered to be qualitative?

4. Pollution caused by dioxin, is it qualitative or quantitative?

5. Which method is preferable for water disinfection?

- a) by ozone,
- b) by chlorine,
- c) by potassium permanganate,
- d) by ultraviolet radiation.

Give reasons for your preference. You should also explain why you haven't chosen the other methods.

6. Dioxin-like toxicants can also appear in old books. What is the mechanism of their appearance?

7. Why are the polychlorvinyl plastics called a "container of chlorine"?

8. In Armenia there are edible salt mines and by means of salt electrolysis a large amount of bleach liquid is made. During this procedure dioxin-like toxicants appear as well. How does this happen?

9. According to media reports, in Dilijan ("Armyanskaya Switzerland») million trees were felled in the forest. What will be the punishment for cutting down trees?:

- a) Life imprisonment
- b) Death sentence
- c) I will propose to forgive

Conclusion

This article presents how the contents of education, by providing it with issues of ecological education, turns into the contents of teaching. We have been convinced that formation of ecological culture is an optimal form of ecological education.

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Cite this article as:

Sahakyan LA, Manukyan SM, Sahakyan NV (2018). Formation of the ecological culture of learners as an important way of solving the environmental problems. *Acad. J. Environ. Sci.* 6(6): 140-146.

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