THE USE OF LABORATORIES IN SCIENCE TEACHING

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ABSTRACT: Science is one of the significant fields in today's world. It can be described as the process of perception and recognition of the world, thinking about the nature of knowledge, analysis of knowledge and the ways to access information, construction of new information based on the existing one and making estimations about new events. Laboratories can be regarded as places where experimental studies with various equipment and devices and analyses as well as observations are carried out. In the last century, the number of laboratories increased and nearly all disciplined had their own laboratories. In Turkey almost all middle and high schools have their physics, chemistry and biology laboratories and universities also have highly specialized versions of them. Reforms about the improvement of science education programs in the USA soon affected the science education in Europe and similar educational activities began to be used. Such reforms covered the improvement of the contents of science and mathematics courses. At the same time, the significance of science education was again recognized. It was assumed that laboratories were one of the valid and valuable teaching methods in science education. All these changes in the world also affected in the science education in Turkey. In Turkey, science education program was revised in the years of 1936, 1948, 1968, 1992, 2004 and 2013. According to this arrangement of 2013, the program adopted a holistic approach towards teaching and learning, but it was also accepted that students are responsible for their own learning and active student involvement is needed which requires a constructivist approach. Laboratory work is the basis for and indispensable part of science education and all technological research. Individuals could only use their theoretical knowledge of science in laboratories which makes their learning much more permanent. Therefore, studies at laboratories have some certain risks. It requires that at laboratories there should be a safe working environment since workplace laboratories are classified as dangerous. Therefore, staff should know what to do in emergency situations and be aware of potential dangers. In order to provide a safe environment, certain laboratory rules and techniques as well as necessary equipment should be employed. Following such rules is very significant for the health of staff and their safe.

Keywords: laboratory use, laboratory safety, laboratory accidents

INTRODUCTION

SIGNIFICANCE OF SCIENCE TEACHING

Scientific knowledge is the accumulation of the knowledge gained by scholars beginning by the history human beings. People have used it in different forms. This process is considered to be a process of acculturation, which is also called education. It is known that developed societies have well-educated human power. It is widely accepted that effective education is required to produce qualified human power. Therefore, education is considered to be a process of improving individuals' thinking capacity, knowledge base, understanding and skills.

Science is one of the significant fields in today's world. It can be described as the process of perception and recognition of the world, thinking about the nature of knowledge, analysis of knowledge and the ways to access information, construction of new information based on the existing one and making estimations about new events. Science is the result of individuals' attempt to understand the nature and themselves (Collette & Chiapetta, 1989), and is defined as the systematical way of describing the nature and natural events and the attempt to make predictions about the potential events (Turgut et. al., 1997). Science plays a significant role in the development and economic advancement of countries. Therefore, countries put an emphasis on science education in order to keep up with scientific and technological developments to produce individuals who develop knowledge and technology (Ayas, 1995; Ünal, 2003). Therefore, in the last century, countries have attempted to improve the quality of science education. Such attempts are mostly focused on the modification of educational programs (Ayas, 1995; Ayas, Çepni, Akdeniz, 1993). Such changes in educational programs are crucial for the development of countries. Advances in science and technology require that education programs should cover them. At schools, science-related topics are taught in the course of science and technology. Hançer, Şensoy and Yıldırım (2003) argue that one of the basic goals of science education is to produce individuals who can keep up with the changing periods and who could effectively employ all novice technological devices. Another basic goal of science education is to teach individuals that in all technological inventions science is the prerequisite. Science education aims at teaching the ways of thinking and improving the concepts based on experience and the methods of analyzing the cause-effect relationships (Aydoğdu, 1999). Some of the people' motivations to learn about science are as follows:

1) Individuals' desire to learn about themselves,
2) Individuals' desire to learn about their environment,
3) Individuals' desire to arrange the relationships between themselves and their environment,
4) Individuals' desire to deal with difficulties experienced in the world.

Science education is a field which gives importance to experiments, observation and discoveries as well as to the questions asked by students, student research, hypotheses and their interpretation of the results (Çilenti, 1985; Odubunni & Balagun, 1991). Science education has been delivered using distinct teaching and learning methods and techniques. One of these methods is the use of laboratories by first hand (Lawson, 1995; Hofstein, Nahum & Shore, 2001; Hofstein & Lunetta, 2003; Hofstein & Naaman, 2007; Kirschner & Meester 1988).

HISTORY OF LABORATORY USE IN SCIENCE EDUCATION

Laboratories can be regarded as places where experimental studies with various equipment and devices, and analyses as well as observations are carried out. In the last century, the number of laboratories increased and nearly all disciplined had their own laboratories. In Turkey, almost all middle and high schools have their physics, chemistry and biology laboratories and universities also have highly specialized versions of them.

In the USA science education was first regarded as the study of nature philosophy (Elliott, Stewart, & Lagowski, 2008). Early American leaders such as Franklin and Jefferson partly emphasized the significance of science education (Fay, 1931; Newell, 1925). Laboratory education and laboratory methods were not used in the USA until the mid-19th century. The history of laboratory education informs us about its development. Although there are chemistry laboratories both in the USA and in Europe, the use of laboratories for educational purposes originated in Germany (Good, 1936). There were education laboratories at the end of the 1700's in the USA, but the influence of German scholar, Justus Von Liebig, made the laboratory education much more widespread (Browne, 1941; Fay, 1931; Fife, 1975; Sheppard & Horowitz, 2006; Sheppard & Robbins, 2005).

Reforms about the improvement of science education programs in the USA soon affected the science education in Europe and similar educational activities began to be used. Such reforms covered the improvement of the contents of science and mathematics courses. Following World War I, a discussion about the necessity of laboratories for educational purposes was started. This discussion focused on the following questions: "should students do experiments at the laboratories to learn?" and "Could students learn science only through the technique of demonstration?" Following World War II, the questioning of the use of laboratories for educational purposes became uncommon. At the same time, the significance of science education was again recognized. It was assumed that laboratories were one of the valid and valuable teaching methods in science education. Probable reasons of these actions are significant scientific findings during war. Questions about laboratory evaluated as how laboratory education is should be. Based on these views, educational programs were revised around 1960's and laboratories began to be part of these programs.

All these changes in the world also affected the science education in Turkey. In Turkey, science education program was revised in the years of 1936, 1948, 1968, 1992, 2004 and 2013. Such revisions began in the period of 1953-1954 in regard to science education at the levels of primary and secondary education. The programs were expanded to include Modern Physics (PSSC-Physica Sciences Study Committee), Modern Chemistry (CHEM-Chemical Education Material Study and CBA Chemical Bond Approach), Modern Mathematics (SMSG-School Mathematics Study Groups) and Modern Biology (BSCS-Biological Science Curriculum Study). These programs also included lab handbooks, teacher guidance materials, movies and materials. Reforms about science programs in western countries initiated at the end of the 1950's began to influence Turkish education system from the 1960's. One of the activities to improve science education was a project named BAYG-E-14 which was developed by science high schools. The project was implemented in nine high schools. It covered several topics including the improvement of laboratory, course and complementary materials, and other teaching and learning materials. In order to use the program improved through the project BAYG-E-14 in much more schools, another project, called BAYG-E-23, was developed. This project was implemented in the period of 1971-1976 on 100 high schools and 89 teacher training schools (Demirbaş, Soylu, 2000).

Modernization studies of the secondary science education ceased and in 1984 were completely disappeared (Çilenti, 1985). Then the Ministry of National Education (MONE) formed several commissions to develop a new science program. It produced textbook-oriented science education (Ayas, Çepni, Akdeniz, 1993). In February 2013, the board of education of the ministry decided that the course was named as science from the school year of 2013-2014 for the fifth grade of elementary education and from the school year of 2014-2015 for the third grade

of elementary education. The course would be for three hours for the classes of 3 and 4, and for four hours for the classes of 5 and 8 (MONE-board of education, 2013b). According to this arrangement of 2013, the program adopted a holistic approach towards teaching and learning, but it was also accepted that students are responsible for their own learning and active student involvement is needed which requires a constructivist approach.

ACCIDENTS AND SAFETY AT SCHOOL LABORATORIES

Laboratory work is the basis for and indispensable part of science education and all technological research. Individuals could only use their theoretical knowledge of science in laboratories which makes their learning much more permanent. Research indicates that laboratory work is necessary for successful science education, but laboratory work is not at the desired level yet (Erten, 1991; Aydoğdu, 1999; Gürdal, 1991; Alpaut, 1993; Ayas et. al., 1994; Ekici, 1996). There are many factors of ineffective laboratory work. Such factors include negative school and laboratory environments, lack of necessary equipment and devices, crowded classes, and teachers' lack of necessary information about teaching and learning materials and about laboratory work. Another factor contributing to low achievement in science education is related to teacher training programs, which could not produce qualified teachers (Nakiboğlu and Sarıkaya, 1999; Nakiboğlu and İşbilir, 2001; Çallıca et. al., 2001; Güven et. al., 2002; Uluçınar, Cansarar and Karaca, 2004; Kaya and Böyük, 2011; Raju, T. J. M. S., & Suryanarayana, N. V. S. 2011; Aydogdu, 2015). In addition to these difficulties, there occur many accidents during the laboratory work which cause physical injury and even death (Aydogdu, 2015; Aydoğdu, & Yardımcı, 2013; Aydoğdu, & Pekbay, 2016). Some of the laboratory accidents occurred in Turkey are given below.

1. Alcohol Burst

21 November 2006

At The Primary School Laboratory In Bolu, A Tube Filled With Spirit Exploded During The Experimental Study Of The Fifth-Grade Students And Three Students Were Wounded.

It is reported that at Ayşe Yılmaz Becikoğlu elementary education school in Doğancılar village, students and their teacher İ. A. were conducting an experiment in which they were observing the power of steam resulted from boiling water. When science teacher İ.A. poured ethyl alcohol on fire, alcohol tube exploded. As a result of the explosion, the fifth-grade students M.İ., B.K. and D.K. were burnt and wounded. Students were taken to Bolu İzzet Baysal Hospital. Parents rushed into the hospital and wounded students said "We were conducting an experiment. Suddenly an explosion occurred. We did not understand what happened." It is reported that they had no life-critical situation.

Source: http://www.habervitrini.com/haber.asp?id=248562-21 Kasım 2006

2. Tube Explosion at Science Lab, Two Students Wounded.

18 December, 2008

In Kazan, at the science laboratory of Tahsin Şahinkaya elementary education school experiment tube was exploded during the experiment. Hands of two students were wounded as a result of the explosion. They were taken to a hospital in Ankara. Kazan district governor Özlem Bozkurt Gevrek reported that they were taken there to control their situation.

Source:http://www.cnnturk.com/2008/turkiye/12/18/okulda.deney.tupu.patladi.2.yarali/505307.0/index.html-18.12.2008

3. Thinner Poured Into Stove Killed.

In 2003, a student poured thinner into the stove at the Ortadirek village elementary education in Ağrı Doğubeyazıt district and it caused explosion. Although most of the students were in the garden during the explosion, the student poured thinner into the stove was killed. The school administrator who threw the can full of thinner and another person who tried to help both seriously were injured in the explosion. The student poured the thinner in to the stove. The school administrator Kayalar (23), who saw the event tried to help but she was also burnt. The teacher Uysal (25) was also burnt. Another teacher Elif Tezcan broke the window to help the other students in the classroom. Injured people were taken to the hospital in Diyarbakır. However, the student died on the way to hospital.

Source:http://blog.milliyet.com.tr/yanginlar-icinde-yuregim--aysun-veburcin%20ogretmen/Blog/?BlogNo=215461

4. They Were Burning During Experiment

21 November, 2006

The alcohol caused explosion during the experiment. In the event four students were injured. In Doğancı village basic education school in Bolu province the fifth-grade students were conducting an experiment with their teacher in the course of science and technology. The alcohol used in the experiment burst into flames. The students Murat İpek, Burcu Koçak, Deniz Koç and İsmail Okay were injured. They were taken to theme village clinic. Then they were taken to a hospital in Bolu. Three students received outpatient treatment at the hospital. The other one treated at the ambustion service. Ten-year old Murat İpek injured from hands and face reported that they were conducting an experiment which shows how steam moves wheels. İpek reported: "We would heat the water in tubes using water. We tried to fire, but we could not manage. Finally, we did it, but the fire died down. The teacher poured alcohol on it and an explosion occurred."

Source:http://www.yenisafak.com.tr/gundem/?t=21.11.2006&q=1&c=1&i=15970&Deney/yaparken/yanıyorlardı/

5. Test Tube Exploded: 2 Students Wounded

09 December, 2011

Experiment tubes used in the experiment in Yüzüncü Yıl Atatürk basic education school in Kocaali exploded. Two students were wounded and taken to the hospital. The sixth-grade students Mert Erkan K. and Furkan T. were conducting an experiment in the course of technology and design. During the experiment, experiment tubes exploded due to the student mistake. They were taken to the hospital. Furkan T. received an outpatient treatment, but Mert Erkan K. İs still at the hospital. The father of Mert Erkan K. Özgür K. reported that the explosion occurred during the experiment.

Source: takvim.com.tr /09.12.2011

6. Unfortunate Accident in School Lab

21 November 2015

Ten students wounded in the acid-caused explosion at chemistry lab of a private high school in Tunceli.
It is reported that ten students wounded in the acid-caused explosion at chemistry lab of a private high school in Tunceli. According to the reports the tenth-grade students at Private Özel Munzur science high school were doing an experiment at the chemistry laboratory when an explosion occurred. It was due to acid use. In the explosion ten students were wounded. They were taken to Tunceli Public Hospital through ambulances.

"Seven of wounded students were discharged Tunceli local education director Ali Eyyüpkoca reported that the tenth-grade students at Private Özel Munzur science high school were doing an experiment at the chemistry laboratory when an explosion occurred.

Source: http://www.trthaber.com/haber/turkiye/okul-laboratuvarinda-talihsiz-kaza-217446.html

7. Experiment at The School Made a Student Blind: My Tears Hurt Me!

21 December 2014

As a result of the accident during the experiment at a school in İstanbul eyes of a student aged 11 were burned!..

*As a result of the accident during the experiment at a school in Uskudar district of İstanbul eyes of a student aged 11, **Mert Öztoprak**, were burned. Mert stated "I could not see anything. I always cry and my tears hurt me. I will never forgive my teacher who darkened my future". According the news by **Gökhan Karakaş** in Milliyet newspaper, on 3 December the sixth-grade students at Ali Fuat Başgil secondary school in Uskudar district of*

Istanbul were doing an experiment in the laboratory in science course. Science teacher Mehmet Aslan told the students that he would explain the mixture of zinc and mercury using an iron tube. The teacher added that a metal container would be used since the resulting substance could melt a plastic container. The teacher, Mehmet Aslan, asked 11-year-old Mert Öztoprak to help him. He gave the iron tube to Mert and began to pour the zinc and then the liquid mercury. While the student was mixing them using the iron tube the teacher blowed the iron tube. Then it caught fire.

'I will never forgive him.'

Mert had four operations in a week. When he learned that if he used a glass of which price was five liras this event would not, his sorrow increased. Mert reported "While the teacher were pouring mercury into zinc he blowed the iron tube. Then it was exploded in my hand. I recognized that my eyes burned and I extinguished the fire on my hair. He told us that he was a bit clumsy and that he burned his jacket or apron in the experiments. But he fired my future this time."

Source: http://t24.com.tr/haber/okuldaki-deney-kor-etti-gozyaslarim-bile-bana-aci-veriyor,281120

8. Explosion during an Experiment at a Private School: Two Wounded

03 December, 2014

An explosion occurred during the experiment at the science laboratory of a private school in Üsküdar. Teacher Mehmet Aslan and 11-year-old student Mert Öztoprak were injured in the explosion.

The event occurred yesterday at 17.00. The explosion of which the reasons are not clear wounded both the teacher Mehmet Aslan and the student Mert Öztoprak who were helping his teacher. They were both taken to Haydarpaşa Eğitim ve Araştırma Hospital. The face of the teacher burned and he treated at the hospital. The student was wounded from his face and eyes and he was transferred to Kartal Eğitim ve Araştırma Hospital. His treatment is still going on and it is learned that he will had an operation.

Mert Öztoprak's parents and relatives came hospital whenever they heard the accident. His mother Ayşe Öztoprak said "I just sent my son to the school, not to the war. I will sue those people who responsible for his injuries." She added "My son's eyes burned. One his eyes may not see again. How an experiment is this? Students do not use gloves and glasses at the laboratory. Why was my son so near to the experiment? Not my son but another student may be injured at the laboratory. I will sue those people who responsible for his injuries."

Source: http://www.hurriyet.com.tr/ozel-okulda-deney-sirasinda-patlama-2-yarali-27699269

9. Explosion at the Laboratory during The Experiment

04 March, 2015

During an chemistry experiment at the laboratory of Yalova Vocational and Technical Anatolian High School an explosion occurred. Teacher Mustafa Keskiner was injured in the explosion. Parents called for the steps to be taken in order to avoid accidents and wanted that until these steps are implemented all dangerous experiments at the laboratories should be cancelled.

It is reported that the explosion occurred when sodium was contacted with water. Due to the explosion teacher Mustafa Keskiner was injured from his hands and face. He was taken to the hospital. The students were affected by the smoke.

Source: http://www.hurriyet.com.tr/deney-yapilan-laboratuvarda-patlama-28361081

10. Explosion at an Elementary Education School: 6 Wounded

04 June, 2012

Spring festival was organized at a basic education school in Kağıthane district of Istanbul. One of the activities covered in the festival was an experiment work. It is reported that an explosion occurred during the experiment. Six students were injured in the experiment. Teachers working at Zuhal basic education school organized a spring

festival near to the end of the semester. One of the activities covered in the festival was an experiment work. It is reported that an explosion occurred during the experiment. Six students were injured in the experiment.

Source: http://www.hurriyet.com.tr/ilkogretim-okulunda-patlama-6-yarali-20689960

Therefore, studies at laboratories have some certain risks. It requires that at laboratories there should be a safe working environment (Yılmaz, 2005). Research strongly suggests that necessary information about chemicals should be given before their use in the experiments (Long 2000; Yılmaz 2004a; İdin & Aydoğdu, 2016). It is certain that safety is the key consideration in all experiments. Safety-related rules are developed and employed not to limit the practical work, but to provide a safe working environment at laboratories (YÖK, 1997). Laboratory safety includes the following topics: taking steps to eliminate all kinds of threats towards equipment, machines and tools; teachers, students and school facilities during experiments and other related activities, and adopting a scientific approach towards all potential problems (Canel, 1995**).**

Although having information about experiments' equipment and tools and about the use of chemicals, it is also important to take steps to mark and store chemicals. Research emphasizes that protecting from dangerous effects of chemicals and from potential danger are significant not only for human safety but also for laboratory facilities and materials (Richards-Babb, Bishoff, Carver, Fisher, & Robertson-Honecker 2009; Wu, Liu, & Lu 2007; West, *Westerlund*, Nelson, Stephenson, & Nyland 2002; Yılmaz 2005; Yılmaz 2004). Yılmaz, Uludağ and Morgil (2001) concluded that undergraduate students do not have higher levels of information about the toxic effects of some solutions and materials, and about the protection in organic chemistry laboratories. Therefore, elementary education should be much more cautious in work at laboratories. At the laboratories of elementary education schools and high schools not many chemicals should be used. Instead, other familiar materials can be used in these experiments to avoid accidents. It is seen that the major reason for accidents at school laboratories is teachers. Teachers should have and adopt a well-established and proper approach towards accidents and risks at laboratories and have necessary education and training on the subject. In order to achieve it, teacher training programs may cover courses on laboratory safety and norms. In addition, textbooks should inform both teachers and students about materials to be used in experiments covered. Yılmaz (2005) analyzed the experiments included in chemistry textbook for the first grade of high schools and reviewed the information given regarding these experiments in terms of laboratory safety, chemicals and other relevant points. It was found that textbooks provide no information concerning laboratory safety and about the safety notes on chemicals. Laboratory use techniques include information about the characteristics of chemicals to be used in experiments, safety rules, how to take steps to avoid accidents at laboratories and how to react when an accident occurs at laboratories. It can be defined as a way to be familiar with the characteristics of chemicals to be used in experiments, safety rules, how to take steps to avoid accidents at laboratories and how to react when an accident occurs at laboratories and the scientific approach towards each of these points (Aydoğdu & Candan, 2012).

STEPS TO AVOID ACCIDENTS AT LABORATORIES

As a workplace, laboratories are classified as dangerous. Therefore, staffes should know what to do in emergency situations and be aware of potential dangers. In order to provide a safe environment, certain laboratory rules and techniques as well as necessary equipment should be employed. Following such rules is very significant for the health of staff and their safe.

- At laboratories aprons and gloves should always be used. Protective glasses should also be used. Dress should be proper for laboratory work.

- Laboratories should have fire exits. These should be shown by signs.

–Laboratories should have a good ventilation system. There can be a room next to laboratory which has a ventilation system.

- There should be a fume cupboard at laboratories. It should be placed at a remote place which is far away from doors and ventilation system. In other words, it should be placed where traffic is less. Fume cupboards should be made from materials which are durable against chemicals and steam. These devices should provide a continuous air flow and be ready to be used. Fume cupboards are designed to avoid the effects of hazardous chemicals at laboratories. Standard fume cupboards can be used at laboratories where less hazardous chemicals are employed. At the laboratories where hydrofluoric, perchloric or mineral acids in hot concentration are used, those fume cupboards with higher performance levels are needed.

- A scientific approach should be adopted to provide a safe laboratory environment in order to identify potential and to reduce the possibility of experiencing an accident. A laboratory safety program should be developed to have a safe working environment at laboratories. Such safety programs make it possible to protect from dangers in terms of human health, the storage of chemicals and to avoid accidents at laboratories. Therefore, in order to avoid potential problems, there should be a first-aid kit at laboratories.

- Chemicals that are used in experiments are mostly unhealthy and being familiar with the characteristics of these chemicals is significant for both human health concerns and what to do in emergency situations. Major unhealthy chemicals are as follows: Heavy metals, aromatic nitro compounds, aldehydes, alkali metals, alkali salts (NaOH, KOH), ammonia, benzene, mercury, phenols, carbon tetrachloride, chlorinated hydrocarbons, methyl alcohol, toluene etc.

- Laboratories should always be kept clean. Necessary rules should be followed in cleaning of laboratories.

- While labelling chemicals, the following points should be avoided: using wax pen, water-soluble ink pen, abbreviations, title of the material, formula, and using numbers and codes.

- Chemicals should be stored based on the following rules.

- Removal of wastes
1. Waste materials should be classified based on their chemical characteristics and then, should be removed.
2. These waste materials should be removed in accordance with the groupings written on the waste boxes.
3. Cracked and broken glassware should not be used.
4. Bins with cover should be used to collect flammable waste materials at laboratories.

- At laboratories there should be extinguisher for each fire type and it should be known which fire extinguisher is used for which type of fire.

- Water, electricity, gas, air pipes and their valves should be painted with distinct colours and this system should be shown with a panel at laboratories.

- Electric and gas valves should be known by everyone through signs.

- At laboratories there should be fire blankets to be used in emergency situations.

- Waste materials and dangerous, flammable chemicals that will be used later should be kept at laboratory in small amounts. Following their use, the remaining ones should be immediately stored again. When these materials are poured, they should be cleaned using a proper technique.

- Solvers should never be poured into sink. Waste solutions should be collected in cans and they and trash bins should be discharged every day.

- At laboratories before using fire, the environment should be checked to see if there are flammable objects. Gas or natural gas hose should be frequently checked and they should be changed when necessary. The hose should not contact with the fire.

Laboratory staff should know where main gas valve of the laboratory is. There should be signs to show the place of the main gas valve of the laboratory. In the experiments in which flammable items are used fume cupboards should be employed. Distillation of flammable liquids should be done on sand bath to avoid spreading of fire.

- Fire Extinguishing Equipment should exist in laboratories and in corridors. Laboratory personnel should know where this equipment is and which equipment is used to which type of fire. They should be trained on these topics.

- Soda-Acid Type Fire Extinguishing Equipment: these devices are filled with the solution of sodium bicarbonate and are used to extinguish fire caused by paper, wood etc. They cannot be used to extinguish fire caused by magnesium, sodium and electrical contacts. They can also be used to extinguish fire caused by alcohol and acetone which can be mixed with water, but cannot be used to extinguish fire caused by oil which is not mixed with water.

- Foam Fire Extinguishing Equipment: These devices are mostly used in fire caused by solutions such as oil, gasoline which are lighter than water and do not mix with it. These devices are not used in the environments where electric circuits exist.

- Carbon tetrachloride extinguishers: These devices are used to extinguish small-scale fire. When used in closed places, its steam should not be respired. When fire is totally extinguished, the room should be vented. These devices can be used in the environments where electric circuits exist.

- Methyl Bromide Fire Extinguishing Devices: These devices are used in fire where carbon tetrachloride extinguisher is employed. Given that the steam of these devices is toxic, they should not be used in closed places.

- Carbon Dioxide Fire Extinguishing Equipment: This equipment is used in small-scale fire at laboratories. It can be used in the environments where electric circuits exist. Given that, its cooling effect is at a minimum level following the extinguishing of fire, the material burned should be observed not to flare up again. In fire which is caused by explosive metal such as magnesium graphite or dry salt are employed.

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