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ACCIDENT DEVELOPMENT STAGES AND SAFETY MEASURES AGAINST CHEMICAL ACCIDENT EFFECTS

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Abstract. *Production processes and technological procedures are characterized by the application and processing of different hazardous materials, as well as by operations during which dangers of any material may occur. There are many general dangers, particularly in processing organic materials.*
This paper analyzes the stages in the development of accidents, the levels of preparedness and possible efficiency in performing numerous, very complex and highly qualified tasks and the timely detection of all, especially peacetime accidents. It also proposes measures for establishing a system of environmental protection in the case of chemical accidents.

Key Words: *accident, accident effects, chemical substances, technical equipment, reaction quickness*

1. INTRODUCTION

Many companies, within the scope of their regular operations, produce and use chemical substances, which represents a permanent potential danger from chemical accidents and, naturally, places a problem before society and companies: how to get organized and be prepared in the best and most efficient way for preventing the occurrence of chemical accident conditions.

The living environment may be chemically polluted by wars or natural disasters, which is an accident.

Pollution occurring due to the wars is not a matter to be discussed in this paper.

Evaluation of the living environment vulnerability to peacetime disasters essentially represents an analysis of the kind, scope, level of effects and probability of danger appearance within a temporal, spatial, and material-technical dimension.

The risk management process involves:

- Danger of Accident Analysis (danger identification, analysis of effects, and risks assessment).

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- Prevention and Accident Response Measures (measures planning for accident prevention or risk reduction, organizing precaution measures and accident response planning).
- Accident Effects Elimination Measures (planning of accident effects recovery measures and accident reporting).

The main goal of this paper is to analyze the stages of accident development, the levels of preparedness and possible efficiency in performing numerous, very complex and highly qualified tasks and the timely detection of all, especially peacetime accidents. It also proposes measures for establishing a system of environmental protection in the case of chemical accidents.

2. ACCIDENT DEVELOPMENT STAGES

An accident, unlike a natural disaster where everything happens immediately and the effects are immediately visible, has two phases of its development.

The First Phase is latent and there are no visible and measurable manifestations. Because of irrational planning, construction and usage of buildings, an unpredictable malfunction may occur, thus releasing aggressive dangerous substances into the area surrounding that building. Therefore, one should always tend to properly plan and position the relevant buildings, at an adequate distance from settlements.

The Second Phase is the manifested one, during which there are visible and measurable effects. During this phase, an accident may have five levels:

The First Level is the level of dangerous installations; effects of accidents are limited to a part of the installations or to a complete installation, without affecting a wider environment;

The Second Level is the level of an industrial complex, negative effects of accidents have affected one part or the whole industrial complex, negative effects on a wider environment are not expected;

The Third Level relates to a surface greater than the industrial complex, and negative effects of the accidents may spread from the industrial complex to the environment and the effects are expected to appear in one part or in a whole territory of a municipality or a city, even to some parts of another municipality;

The Fourth level is a regional level, negative accident effects may spread to the area of several municipalities;

The Fifth Level is an international level, the accident is of a very large scale and its negative effects threaten to spread beyond the borders a country, so that involvement of the competent federal authorities, for the purpose of establishing international collaboration in order to undertake adequate accident response, is necessary.

The research and study of human reactions in disaster situations cannot be performed experimentally but only in real life-threatening conditions, so that science can study human behavior only in disaster situations, based on the subsequent statements of people who had directly or indirectly experienced a disaster.

Chemical substances may get into the living environment in two ways:

– the first way: persistently and on a daily basis, imperceptibly in relatively the same quantities.

– the second way: in accidental situations, very tempestuously and in short time interval, in different states of matter, enormous quantity of agents with different harmful levels is released into a certain space.

Production processes and technological procedures are characterized by the use and processing of different hazardous substances, as well as by procedures during which the dangerous effects of all the substances may occur. There are several general hazards, especially when dealing with organic substances such as danger of explosive mixtures occurrence, uncontrollable burn out, self-inflammation, etc.

When carrying out a certain activity, for the purpose of controlling a production process or operation which is not in harmony with the prescribed standards does not cause any undesirable effects or system changes, that activity becomes a habit. Under such conditions, if any, other factors may join in and an accident will occur.

Some industrial buildings and warehouses with flammable and explosive substances are situated on the outskirts of a city, immediately next to the housing zone, without an appropriate protective area, and railway stations are located even within a city. In that way, they are a constant source of explosions, fire, and chemical accident hazards.

With the existing industrial and warehousing buildings and railway stations, in accident situations, the location is known, but the time of the accident occurrence is unknown, as well as when the living environment may be polluted.

In highway and railway transportation, when transporting hazardous substances, neither the place nor the time when an accident may occur is known.

3. MEASURES PROPOSAL

Protection of the living environment, recognizing research results and previous experiences worldwide and in Yugoslavia should be organized according to the model of:

1) assessment
2) prevention measures
3) early notification and safety system management measures
4) quick intervention and recovery measures
5) rehabilitation measures

3.1. Assessment

Assessment is a basic and integral part of an accident protection plan. It should contain:

– cadastre of chemical substances (types and quantities) which will be available to all services;
– the location of dangerous substances and their characteristics;
– assessment of possible chemical accidents according to technological processes;
– anticipated possibilities and kinds of accidents;
– safety systems data;
– data on housing and other buildings nearest to a potential place of accident;
– assessment of polluting substances spreading by air flow, sewage systems and water currents;

– assessment of pollution levels in the relevant parts of a city and its surroundings, that is, water currents;

– assessment of the most possible transportation accidents both in railroad and highway traffic and

– assessment of spreading of the spilled or released chemical agents.

3.2. Prevention measures

Preventive action and timely assessment reduce the probability of accident occurrence and ensure safer protection of the living environment.

This means prevention during the appropriate working process for the purpose of preventing all accident levels.

Therefore, it is necessary to undertake everything needed, primarily, informing and preparing people, regulating their rights and obligations, regardless of their social status and position, while continuously organizing training courses, supplying training materials and modern training methods for the purpose of a full and complete attitude to chemical accidents in general.

At the beginning of the 21st century, it cannot be justified to refer to certain human characteristics that cause human suffering or property destruction. One should tend to differentiate knowledge from ignorance, negligence and irresponsible work from responsible and conscientious work. Negative occurrences should be suppressed most drastically.

It is necessary to establish inspection at the company level and city level, which would control measures undertaken for the purpose of accident prevention, as well as measures planned for appropriate interventions.

Prevention for the purpose of preventing transportation accidents is a very important safety measure which, in any aspect and scope, must not be neglected, omitted or reduced.

3.3. Notification and safety system management measures

For the purpose of timely notification, it is necessary to organize a service that will be on duty 21 hours, which has to be connected to all the relevant services or persons on duty in every company, as well as to have all the assessment data related to the cadastre of chemical substances, plans of action, and all measures planned for a preventive intervention. Because of everything mentioned, it has to be continuously in touch with individual intervention services.

It is necessary to establish a central (coordination) body, which will coordinate all actions and systems for assessment, prevention and intervention, and which will be in contact with all the services at the city level, but which will also have right to manage intervention in case of an accident.

It is necessary to provide timely information to the public by means of the media as well as informing and notifying competent state bodies of the Republic.

3.4. Quick intervention and recovery measures

According to the assessment data, each of the companies, as well as appropriate city services, should have measures planned for quick-immediate intervention in case of accidents, such as:

– Measures within a particular company, at the moment of accident occurrence, at the company initiative or according to the appropriate company service instruction. Consequently, they must have planned measures, the needed number of people, as well as that these people should be trained both for giving first aid to victims and for technical-technological and other measures for the prevention of the spreading of chemical agents and for their neutralization.

– For the purpose of reducing the possibility of accident occurrence to a minimum, it is necessary for all technical-technological solutions to be carried out in a way so that, from the point of technical safety, they represent good solutions. In relation to safety and rescue measures, all company buildings should be equipped with appropriate technical devices: for automatic fire notification, explosion detectors, stabile installations for fire extinguishing, mobile fire extinguishers, equipment for personal and collective protection and chemical detectors.

– For the purpose of operative action, it is necessary to establish teams for efficient acting in a company and upon the request of the Notification Center, they should also be involved in interventions externally, at other locations of the accident.

– In addition, these teams give organizational assistance when evacuating people from the company, and, if needed, from the city. Because of this, all company transportation means are passed onto their jurisdiction.

– Taking into consideration the situation and problems with transportation of dangerous substances, as well as excessive risks to the environment and peoples' health when transporting these substances, one of the very important measures is that dangerous substances should not be transported in the city center.

3.5. Rehabilitation measures

Every company should have rehabilitation plans, that is: terrain after chemical accidents, also, premises after chemical accidents and water currents in cases of penetration of chemical substances into the water currents.

Services at the city level should have plans for the removal of polluting substances from public surfaces, that is, agricultural and other land. Separately, they should have measures for long term protection and immobilization of water sources from long-lasting polluting substances.

Health services should be in community with municipal bodies and other state bodies and have accurate plans for the treatment and rehabilitation of injured persons, regardless of whether they have insurance or not.

4. CONCLUSION

Analyzing the accident situations with dangerous chemical substances which happened worldwide, and, in smaller number of cases, in our country, we come to the conclusion that certain situations and circumstances, more than others, could also influence events of accident situations, such as:

– not abiding by the guidelines and regulations for working with hazardous substances in the process of production, transportation or when pouring hazardous chemical substances from a cistern into reservoirs;

– bigger pressure of filling to overflowing (completely filled cisterns);

– use of open flames in warehouses and zones of transfusion of flammable and explosive chemicals; - irregular controls of cisterns and reservoirs used for transportation or storage of dangerous chemical substances, as well as situations in warehouses with dangerous chemicals;

– acts of sabotage in special war activities, sabotage, which nowadays cannot be neglected.

In order to have a complete picture of dangerous substances, it is necessary to:

– make a cadastre of polluters and dangerous chemical substances;

– establish services for living environment protection;

– in regards the hazards that may occur in companies, and the need to pass information to all subjects for undertaking safety measures, a system of observing and notifying should be developed.

Starting from the fact that man is the basic factor for preventing accident occurrence but also the cause of an accident due to his negligence, it is necessary to train workers and population both for preventing accident occurrence and for rescuing and assisting the affected population. It is necessary to abide by all the prescribed standards. Also, it is necessary to get informed, increase knowledge of dangerous chemical substances and the danger of chemical accidents, and find particular measures and procedures in solving and overcoming a problem.

Protection from chemical accidents covers complex and complicated problems. It is observed that each institution is getting organized on its own for accident situation response and there is no mutual coordination. In relation to this, it will be good if, at the company, city or regional level, a coordinating body for chemical accidents is established, as multi-disciplinary specialized consulting body, which, first of all, would act preventively and then operatively, in the case of accidents.

Also, there is a need to train people working in the media, so that they can give appropriate information without causing panic.

To impose a stricter working and technology discipline of the employees and ensure that all city subjects and specialized services have the operational plans for using the resources and means for quick interventions in accident situations for all chemical substances at their disposal, which may be released without control and that these plans allow coordination both vertically and horizontally, and in time, place and resources.

By these and other measures, procedures and activities, together with continuous care and collaboration of all the city subjects for a healthy and safe living environment, it is possible, at least to a certain extent, to alleviate the harmful effects of polluting the living environment and prevent accident situations involving harmful chemical substances, whose effects on the population and material assets could be unforeseeable.

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Ovaj rad sagledava faze nastajanja akcidenata, stepena pripremljenosti i moguće efikasnosti u izvršavanju brojnih, veoma kompleksnih i visokostručnih poslova i zadataka i blagovremenom otkrivanju svih, a posebno mirnodopskih akcidenata, sa predlogom mera za uspostavljanje sistema zaštite životne sredine u slučaju hemijskih akcidenata.

Ključne reči*:* *akcident, posledice udesa, hemijske supstancije, tehnicka opremljenost, brzina reagovanja*