Sustainability - Environment - Safety ´2013
Zborník z medzinárodnej vedeckej konferencie, Bratislava, 11.-12. október 2013
Proceedings of the International Scientific Conference, Bratislava, October 11 -12, 2013, Slovakia
■ Žilina: Strix. Edícia ESE-13, Prvé vydanie. ISBN 978-80-89281-89-3 ■ Rusko, M. [Ed.] ■

SELECTED ISSUES OF DECONTAMINATION - SECONDARY CONTAMINATION

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ABSTRAKT
Tento článok sa pokúša objasniť významné hľadisko emisií, problémy dekontaminácie a sekundárnej kontaminácie osôb a zariadení. Autor podrobným popisom druhotných zdrojov znečistenia sa snaží navrhnúť súbor opatrenia zamerané na minimalizáciu rizika otravy ľudí. Zabrániť priamemu pôsobeniu chemického nebezpečenstva na osoby. Navrhované riešenia sú založené na skúsenostiach v odbore chemická vojna chemická dekontaminácia veľkého počtu ľudí. Tieto riešenia tiež berú do úvahy existujúce pravidlá organizácie chemickej a ekologickej záchrany a tiež technické schopnosti vykonávať hromadnú dekontamináciu v rámci záchrany odsôb a hasenia požiaru. Tento článok tiež uvádza príklady sekundárnych znečisťujúcich látok a ich zdravotné dôsledky na záchranárov a ostatných ľudí, ktorí nie sú zainteresovaní na záchranných operáciách.
Kľúčové slová: *sekundárne kontaminácie, riziko kontaminácie derivátov, dekontaminácia, balíky (sady) pre dekontamináciu*

ABSTRACT
This article attempts to depict the significant from the standpoint of mass decontamination issues of secondary contamination of people and equipment. Author by a detailed description of secondary sources of contamination is trying to propose a number of measures aimed at minimizing the risk of poisoning in people not exposed directly to the action of chemical hazard. The proposed solutions are based on experience in the field of chemical warfare chemical decontamination large number of people. These solutions also take into account the existing rules of the organization of chemical and environmental rescue and the technical ability to conduct mass decontamination within the national rescue and firefighting. The article also presents examples of secondary pollutants and their health consequences rescue workers and people not associated with the rescue operation.
Keywords: *secondary contamination, threat of derivative contamination, decontamination, packages (kits) for decontamination*

INTRODUCTION

Grading the contamination using several criteria , of which the most important are : the type of dangerous substance (chemical, biological, radioactive), the type of contaminated object (terrain, objects, people, animals), or duration of contamination. It should also be noted that not all types or types of pollution threaten human life. You can give an example of chemical irritants such as chloroacetophenone, CS substance. They are relatively safe, but it is required to remove them from the body surface due to the accompanying very unpleasant smell. During rescue operations related to the liquidation of contamination (decontamination), it is important to exercise caution and to prevent the spread of contamination to clean the zone , also called the "cool zone". Contamination that may occur in the area of rescue operations can be divided in terms of place and time of their creation into two categories: primary containment and secondary containment [1].

Contamination of primary

The category of primary contamination include contamination arising directly in the field contaminated (the danger zone), or by contact with contaminated air cloud are hedging activities. Contamination are formed at the time of release of hazardous substances and can cover not only the area, plant, vehicles, but also clothes and exposed skin of people who were in the danger zone at the time of the leak. The category include primary contamination and contamination caused by contact with moving cloud of contaminated air. Hazardous substances moving from the wind can result in contamination of objects by:

- penetration into porous materials or easily absorbing volatile substances in the form of vapors and gases;
- spontaneous (gravity) precipitation of contaminating dust or droplets;
- contact with atmospheric precipitation containing dangerous substances released.

In this category we can also include contamination of rescue equipment and rescue workers residing in the zone of contamination.

Secondary contamination

Secondary contamination in contrast to the previous category created outside the zone of contamination or after decontamination mostly through contact with contaminated objects. Contamination of this type may be not only the people in the area of rescue operations (victim, rescuer), but also people outside the region.

The group of people at risk of contaminating the secondary include:

- victims undergoing decontamination;
- medical staff dealing with victims evacuated from the area of rescue operations;
- staff having contact with people (clothing, rescue equipment) originally contaminated, and then given incorrect or inaccurate decontamination;
- people involved in the liquidation of contamination or disposal (neutralization) of contaminated clothing or personal items of the victims.

Potential sources of secondary contamination

The objective of picking the most likely sources of contamination secondary analysis was conducted of materials concerning industrial accidents, terrorist attacks, incidents (accidents) of weapons of mass destruction and numerous workouts and exercises Specialized Group Chemical and Ecological Rescue of the State Fire Service. The analysis included, inter alia:

- 3/20/1995 terrorist attack on the Tokyo using sarin;
- accidents contact with chemical weapons sunken in the Baltic Sea;
- failure of a nuclear power plant in Chernobyl in 1986;
- contamination of mustard gas in Borne Sulinowo (Poland) in August 2009;
- contamination in 1979 in Sverdlovsk anthrax bacterium (former USSR) - now Yekaterinburg - as a result of a failure in secret biological weapons factories.

While analyzing previous events related to the decommissioning of mass contamination may be predict the main source of secondary contamination. These are mainly contaminated clothing and personal items of victims, rescue equipment, means of protection against contamination, personal equipment lifeguards, rescue vehicles, means of transport.

Contaminated clothes and personal items

The greatest risk of secondary contamination associated with contact with contaminated clothing and personal items of the victims. At the risk of contamination of both rescuers and victims themselves. The risk of contamination is always present and is subject to the supervision of the conduct decontamination by the victims themselves. In addition to proper supervision is essential to the preparation of sound - a simple and unambiguous - the conduct of the body surface decontamination. Proper preparation procedures and equipment limits the formation of secondary pollutants. Taking into account the personal observations of practical exercises conducted in preparation for decontamination services a large number of people during mass events (such as Euro 2012) can cite a few examples of potential secondary contamination. The first and the most likely example is the extent failure to deposit leave valuables with you or of great sentimental such as jewelry, watches. This should prevent people passing control to the tent-washroom. Unfortunately, rescuer, who oversees the proper removal of clothing is not able to watch all the victims. This results in a contribution to the washroom contaminated objects and then carrying them without decontamination. Repeated contact with such objects can lead to contamination of the local body or clothes issued a replacement. As far as chemical contamination of induce symptoms of poisoning relatively quickly and concentrations on the order mg/m^3 contamination of biological substances or radioactive are much more dangerous. A small amount of the pathogen can also cause disease, and prolonged contact with the radioactive substance can lead to local burns or radiation exposure of a person to internal contamination[1].

Analyzing the cases of intentional disregard of the victim's procedures should also mention about the possibility of wearing clothes or underwear. The reason for this behavior is the psychological discomfort associated with removing clothes and wash the entire surface of the body in the presence of other victims. People who feel constrained by such a situation can consciously leave wearing such underwear. Wash clothing shielded body surface area may be less effective and cause the effects described earlier.

During rescue operations can pretty well to contact the victims and rescuers with contaminated clothing or deposited items. As far as decontamination of victims before contact with contaminated clothing is taken into account, after its completion cannot come to such a situation. Although it can to this rather as a result of poor records or failure to deposit decontamination deposited items. Contaminated clothing may be a source of secondary contamination only in the case of non-compliance with the rules of procedure of these things. Basically decontamination processes clothes are expensive and do not guarantee the behavior of functional properties. Therefore, it is reasonable to remove the risk of contamination by spreading the destruction of the contaminated with dangerous clothing.

At this point should be mentioned events that the scale could not be predicted in advance, and develop appropriate procedures. An example of such a situation is to assist injured during a terrorist attack in the Tokyo subway in 1995. A significant part of the medical staff providing assistance in hospitals and emergency medical facilities has been exposed to contact with the contaminated clothing of the victims. It is estimated that in connection with the attack and evacuation of subway passengers were injured 6000 people, poisoning has been 135 members of the medical staff and the deaths of 12 people. Probably, is no other large metropolis is not prepared for such a massive event related to contaminated providing a medical assistance for a harmed people.

In accordance with the procedures in force in the armies of soldiers after chemical decontamination can take (give back) only those personal items that have been disinfected or decontaminated. Biologically contaminated items are destroyed. Decontamination processes are not subject to the objects which in the process lose their useful properties such as money, paper documents. In such cases, these items are recorded and possibly recreate them. The group of items not subject to decontamination classified documents have also been made in a sustainable manner such as plastics. The reason for this is the ability to penetrate into the depths of toxic material.

These procedures in force in the armies of the chemical should be applied also during registration and segregation deposits victims. Limited to a contact with contaminated objects to a minimum and prevented the release of the deposit subject contaminated and thus the formation of secondary contaminants [2]. It is suggested to have been paid compensation for the deposited items and cash. The amount of compensation would be determined by experts on the basis of the cadastral documentation and information from the victims. Items undergone processes and utilization of the consent of the owner (the

[1] Internal contamination resulting from penetration by the oral route or inhalation of radioactive material in the form of gas, vapor or dust. Contamination be charged to your body for a long time, sometimes for life.

victim). The documents would be issued while the new ones. Basically, the owner would return only those items whose value compensation was to much higher than the cost of decontamination or deactivation. In terms of biological contamination should adopt appropriate procedures (destruction or decontamination) depending on the type of pathogen and its virulence.

Contamination of rescue equipment, measures for protection against contamination, personal equipment rescue, emergency vehicles

Conducting long-term rescue of eliminating the contamination is always associated with the risk of secondary contamination among rescuers. To contamination of these occur as a result of the use of incorrect procedures or the fault of the rescuers themselves. An example of the use of incorrect procedures could be a disaster at Chernobyl nuclear power station in 1986. During the evacuation of the population and securing the area of potential radioactive contamination Militia officers perform their duties equipped with respirators and capes raincoats. Given the nature of radioactive fallout can be considered that these measures fulfill a protective function. Deserves the criticism that the militia leaving the area shares of contamination removed only with capes. Full-time uniforms were exposed to the contamination and decontamination was served. This resulted in the possibility of radioactive the secondary contamination.

For secondary contamination can also occur through the fault of the rescuers themselves. The potential risk of their occurrence is related to the lack of appropriate work habits in the area contaminated. This applies to the rescuers of the support Specialized Group Chemical and Ecological Rescue of the State Fire Service. According to the author it is a consequence of preparedness for implementation by the State Fire Service of many diverse and highly specialized tasks. An example of the lack of these habits is the decontamination of emergency workers performing work in protective clothing and SCBA (breathing apparatus). Rescuers did not give decontamination apparatus, namely carrier webs and protectors cylinder. This causes a secondary contamination in case of subsequent use of the camera.

Due to the fact that the contamination concern themselves lifeguards should be paid to such situations, particular attention because of the need to preserve the potential of the emergency services. Consequences of the exclusion of rescue operations even one rescuer can be significant.

The problem of secondary contamination also applies to improper decontamination of emergency equipment that was used in the danger zone. In most cases, this equipment wash a strong stream of water and detergent. Unfortunately, this method is not universal and may lead to a situation in which contaminated (Inaccurate cleaned) equipment contaminate emergency vehicle load space. In the case of contamination of its dangerous odorless substance concentration can be long kept in unventilated space building emergency vehicle.

Proposition adaptation of the procedures applicable in the armies of chemicals in order to reduce the risk of secondary contamination when conducting mass decontamination

In the case of the use of military equipment to support non-military elements of the system, it is necessary to create a detailed procedure for the organization of traffic in the square decontamination of the personnel who are non-military in accordance with the nomenclature of the place should be called decontamination of victims. As a result of the work of the research project Analysis cooperation opportunities for chemical and non-military elements of the subsystem in the liquidation of consequences of terrorist acts with the use of toxic chemicals and / or radioactive created, among others, variant traffic organization of victims during decontamination (Fig. 1).

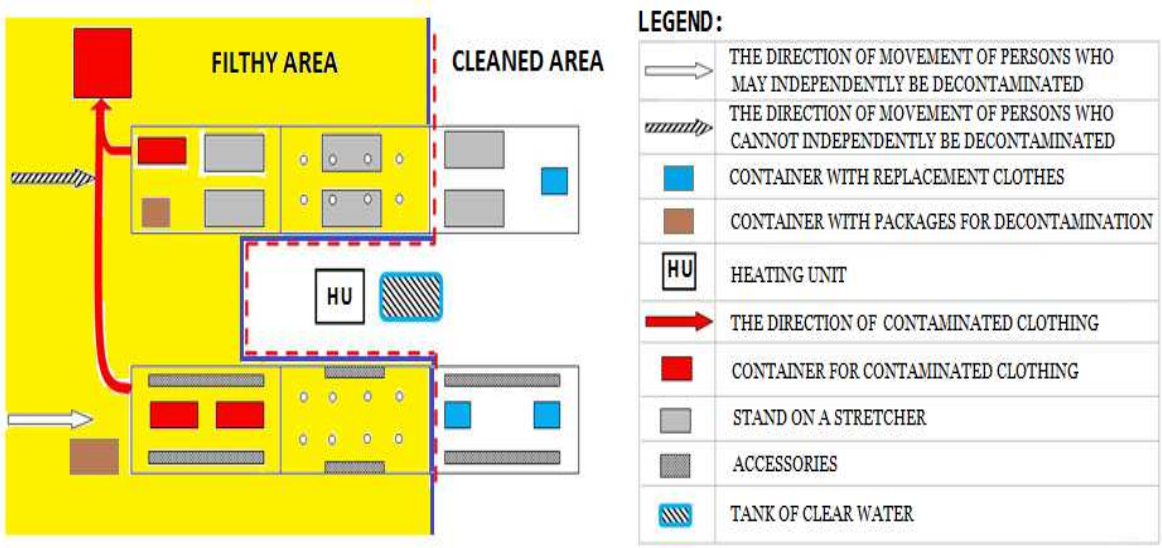

Figure 1. Embodiment consisted decontamination by the team of the personnel decontamination of chemical warfare using bath field – tent *Source: own*

Shown in Figure 1 variant affected traffic organization during decontamination and the use of the package decontamination with universal allows to reduce the manual handling of one string ("normal") for the minimum amount of three men (responders), in that a paramedic. Within this bandwidth is estimated between 48 and 96 people / h and is dependent primarily on the type of contamination and the air temperature. The string "horizontal" - designed for people who cannot move on their own or in need of medical care - is supported temporarily. On the basis of anticipation can be considered a variant based on 4 soldiers (paramedics) and 2 medical rescuers. In the first stage, paramedic and rescuer simply prepare for the injured person to a decontamination tent - undressing. Then, a couple lifeguards liquidations lead contamination at the victim in a tent - a bath. In the case of unconscious victims would need the additional presence of a paramedic (the doctor), supervising the victim's vital signs. Finally, the third pair of lifeguards would deal with victims in a tent - dressing room and was preparing to go to medical transportation.

Reducing the risk of secondary contamination through the use of package decontamination

Particularly noteworthy are the decisive steps for the safety of victims and minimize the potential for loss of personal items (documents, valuables). These activities include:

- removing contaminated clothing;
- preparation of contaminated clothing to further decontamination or disposal;
- protection against the destruction of documents and personal valuables;
- release the victims 'clean' clothes.

Intuitive and unambiguous communication of information using characters certainly improve the safety of victims and minimize the risk of secondary contamination during the decontamination process [3]. An example scenario of such an organization of victims of traffic on the Elimination of Contamination Square organized by units of chemical warfare can take place according to the following points:

- Person contaminated before entering the tent - undressing receives an individual package decontamination, consisting of three plastic bags, towel and linen. The method of use of the package is presented on the package in graphical form (Fig. 2) and on the board in the tent.
- In the first tent - undressing the victim opens the package and removed two bags: red and blue. Then takes off clothes and put me into a red bag. Personal items, documents, money, etc. put into yellow bags, which was packed the entire package. Service undressing on a closed red bag glued card with information about the owner: name and surname.
- The victim takes the blue bag and goes into the tent - the bath, where the use of decontamination or warm water and soap washes the entire surface of the body. Paramedic validates decontamination and skin condition the victim, and then orders to go into the tent - dressing room.
- In the dressing room the victim opens the bag and takes out a blue towel and underwear and shoes. In addition, in order to avoid hypothermia, the victim gets a blanket and out of the tent [4].

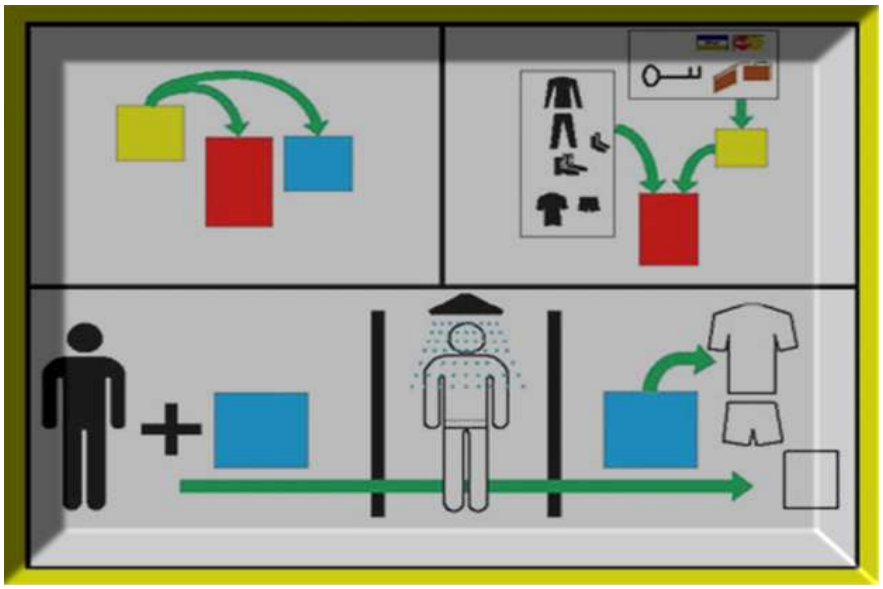

Figure 2 Instructions for use of package decontamination. *Source: own*

Summary and conclusions

Because of the potential difficulties in communication between rescuers and victims, there is a need for a universal language. The solution to this problem can be pictograms and pictorial instructions. Fast and simple instruction to carry out

decontamination significantly streamlines the process of liquidation of contamination and positive impact on the safety of victims.

Special attention should also prepare a comprehensive logistics entire liquidation of contamination process including: segregation of contaminated items (clothes), the issuance of decontamination and to provide comfort to victims after liquidation of contamination process. These tasks can be completed by early preparation and publication at the site liquidation of contamination packets containing the necessary measures to carry out the liquidation of contamination - decontamination kit.

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Contributions published in proceedings were reviewed by two members of scientific committee of the conference. For text editing and linguistic contribution corresponding authors.