Asbestos and disasters - example of a country in transition

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Abstract

The aim of this paper is to present the state of asbestos waste management after disasters in a country in transition, such as Serbia. Along with raising awareness of the overall management of asbestos waste, especially after disaster. The highest consumption of asbestos products was recorded in Serbia from 1975 to 1985. It was built into buildings, used for numerous products, put into brakes. In the period of the 70s and 80s of the last century, approximately 32,000 tons of asbestos were used. The trend shows that the number of accidental events, such as earthquakes, floods, fires, etc., increases from year to year in Serbia, with a tendency for further growth. There are no databases with data and location maps of used asbestos, nor such disaster distribution maps. Defining an asbestos waste management plan in the event of a disaster, which would include identification, safety procedures for workers and landfills, is necessary for the territory of Serbia.
Keywords: asbestos, waste, disasters, management

Introduction

Asbestos is a group of minerals with unique physical and chemical properties. Because of its exceptional properties and affordable price, asbestos was used in over 3,000 products for various purposes around the world. Asbestos materials are characterized by resistance to heat, abrasion and tearing and possess flexibility and a large specific surface area. It is now known that diseases such as asbestosis, lung cancer and mesothelioma can be caused by asbestos, and by establishing this link between disease and asbestos, asbestos has been banned in many countries. In 1983, Iceland was the first country to ban all types of asbestos, currently more than 50 countries have completely banned asbestos, including European Union countries. After the ban on its use and production, asbestos is still found in significant quantities embedded in buildings and products [1]. Danger occurs when these materials are disturbed and when their autonomy is violated, and then asbestos fibers are released. Situations like this especially arise during unforeseen events such as earthquakes, fires, floods, etc. Considering the terrible consequences after the earthquakes in Turkey and Syria, we are again witnessing how much waste remains after such events. This waste often contains asbestos, especially in countries that actively use it. Figure 1 shows an example of asbestos waste generation after a disaster.

The interaction of anthropogenic influences and natural factors make it difficult to predict the occurrence and development of disasters and emergencies. The lack of capacity of society to adequately respond to the present challenges, risks and threats is evident. The aim of this paper is to present the state of asbestos waste management after disasters in a country in transition such as Serbia. Along with raising awareness about the overall management of asbestos waste, especially afterdisaster.

Figure 1. Asbestos in debris [2]

Material and methods

Study area and asbestos

The Republic of Serbia was once the leading republic of Yugoslavia, located in South-eastern Europe. It currently has about 7 million inhabitants and occupies an area of 88,000 square kilometers. It is in a transition economy and has applied to become a member of the EU [3]. The use of asbestos in Serbia began at the beginning of the 20th century with minor import. Afterwards, two larger chrysotile mines were operating, and today they no longer work, with no rehabilitation of these sites that were carried out. Due to the presence of these mines, asbestos products were made by several companies. data on the quantities of asbestos used and the resulting products are not available. However, there is the absence of a single database on the spatial distribution of asbestos products incorporated in buildings or any other base of asbestos products that are still in the surrounding. Therefore, for the estimation of quantities of used asbestos fibers, and waste that were generated and will be generated in Serbia can be used newly developed model [1]. Figure 2 shows estimated quantities of asbestos fibers used in Serbia during 1930-2017. In Serbia, products that were in use before July 1, 2011, can be used until the end of their life, and in 2015, a complete ban on the production and use of new products containing asbestos fibers entered into force (previous national exemptions were abolished) [1].

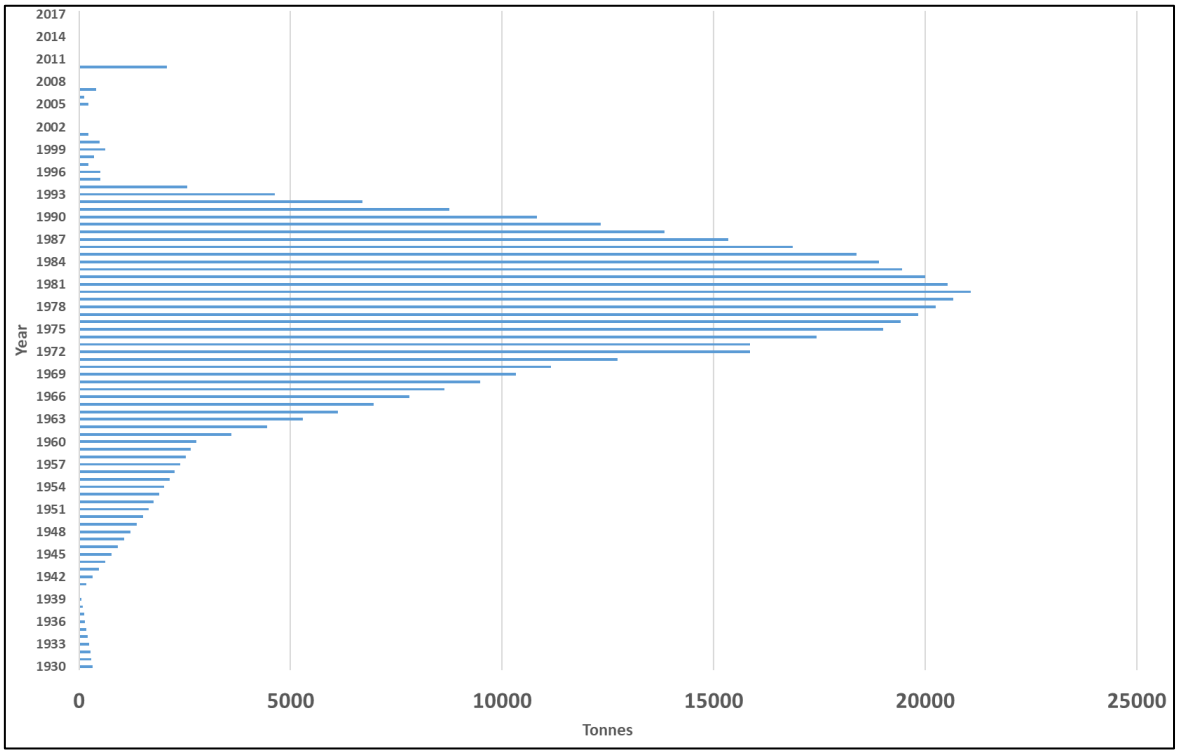

Figure 2 Consumptions of asbestos in Serbia

As shown in Figure 2 main period of asbestos use in Serbia was starts at the beginning of the 20th century. The highest consumption of asbestos was recorded between 1975 and 1985 for Serbia. In the period of the 70s and 80s of the last century, approximately 32,000 tons of asbestos were used. During the 90s, Serbia was under sanctions and war, and then there were bans on the European and world stage, which is reflected in the decline in the use of asbestos in Serbia as well. The main use was production of asbestos cement, plastic fillers, insulating materials, asbestos cloth (protective clothing) and friction products. Tapes impregnated with plastic materials are used for brake linings and couplings, most coatings are made by mixing asbestos fibers, plastics, and suitable fillers. It could be said that today there is no residential or public building, no vehicle without asbestos, which appears in them in various forms and quantities. Products containing asbestos were used for construction and in industries [1]:

- roof coating,
- brake systems,
- plumbing pipes,
- insulation block,
- glues,
- components of electrical devices,
- ceiling products,
- cement boards,
- products for the garden,
- floors,
- colors,

- roof cover,
- partitions,
- isolation,
- fireplace decorations,
- plaster,
- electrical insulation and panels,
- heating and cooling systems, etc.

Disasters in Serbia

Normative Term in Serbia: a disaster is a natural disaster or a technical-technological accident whose consequences threaten the safety, life, and health of many people, material and cultural goods or the environment on a larger scale, and whose occurrence or the consequences cannot be prevented or eliminated by the regular action of competent authorities and services [4].

-A natural disaster is a phenomenon of hydrological, meteorological, geological or biological origin, caused by the action of natural forces such as earthquakes, floods, torrents, storms, heavy rain, atmospheric discharges, hail, drought, landslides or landslides, snow drifts and avalanches, extreme air temperature, accumulation of ice on the water course, pandemic, epidemic of infectious diseases, epidemic of livestock infectious diseases and the appearance of pests and other natural phenomena of a larger scale that can threaten the safety, life and health of a large number of people, material and cultural goods or the environment on a larger scale [4].

- A technical-technological accident is a sudden and uncontrolled event or a series of events that got out of control during the management of certain means of work and during the handling of dangerous substances in production, use, transport, traffic, processing, storage and disposal, such as fire, explosion, accident, traffic accident in road, river, railway and air traffic, accident in mines and tunnels, stoppage of cable cars for transporting people, demolition of dams, accidents at power, oil and gas plants, accidents when handling radioactive and nuclear materials, severe pollution land, water and air, the consequences of war destruction and terrorism, the consequences of which can threaten the safety, life and health of a large number of people, material and cultural goods or the environment on a larger scale [4].

Natural disasters have always been a great danger for humanity and its cultural, historical, and other material assets, the consequences of which were often very severe and catastrophic. Many human victims, great devastation and destruction have been recorded in history as a result of catastrophic earthquakes, floods, storms, volcanic eruptions, landslides and other disasters. Too many data testify to this, and, the territory of Serbia was affected by these events, such as earthquakes (Kraljevo, Figure 3), floods (Danube, Sava, Tamish, Tisza, V. Morava in 2006, 2014.), landslides, etc [6]. In addition to numerous human victims, severe disturbances of a social and psychological nature, the material damage suffered by the residents and the state is also priceless. Many cities and settlements, large arable areas are still threatened by flooding, sliding of unstable terrain and earthquakes, which indicates the seriousness of the situation in which it is necessary to act adequately and in a timely manner in terms of saving lives, property and managing the remains after remediation. The trend shows that the number of accidental events is increasing from year to year, with a tendency for further growth [6].

Figure 3 Kraljevo after the 2010 earthquake [5]

Results and discussion

Disasters in Serbia such as the earthquake in Mionica in 1998. where around 8,000 buildings were damaged. Or in the 2006 flood, when the Danube, Sava, Tamish, Tisza, and V. Morava flooded 6,000 buildings, indicate the need to plan procedures that will regulate the management of waste and hazardous waste as soon as possible [6]. In emergency today, a new worrying problem is observed, which is waste management. The area affected by the disaster is often partially or completely collapsed, inaccessible, as shown in figures 1 and 3. In the first moments of emergency response, the emphasis is placed on saving lives and the safety of all participants, while dealing with waste management comes much later. However, in generated waste could be found dangerous substances that were used for construction, such as asbestos and synthetic mineral wool, formaldehyde and PCB; or dangerous products used in households (pesticides, household chemicals, batteries, etc.). In this way, the danger for the vulnerable groups and for all participants in rescue and rehabilitation is additionally increased. Different types of natural disasters present different risks of exposure. Serbia does not have a waste management plan (nor specifically for asbestos waste) during catastrophic events, at least not to the extent that would include identification, safety procedures for workers and temporary and permanent disposal sites. Asbestos remains most often mixed with all the debris, and this further increases the volume of hazardous waste and, therefore, the risk of fibres being released into the atmosphere. All that waste generally ends up in landfills that are not adequate for accepting this type of waste.

The current state of protection against natural disasters on the territory of Serbia is characterized by the incompleteness and unavailability of information on the risks of possible natural disasters, as well as on the consequences they can cause, with insufficient "public participation". The insufficient capacity of local authorities, professional services and consultants for a modern approach to disaster risk management is emphasized. The current situation is also characterized by the absence of a single database on the spatial distribution of certain natural disasters, i.e. determination of potentially critical zones (floods, landslides, torrents, etc.). A detailed, comprehensive analysis of all aspects of the causes of occurrence and appearance of flash floods was missing. Extensive works were carried out on the reconstruction and repairs of the damaged water infrastructure, but few new facilities were built, while biological and biotechnical works were almost completely neglected [7].

In Serbia, there is no obligation to replace materials containing asbestos, in the buildings and products in which it was installed. In practice, if the asbestos material is autonomous and not damaged, it is justified not to touch or change it. However, the problem arises due to the occurrence of events that would damage the material, such as collapse due to earthquakes or floods, fires and explosions. When an asbestos product is torn, broken, burned, blown up, or washed away with water, asbestos fibres are released into the air and pose a hazard to the environment. If a disaster were to strike a building built in 1970/1980, there is a high probability that asbestos would be found in the waste.

For example, builders built the World Trade Center (New York, USA) using approximately 400 tons of asbestos in insulation, drywall, fireproofing, and steel. The terrorist attacks of September 11, 2001 released deadly asbestos in a cloud of dust over Manhattan, New York [8]. Depending on the area affected by the disaster, the amount of asbestos that will appear in the waste will also depend. Asbestos has been used significantly in Serbia, therefore its occurrence in residential and industrial zones can be expected. Two asbestos mines additionally represent sources and hazards for the environment in case of accidents.

There is no known safe level of exposure to asbestos [1]. Because of this health hazard, it is highly recommended that asbestos-containing material damaged by a disaster be repaired, fenced off, isolated, or removed. Any material containing asbestos must be removed carefully and properly, containerized, and disposed of at a landfill approved to accept this type of waste [9]. Figure 4 shows how the demining work should look like where the asbestos phenomenon has been identified.

Figure 4 Work on rehabilitation when asbestos is identified [10]

Emergency crews and volunteers, as the first people on the scene, face an increased risk of exposure to asbestos after natural disasters. The risk of adverse health effects for these workers increases with time and depends on how many times and in what amounts they are exposed to asbestos.

Recommended asbestos procedures for post-disaster exposure prevention:

- If, during cleaning, it is suspected that there is material containing asbestos on the site, experts recommend that it not be touched unless it is damaged. Mixing asbestos debris can release asbestos fibres and exposure is very possible.
- If materials must be moved before professional help arrives, they should be sprayed with water so that the fibres are less likely to become airborne dust. Keep all damaged asbestos damp and covered to reduce dust generation.
- To reduce exposure, only appropriate respirators, standardized and approved by the competent authorities, are used. Paper masks, surgical or other similar respiratory protection must not be used, as they provide little or no protection from asbestos fibres.
- Always wear additional protective equipment such as boots, coveralls and gloves when removing and working with materials that may contain asbestos.
- After removing all the remains, put the asbestos in double bags.
- Close the work area with plastic film and tape to reduce the emission of dust containing asbestos, adequately mark the work zone.
- Work and move only asbestos-containing construction materials that must be removed, while minimizing excessive breakage to prevent dust and fibres from becoming airborne.
- It is mandatory to take a thorough shower and wash after the removal of asbestos, throw away the wardrobe as well as asbestos waste, to remove all dust and fibres. If it is a question of reusable work clothes of persons who professionally deal with asbestos removal, they are washed separately from other clothes and in special machines intended only for that [11].

Additional, different types of natural disasters pose different risks of exposure. For example, tornadoes can carry asbestos debris from one location to another, while floods can contaminate local waterways and neighbourhoods with asbestos materials. Asbestos fires present the greatest risk to firefighters, unlike other emergency responses. Below are the hazards according to the various events [8, 11]:

- Fire;

Fires leave ash, partially burned materials, and unburned materials that are otherwise damaged or destroyed. This waste is almost always removed from firefighting areas and sometimes contains hazardous asbestos. Only if the specific location that was burning is examined specifically for the presence of asbestos can the clean-up workers be safe;

- Naturally occurring asbestos and flooding;

Flooding can also disrupt natural asbestos deposits. Asbestos fibers from natural deposits are easily carried by flood waters into communities and local water sources. For example, in parts of the state of Washington (USA), the mineral was released by a slow-moving landslide and then ended up in the Swift River. When the river flooded, asbestos fibers were deposited in residents' yards and homes.

- Demolition after floods;

For severely damaged structures built before 1980, demolition and removal should only be performed by individuals who are trained and licensed to work with asbestos. All demolition workers should use equipment specially designed to protect them from exposure to asbestos during demolition and waste handling, particularly respirators required by relevant regulations.

- Earthquake;

During the clean-up of damaged and destroyed buildings after an earthquake, it is likely that asbestos-containing materials will be handled, broken up, and disposed of. Much of this work can be undertaken by temporary workers, volunteers and residents who are unfamiliar with the dangers of asbestos and who cannot identify asbestos-containing material. It is unlikely that workers will initially be provided with appropriate personal protective equipment. Many will also be unaware of methods for proper cleaning and removal of asbestos materials. As a result of clean-up operations, there may be an accumulation of asbestos-containing waste that will pose a hazard to people in the local environment and those living in the immediate vicinity of the final disposal site. Figure 5 shows a temporary landfill created from the debris after Hurricane Katrina in 2005.

Figure 5 Temporary landfill waste after hurricane Katrina, USA[12]

- Tornado

Tornadoes can destroy property and cause a potential asbestos exposure hazard among people cleaning up debris.

Conclusion

As mentioned, in Serbia, there are no databases with informations and location maps on used asbestos, nor on the distribution of disasters. On the other hand, serious disasters occur in Serbia with a tendency to increase in frequency. There are no asbestos waste management plans in general, and especially not in emergency situations.

Also, by establishing a database of potential locations that are threatened by the possibility of disasters and one with location with asbestos products incorporated, and crossing these two databases, it is possible to obtain an adequate platform for the formation of plans for organization and response in case of disasters. This would lead to safer management of waste after disasters, especially hazardous asbestos waste. Therefore, additional research is needed on the quantities and spatial distribution of all asbestos materials used in Serbia, which would facilitate the identification of particularly vulnerable areas during emergency situations.

The necessity of developing a long-term strategy for the prevention and rehabilitation of the consequences of an emergency represents a fundamentally new task in emergency management systems and requires a new management organization, especially from the aspect of asbestos waste management. The US EPA has issued guidelines for effective asbestos management during disasters to reduce exposure and protect workers and the public, such guides are necessary to implement in Serbia according to possibilities of disasters and dangers that may occur, especially from asbestos products and waste [13]. Defining an asbestos waste management plan in the event of a disaster, which would include identification, safety procedures for workers and disposal sites, is necessary for the territory of Serbia.

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