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Landfill workers' proffesional education for protection against injury and damage

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ABSTRACT

Common practice in Southeast Europe (SEE) countries is that mostly low skilled workers work in waste management sector. In SEE countries there are no institutions specialized for educational training concerning safety of the employees who work in solid waste management system. It should be emphasized, that this specific type of profession, which is dealing with the high occupational health risks, needs legal basis for proper education and training, like it is defined for numerous professions in public sectors. Evidently, companies that provide the education and training for their employees will have direct benefits. The main focus of professional education is on workers on landfill, as this is the working place with the highest risk, but at the same time very important for operational practice and sustainability of a landfill. For these workers, there are following focus points: Professional training; Health and Safety protection; Fire protection; Landfill gas management; Leachate management. Well defined educational programmes for H&S, emphasizing safety precautions in handling with hazardous materials and fire protection, are good way to reduce injuries and to improve efficiency of employees as well.

1. Introduction

The poor employers' awareness of the complexity and benefits that the proper implementation of occupational safety and health (H&S) brings, represents the biggest problem at landfills and utility companies. Every injury in the workplace costs the employer much more than the expenditures related to the introduction of H&S.

The most important regulations in H&S area are acts of the International Labor Organization, World Health Organization, European Union and other European integrations whose regulations are accepted by EU Member State. EU laws are mandatory for Member States of this organization, and in good part also for countries that are preparing to join because this is one of the conditions for admission to the EU.

For safety and health at work most important are the directives of the general character to which have determined guidelines (frameworks) of national policy and national protection systems; and specific directives that determine the conditions of work and security measures in certain areas. In terms of defining the obligations and activities of the state at the national level and employer at the enterprise level, the most conclusive are the Convention no. 155 and General Directive no. 391/89. In the Republic of Serbia, right to health and safety as a fundamental right of employees, institutional organization, and mechanisms necessary for its

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realization are regulated by laws, by-laws, norms and standards, collective contracts, employer's act, and employment contract. Right to protection on work is guaranteed by the Constitution, and systemic issues, rights, obligations, and responsibilities are regulated by the relevant laws (Law on Safety and Health at Work, Labor Law, Laws on Social Insurance - health, pension and disability) and conditions for direct implementation by other legal acts. Harmonization of the Law and related by-laws in this area was conducted in such a manner that the majority of requirements stated therein was adopted in accordance with national market conditions. The Law on Health and Safety at Work set up all the activities intended for undertaking preventative measures for the purpose of preventing the risk of injury (Law on Safety and Health at Work, 2005).

Most companies in Serbia and countries in the region carry out regular training for workers in the field of occupational safety and fire protection, as imposed in the current legislation. Nevertheless, despite all the measures that are being taken, there were cases of lighter injuries, several cases of self-ignition of the waste at the landfills, as well as improper handling of the machinery. For that reason, professional education and H&S must be seriously considered. It is necessary to consider its introduction into every business system, and the final result would be safe workplace, as well as a higher productivity of employees (Thornton, 2002).

Incorrectly installed machines, poorly constructed landfills, improperly disposed or stored municipal waste, poor worker skills, and wrong working procedures inevitably lead to accidents. The variety of work, and in that sense a wide range of hazards, leads to a high level of injuries (Needham et al., 2004). It is indisputable that it is very difficult, almost impossible, to achieve completely safe working conditions in which there would be no accidents, especially if the work does not always occur in the same place and using the same means of work. Utility companies face precisely these difficulties. Well-defined professional education and H&S program are a good way to reduce injuries and improve efficiency of employees.

The goal of professional development is to acquire knowledge about waste management system and adequate operating procedures on landfill that will reduce number of accident situations, as well as to provide more efficiency in the municipal waste management sector.

Companies that provide H&S training for their workers will see benefits through improved and safer working conditions, which will further result in better motivation for employees.

2. Analysis of accidental situations at landfills

Hazardous emissions, dust, smoke, flies, odour, heat, cold, and long days in the cabin are not favourable conditions for most workers and drivers of machinery at the landfill (Bogale et al., 2014).

A large number of hours (32 hours per week) spent in the cabin during the day and in the cramped space can create discomfort and increase the likelihood of making a mistake (Pagano, 1964). People who do not have enough experience and knowledge with operating machinery often apply to work as drivers. In Republic of Serbia there is a lack of compaction and the daily corresponding landfill covers. Consequently, the approximate use of the working time for workers at the landfill is 800 hours per year.

The cause of lighter injuries at the workplace, for example during the landfill fire or improper handling of the machinery, is the fact that the company generates a lower level of income than required (Thakur et al., 2018).

This is usually the case when authorities do not approve the economic cost of utility services, and thus the utility companies need to reduce the expenditures, which directly negatively affects the procurement of H&S equipment. In order for utility companies to maximize savings in the process of the disposal of municipal waste, the application of a minimum or no layer of inert material on sanitary cells is applied, which does not provide adequate protection in the event of landfill fire. Also, the fact is that the sanitary waste disposal is new in the countries in the region, and that the work of mechanization in the handling of municipal waste is different from the work on the same mechanization on construction sites, quarries, excavations, etc.

This specificity is reflected in the fact that training of operators in the procurement of work machines is not adapted to specific conditions at the landfill (soft ground, heterogeneous composition of the ground, uneven load in manipulative work, etc.), and that general handling rules are not entirely sufficient for proper operations of machinery on landfills, thus leaving an extremely high possibility of damage to the underbody, engine, hydraulics, or other parts of mechanization.

The data taken from the Statistical Yearbook of the Republic of Serbia on work-related injuries in the period from 1977 to 2005 show that in the utility sector an average of 1170 work-related injuries occurred annually, i.e. three workers were hurt each day in this sector. In 2015, the total number of serious and fatal injuries in the following activities: industry, mining, forestry, construction, etc., was 729, out of which 43 injuries were in housing and communal activities (Ministry of Labour, Employment, Veteran and Social Policy, 2016). The work conditions in communal activities are quite difficult and specific, with a greater number of injuries at work, including death fatalities. According to the data from 2015, this activity includes 5.9 % of the total number of injuries at work in the Serbian economy (Ministry of Labour, Employment, Veteran and Social Policy, 2016).

Also, there are frequent injuries of workers at the municipal landfills (due to the frequent internal transport including vehicles bringing in the waste for klifts, compactors, bulldozers, and other heavy construction

machinery), at the collection and sorting of waste, at the landfill working face, during landfill remediation, machinery maintenance, etc. The risk of injury from the machinery at the landfill is most often associated with the possibility of injury of workers operating in its vicinity, usually from parts of the machine itself.

According to an official 2009 Report from the New York Department for the assessment and control of mortality, a 49-year-old employee was fatally injured when he fell on the road from the rear of the truck on which he was standing. Since he suffered serious head injuries when hitting the ground, he died two days later. In order to prevent such accidents, workers should not stand outside of the cabin of vehicles moving faster than 10 km/h. Also, in 2008, the 69-year-old worker from the private sanitary sector died after being run over by a garbage truck. After compaction, the vehicle started to move, the worker ran for the vehicle, fell under the truck and died. In such situations, workers should turn on handbrake before leaving the vehicle (FACE, 2010; FACE, 2012).

3. Hazards which are present at a landfill and pose a risk for landfill workers

Health risk from working machinery is most often associated with the possibility of injury in the working space of the machine due to moving parts of the machine or the operator/driver of the mechanization. The risk of injury is also present when moving the machine. The landfill machines are being improved daily to achieve the following goals: the highest possible effects, simpler and easier handling by introducing the principle of automation, reducing operating costs per unit of production, simplifying supply and replacement of spare parts, easier and simpler maintenance, improving technical possibilities of movement, rotation, speed change, and operation in different climatic conditions (Thakur et al., 2018).

In many developed countries, the work of the driver/operator is simplified by the acquisition of modern machines. Modern working machines have better control, monitoring, and different operating modes. Any information that a driver can obtain in the vehicle cabin reduces possible accidents and makes safer and more efficient working environment.

However, despite all the information that a vehicle can provide, it is necessary to have trained workers to handle them. The machines have become simpler and easier to operate. Most people think that anyone can do such a job, but this is not the case, since training is required for all operations. For better performance, training and knowledge are needed to work safely and with higher efficiency. It is important to note that, in addition to modern mechanization, qualified drivers are in high demand all over the world. The technology has advanced, but all this comfort has no significant impact if the drivers/operators do not properly operate and maintain the machinery. Handling compactors, dozers, and loaders requires both skill and patience. These are the two qualities that the best drivers possess, and it is often difficult to find such drivers. Each landfill has unique layers and topography. The best drivers know which paths to avoid at the landfill.

Landfills can change their status from ‘controlled’ to ‘uncontrolled’ as a result of as serious landfill fire. Since landfill fire poses a threat to human health and the environment, the need to understand its mysterious nature is higher than ever. If some kind of a heat source contacts the surface, for instance deposits of hot waste, lightning, or arson, this can cause surface fire (Reinhart et al., 2002; Riquier et al., 2003).

For deep-seated fires (below 4.5 meters) the initiation mechanisms are quite different. Deep-seated landfill fires can expand in two different ways, which are known as ‘confined’ and ‘unconfined’ progression. Confined progression starts within multiple thin layers of waste which are pressed by a landfill compactor. The compactor realigns the waste in a way that it is more permeable horizontally than vertically. These thin layers of waste are located between layers of daily cover of inert material. In Serbia, daily cover is not used on any of the landfills, however on certain landfills compactors and buldozers conduct some sort of compaction. In this case, a fire will expand horizontally.

A confined fire might be indicated by a shallow collapse, surrounded by tension cracks at the surface, where operators of the heavy machinery may fall into. At unconfined landfills, fires occur in Construction and Demolition (C&D) sites. There are no horizontal constraints here and fire will progress vertically producing a dangerous sinkhole at the surface, where drivers of compactors, dozers, and buldozers may fall into (Sperling and Henderson, 2001; Reinhart et al., 2002). Surface fires are easy to detect, while deep seated fires may be predicted and often detected early on. The most cost-effective method of detecting a fire is through detections of the trained staff. Some detections include: barbecue-like odour; vertically unaligned gas wells; issues with landfill gas pipelines (breaks or softening); or an unplanned necessity to change the oil in landfill gas engines (Environmental Agency, 2002).

In addition to this, the operator should continuously monitor key properties to detect changes:

- In the topographic shape of the landfill;
- Greater rise of temperature of more than 3 °C, or when the temperature reaches 60 °C;
- Changes in a landfill gas analysis: i. changes in methane and carbon dioxide levels, ii. changes in nitrogen levels, iii. changes in hydrogen content, and iv. a change in carbon monoxide concentration;
- Changes in leachate analysis –increase in the level

of nitrogen, pH, conductivity, heavy metals, Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), and ash (ATSDR, 2001).

Frequently, during the extinguishing of landfill fire, the machinery may fall into the excavation. Due to the increased layer pressure from the water used to extinguish fire, the overload of the edge of the excavation and displacement of the bottom of the excavation leads to unstable geodetic conditions. Early detection and extinguishing of landfill fire are of utmost importance for minimizing the costs.

4. Training program for landfill workers

As part of the training of landfill and utility company workers, the employer should inform the employees of all the facts and circumstances that affect or could affect the safety and health of workers (organization of work, risks, and manner of carrying out work procedures) (Ministry of Environmental Protection, 2010). During training, the worker needs to be educated and trained for the practical application of occupational safety measures that he is obliged to apply during work, in accordance with the assessment of the risks, which he/she is exposed to at work and in connection with work. Training of workers is carried out in accordance with the training program, which must be based on risk assessment, and must cover all the hazards and risks identified by the risk assessment and the ways of eliminating danger and damage (EU-OSHA, 2001). It should be emphasized that this specific type of profession, dealing with high-risk jobs, requires a legal basis for adequate education and training, as defined for many other public sector professions.

Training of employees in the field of H&S consists of theoretical and practical work. Training is conducted for the following jobs:

- Drivers of the mechanization;
- Workers at the landfill.

Theoretical training of employees for safe work is carried out through oral lectures, discussions with employees, and passing on instructions for safe work, and it consists of a general and special part. Testing of the theoretical knowledge is carried out after the completed training by filling out the tests in written form.

The general part of the training includes the basics of waste management, vocational training, proper and efficient work with the means and processes of work, professional development, legal obligations and rights in the field of H&S, fire protection, the basics of handling hazardous substances, the rights of employees and their obligations regarding H&S and the manner of exercising these rights, as well as the procedures in case of violation of the rules, the technological process of work and the working environment, risk assessment, organizing, and the method of providing first aid in the event of accidents and other situations which can affect large number of employees.

Practical training of employees for safe work is carried out by direct introduction of the work process to the employee at his/her workplace, the manner of safe use of equipment for work with special attention to possible failures and risks if the equipment is not used in accordance with the instructions for safe operation, and proper use of personal protective equipment.

The assessment of the time required for theoretical training of the employees is 360 min, and for performing the practical work examination is 240 min.

5. Recommendations for safe work at the landfill

The Solid Waste Association of North America (SWANA) is dealing with HSE issues at landfills, and have tips/recommendations for landfill workers. The occupational health and safety education and training is one of the main priorities of SWANA, since it is revealed that thousands of employees in solid waste sector receive injuries each year (SWANA, 1988).

Recommendations for Landfill managers:

1. Develop a traffic control plan that can be used to monitor the movement of workers on the road, working machinery at the landfill, and garbage trucks;
2. Implant a policy that requires truck drivers to remain in the cabin during unloading;
3. Install additional safety devices on working machines that would alert drivers when someone is in the "dead corner";
4. Require that all employees at the landfill carry high visibility safety vests and all accompanying personal protective equipment.

Drivers often work in an unsafe manner, due to ignorance or other reasons, endangering themselves, as well as other people in the vicinity. This risk can be significantly reduced by appropriate work planning. In order to reduce the risk of possible incidents the recommendations are as follows:

1. Vehicles must be technically sound and equipped in accordance with existing regulations;
2. The work machine at the landfill must be handled by a person who is authorized to work with the machine and who has a medical certificate;
3. The machine driver/operator must comply with the manufacturer's technical instructions for safe working;
4. The driver/operator must have the skills and patience;
5. The driver/operator must be ready to react to

unexpected situations and be able to make quick decisions;
6. The driver/operator of heavy machinery should be aware at any moment of where other vehicles and workers at the landfill are located;
7. The driver must turn on the handbrake before exiting the vehicle;
8. The driver should be familiar with the specific waste streams at the landfill;
9. The driver should know which paths should be avoided due to the flow of process waters;
10. The driver/operator should wear the personal protective equipment at all times;
11. Workers should not stand outside of the cabin of a vehicle moving more than 10 km/h (NIOSH, 1998).

6. Conclusion

After the professional training, employees at the landfill are trained for safe work, as well as for better efficiency at work. Employees are able to recognize specific risks at their workplace, as well as to reduce health risks and more effectively fulfill their work assignments. Companies that provide safety and health training to their employees will benefit directly through a reduced number of injuries, which leads to a reduction in the cost of medical treatment and financial compensations for potential health and safety issues.

Education and training on H&S also imply harmonization with H&S legislation, and companies avoid penalties prescribed in legal acts for this type of offense. A special benefit for companies is the efficiency of employees, given that besides H&S training, employees are also provided with professional training which leads to better and more efficient skills. In this sense, the work process must be adapted to the physical and mental abilities of the employee. Working environment, tools for work and the personal protective equipment must be developed and manufactured so that they do not endanger the safety and health of the employee.

This paper offer perspectives for the future work of presenting the direct and indirect costs of providing such an education. This remains an open issue for further research.

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Profesionalna edukacija radnika na deponiji u cilju zaštite od povreda i oštećenja zdravlja

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I Z V O D

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