

Research Article

Injuries from Mobile Firewood Cutting Machines

Sulejman Meta^{†*}, Muhamet Imeri[‡] and Nderim Zeqiri[†]

[†]Wood Technology Department, University of Applied Sciences, Ferizaj, Kosovo

[‡]Wood Technology Department, University of Applied Sciences, Ferizaj, Kosovo

[†]Mechanical Engineering Department, State University of Tetovo, Tetovo, Macedonia

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Abstract

Injuries caused by mobile firewood cutting and splitting machines can be extremely serious leaving consequences for workers; they can lead to permanent disability and even fatal consequences. In order to point out the frequency and characteristics of injuries during work, in the first part of this paper, we give an overview of the types of mobile machines for cutting and splitting firewood in Macedonia, their characteristics as well as the risks that most often lead to problems and injuries caused by working with these machines. The dangers arise when transporting the named machinery to the place where the works are being carried out. In the second part of the paper, the most frequent injuries at work, their frequency, and the number studied in the three largest cities in the west of Macedonia are reported. The data on the types of injuries as well as their number refer to the period from 2006 to 2011. The results of the research indicate a permanent increase in the number and frequency of injuries that require the need for changes in several sectors of work. In order to change the current situation, certain measures and recommendations for improvement are given in the concluding remarks on using and handling the machines as well as the organization of this type of work in general.

Keywords: Injuries at work, mobile machines, woodcutting and splitting.

1. Introduction

In order to obtain heating energy in Macedonia, firewood is used among other energy sources for heating heating public and private buildings, as well as for domestic use.



Fig. 1 Parked working machines of different types

The economic crisis and the rising prices of oil derivatives, as well as electricity and gas have also led to the increasing consumption of firewood, which is mainly prepared by cutting molds and logs that come in one-meter length on the market. Cutting wood is mainly done by private entrepreneurs who use mobile machines for this purpose, while the work is fieldwork and is done at all time periods and occasions. In manufacturing processes where cutting wood (slabs and logs) and shortening of the salvages occur, various types of mobile cutting machines, such as those with circular saw blades, belt testers and combined machines are used (Photos 1 and 2).

There are mainly two types of mobile machines used for cutting firewood – the first type is with a circular saw – Type A (Photo 2 – left) and Type B using a band saw (Photo 2 – right).

During the inventory of machines that was carried out in the three largest cities in the west of Macedonia, in Skopje, Tetovo and Gostivar, the most common type of firewood cutting machines was Type A with a share of up to 95%. The total number of A-type machines that were in operation was 102. Given that the total population of these cities is slightly larger than 1 million or 50% of the population in Macedonia, it is ascertained that one A-type machine serves an average of 10 thousand inhabitants.

*Corresponding author's ORCID ID: 0000-0000-0000-0000



Fig. 2 A circular saw machine – Type A (up) and a band saw machine - Type B (down)

Saws of the type A that are the most numerous and self-propelled are produced in local locksmith workshops where production and assembly is performed craftily and without any control. There are numerous deficiencies detected in these machines, especially in the part that has to do with occupational safety, leading to injuries of machine workers and users themselves. Injuries that occur when working with the types of machines mentioned, are usually extremely serious injuries, some of which may cause permanent disability or even casualties (with fatal outcomes).



Fig. 3 Firewood cutting and splitting machines with circular saws – Type C (up) and Type D (down)

The Type A mobile circular saws have a framework welded construction in which a diesel engine is assembled (Photo 2-a); a driving system (Photo 2-b); a working axle with a saw (Photo 2-c); a moveable chair (Photo 2-d), a gear changer (Photo 2-e); and wheels.

2. Material and methods

General risks and dangers, which can cause severe injuries, have been analyzed in this paper, along with 386 such injuries, having occurred upon firewood cutting and splitting during the period between 2007 and 2011.

2.1. General risks

In order to analyze and at the same time prevent injuries, it is necessary to look at the machines and tools, the operations performed with them and the working conditions, identify the risks in operation, adjustment and maintenance of machines, etc. [2, 4]. With regard to mobile machines for firewood cutting and splitting, the risk of injuries in operation occurs in the following zones and sections:

- Part of the machine where cutting occurs;
- Parts that transmit energy - parts of machine transmission;
- Other parts of the machine such as the steering and braking system during the transport of the machinery itself, light signalization, etc.

Potential sources of injuries include parts of the machine that perform movable functions such as the working shaft with a circular saw, working wheels with a belt sander, direction mechanisms, suppressors and vacuum cleaners, as well as breaks of the working tools and their parts.

Due to anisotropy and heterogeneity as well as other traits of the firewood, other potential risks that can lead to unpredictable injuries may occur. Firewood slabs and logs of are primarily irregular in geometry, having different humidity levels and as a result different hardness and weight during cutting. In the internal part of the tree there are bumps that are not

visible and have higher hardness, so that during the cutting process, the scars are additionally burdened, which can sometimes lead to cracking or breakage. It is common to find metal parts in the interior of the tree, such as shrapnel of exploded grenades, grain battens and hunting ammunition, parts of wire fences, nails, stone parts, and other materials. These kinds of 'external' materials or items can lead to obtuseness of the cutting mechanism and even to cracking or tearing of parts or the whole machine as such. Due to non-protection as well as other moments, parts of external items or working tools often lead to severe worker injuries in cases of their ejection.

2.2. Machine injuries

Injuries do not happen accidentally; behind every injury there is a cause. The causes of injuries at work can be divided into three groups: faults, deficiencies and human error; lack of protection of the machine and the working environment; and causes related to higher forces.

In forensics injuries are classified according to their appearance and characteristics, or the means (instrument, etiologic factor) they are subjected to. The following groups are featured:

1. mechanical
2. physical
3. asphyxiating
4. chemical
5. nutritive
6. Bacterial
7. Psychological injuries.

An interesting aspect of this kind of work are mechanical injuries; they are the most numerous and occur upon the action of mechanical force or mechanical tools. These kinds of injuries have been classified into two basic groups: injuries and wounds. Injuries are non-specific mechanical injuries, on the basis of whose characteristics we cannot determine the type of mechanical tool that has been used. These injuries include:

- blood clot
- blood flow
- abrasions
- contusions
- breakage, penetration, permeation, jabs
- fissures
- fractures and sprains.

Wounds are specific mechanical injuries, where the continuity of the skin is interrupted and whose characteristics indicate the type of mechanical tool or the principle of the mechanical tool applied to it. The wounds are classified as:

- tearing - caused by the action of a mechanical tool,
- stumps – caused by pins of a mechanical tool,
- cutoffs – caused by blades of a mechanical tool,

- shotguns – caused by the usage of a firearm.

In the case of injuries having occurred during woodcutting, all types of injuries and wounds have been reported except for the shotguns, although there have been injuries similar to shotguns when a fang of a circular saw has been detached and has pierced a person's the hand (Photo 4).



Fig. 4 A cut-off wound on the knee (above) and a shotgun wound on the palm of the hand (right)

3. Results

The following data have been monitored in our paper: gender of the injured persons, the age of the injured, the education of the machine operator, the seasonal nature of the injuries, the type and nature of the injury, the cause of the injury.

The data presented were obtained from the research, whereby the interviewees were those who had been injured during their operations as well as other persons – witnesses to such accidents.

Table 1 Frequency of work injuries in terms of the injured part of the body for the period 2007-2011

Nr.	The injured part of the body	Freq.	%
1	Head (head, eye, mouth, ear, nose, face, neck, multiple head injuries, other head injuries not mentioned here)	69	17.86
2	Body (back, chest, stomach, pelvis, other injuries not mentioned here)	83	21.50
3	Hand (fingers, palm, elbow, arm, shoulders, other hand injuries not mentioned here)	157	40.66
4	Leg (hips, legs, knees, ankle, toes, other leg injuries not mentioned here)	56	14.51
5	Other	9	2.81
6	No data	12	3.11
Total		386	100.00

Based on the data in Table 1, we can clearly see that the most frequently injured part was the hand with 40.66% of the total number of injuries.

All operators and assistants were male; 265 of them had used 102 Type-A machines, as well as 15 other machine types, which have a splitting attachment and serve at least 3 people.

The age stratification analysis found that the largest number of injured - 209 (78.87%), were aged between 21 and 49, followed by a group of people aged between 50 and 65, whose number was 37 (13.96%), while the group of younger subjects, under of 21, included 18 persons (6.89%) all of whom were males.

With regard to the type of injury-wound, hand injuries dominated, including tearing (17.35%), stinging wounds (42.28%), cut-offs (34.65%), and amputation (5.72%).

Wood cutting happens throughout the whole year and the largest number of injuries occurred in October (16.52%), followed by November (13.41%), September (12.24%), June (11.32%), December (3.08%), May (8.63%), July (7.42%), March (6.28%), April (4.42%), February (3.42%), January (3.05%), and August (2.11%).

4. Discussion

Injuries at work caused by wood cutting and splitting machines in the observed five-year period (2007-2011), in the territory of the three largest cities in the west of Macedonia, indicate the need for further investigation of other moments that have not been covered by this paper. The number, variety and frequency of all injuries require the undertaking of actions and measures to improve the situation. The largest number of injuries in the month of October, when the demand for firewood is the highest. Because of the economic crisis, the purchase of firewood is postponed until the beginning of the winter. In recent years, the Government of Macedonia, adopts a decree on reducing the firewood price by 10%, usually in September, and that is when people tend to buy firewood the most. This leads to a large amount of work for woodworkers, which is an additional reason for overtime work, speed work, increased fatigue, and all this increases the chances for injuries at work. In only 4 months, from September to December, a total of 53.35% of all injuries occur, which indicates that during this period, attention must be paid to the change in the organization of work, the introduction of new workforce and the increasing number of machines. Certainly there are other (primarily psychological) factors that lead to this situation.

Staff working on cutting and splitting wood are usually uneducated; no one of the respondents had a completed secondary education; only 108 had a completed elementary school, while the rest were with lower or no education at all.

No one had previously completed any kind of training on handling and working with cutting and splitting machines, as well as occupational safety courses. Also, an important moment that leads to increased injuries is that very few workers (25.28%) use protective equipment.

This situation requires primarily the need to organize trainings and courses for safe work, knowledge of work technology, materials and machines.

Machines that are made without certification must be subjected to technical inspection and acceptance and are subject to the Occupational Safety and Health Act. Mobile circular sawing machines are not registered, they move along local and regional roads, often causing traffic accidents, thus causing the other traffic participants to suffer. More efforts are needed by the competent authorities to eliminate inconsistencies that lead to the existing situation; at the same time, the Occupational Safety and Health Act needs a special chapter that will regulate the issue of mobile machines for wood cutting and splitting.

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