



# The Impact of Occupational Safety and Health Practices in Sri Lankan Rubber Industry

K.G. Nipun shantha, L.P.C. Dilshani, R.M.A.K. Rupasri, W.M.D.B. Weerasekara, H.U. Rajamanthri

Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka

Email address: [egt18538@sjp.ac.lk](mailto:egt18538@sjp.ac.lk)

Received: 05 June 2022; Revised: 30 July 2022; Accepted: 30 September 2022; Available online: 10 Oct 2022

**Abstract:** This is about occupational safety and health procedures' impact on the Sri Lankan rubber Industry. This paper specially focused on discussing the rubber industry and the process, identifying possible risks in the industry. Occupational Safety and Health activities are currently in progress in the rubber industry. Discuss several accidents, injuries, and deaths that are happened in the industry (Five dead in an 'ammonia tank' accident in a rubber factory at Horana, Sri Lanka, a Fire at a rubber factory in Galle, Rubber factory closes due to environmental issues, and Harmful effects to the human body due to Ammonia and TMTD/ZnO), and suggest some risk assessment and analysis methods to achieve zero risk.

**Index Terms:** Hazard, OHS, Risk, Rubber Industry

## 1. INTRODUCTION

Sri Lanka was the cradle of the rubber industry as one of the world's leading natural rubber producers and revolutionised many industries worldwide. Sri Lanka's export in 2021 from rubber products has achieved US\$ 1 billion in income, and the Government of Sri Lanka aims to grow the rubber industry to US \$ 3 billion by 2025 [1].

A 99% of the natural rubber is extracted from a tree called *Hevea brasiliensis*. The Rubber industry has specialized in the sustainable production of rubber products like crepe for shoes, solid tires, and high-quality gloves for the global market. Each product has unique and various procedures. But most products need rubber as latex. Latex is also used to refer to a liquid form of rubber, particularly non-vulcanized rubber [2].

If someone cares about the environment, Organic latex is the right choice. Buying organic latex products helps local plantations keep an eye on sustainability and eco-friendliness. As the organic process prevents the use of chemicals in the plantation and no toxic chemicals are used in the production process in the factory. Therefore, the organic latex label guarantees that the rubber product has no toxic chemicals or pesticide residue, inside or outside. Hence normal natural latex and organic latex are collected and produced separately [3]. Most people see the manufacturing section as riskier, but the hidden reality is the latex collecting and centrifuging sections are riskier and more dangerous. Therefore, this research paper has widely focused on safety before the manufacturing section. Those are latex collecting, centrifuging, and crape units.

Natural Rubber is harvested in the form of the latex from the rubber tree (*Hevea brasiliensis*)[4]. Tapping is the process by which latex is collected from the rubber trees. The work is done in the early

morning or at night before the day's temperature rises. The Tapping panel will yield latex for up to 5 hours, then it collects and brings to the one place that stores the latex temporarily. Ammonia is mixed with latex because it is used to prevent premature coagulation in rubber.  $\text{NH}_3$  prevents the growth of bacteria in latex. but it is not enough therefore TMTD/ $\text{ZnO}$  is added then the Volatile Fatty Acid number (VFA) can be controlled. Below VFA 0.040 is the better range for manufacturing but if it exceeded 0.070 it concerns a High VFA. That latex is used to create a low-level Ribbed Smoked Sheet (RSS) (Fig. 1) [5].



Fig. 1. RSS (Ribbed Smoked Sheet)

Browsers are collected latex from rubber Estates and hand over chemicals according to the given latex quantity (2.5 - 3L ammonia and 120ml TMTD/ $\text{ZnO}$  for 100L Latex). After that, The Factory centrifuges received latex for increasing the DRC (Dry Rubber Content) to suit the products. The latex that has higher DRC after centrifuging is delivered to the main manufacturing factories for manufacturing the product. But low DRC latex is used for creating crape rubbers. After that, the water that has chemicals is filtered before being released into the environment. Finally, Latex which has a higher DRC is used to produce rubber products [6].

## 2. IDENTIFIED POSSIBLE RISKS IN THE RUBBER LATEX INDUSTRY

When considering the latex collection and distributing industry we can identify lots of possible risks. Managing risks with occupational health and safety is a very important thing in each business or company. In any industry, by identifying all possible risks, management can take some actions to minimize and control those risks and protect their workers. In this industry, there are several sections that can have some risks.

### 2.1. Risks at Filling Bowser with latex

In the latex collection process, vehicle assistants climb onto the latex browser and fill latex by hand or pipe. In those latexes, there is Ammonia ( $\text{NH}_4$ ) which is added to prevent latex freezing, and Tetramethyl thiuram Disulfide and Zinc Oxide (TMTD/ $\text{ZnO}$ ) which are added to prevent latex deterioration. As a result of not following proper safety methods in that process, there is a high risk of various accidents if the latex gets stuck in the body as well as in very sensitive organs like the eyes. In addition, when the lid of the bowser is opened, the internal pressure is released at the same time; therefore it has a slight risk of gases being inhaled and causing an accident, as well as the risk of workers falling into the bowser due to negligence or ignorance.

### 2.2. Risks in transporting latex

When transporting rubber latex, there can be several risks while transport. The main risk here is the potential hazard if the lids and the faucets on the bowser are not properly closed. Accordingly, if the lids

and faucets are not closed properly, there is a high risk of rubber gutters spilling across the road during transport and causing accidents to other passengers as well as significant damage to the environment.

### **2.3. Risks of transporting chemicals**

Large gallons of the above-mentioned chemicals are transported by rubber collecting bowser to be distributed to rubber millers. Ammonia ( $\text{NH}_4$ ) is a significant toxic chemical, and TMTD/ $\text{ZnO}$  is highly harmful to the human body. Cans containing these chemicals are usually transported in a compartment made of metal straps on the back of the bowser. The image below shows such a bowser like that.

There is a high risk that the can will fall off the browser and be thrown away during the transportation of the chemicals. Therefore, if the lids of the cans are not securely fastened and packed in a safe manner during transportation, it may cause harm to the people on the road as well as the environment. The other important point is the risks involved in the process of distributing the chemicals to the rubber plantations. When plantations hand over empty cans, they are given cans of  $\text{NH}_4$  filled by latex collectors. It has no significant risk to either side. But TMTD/ $\text{ZnO}$  is given as liters. It fills into a bottle brought by the plantations helpers, who do not follow hygiene measures such as gloves, goggles, or face masks during the chemical exchange, therefore chemicals can contact the human body and cause various infections.

### **2.4. Latex drain from bowser**

The collected rubber latex is filled into large tanks built slightly above the ground level before being sent to a centrifugal machine for centrifugation. Those temporary storage tanks have a large capacity and there is a risk of losing one's life if an employee falls into it because of not being careful.

### **2.5. Bowser cleaning**

Moreover, the cleaning process after collecting these tanks is also high risk. Workers descend into these tanks for cleaning, and if they do not take safety precautions, they may inhale toxic gases and ingest toxic chemicals through the nose, eyes, and mouth. As well as, not wearing gloves or boots increases the risk of infection due to chemical contamination of the feet and hands while cleaning the side of the bowser.

### **2.6. Chemical storing**

The other biggest risk in these factories is the way the chemicals are stored. High Ammonia is used in the factory and low Ammonia is distributed to rubber plantations. This high-pressure Ammonia is stored in tanks and must be transported safely. But unfortunately, due to ignorance or carelessness, some employees keep rolling these high-Ammonia cylinders along the floor. In such a case, if the valve or the lid of that cylinder breaks or leaks, high-pressure Ammonia will come out, and workers can't stop it usually. Therefore, it has a huge risk to everyone who works in the factory as well as near the factory.

Ammonia is irritating and corrosive. Exposure to high concentrations of Ammonia in the air can cause rapid burning of the nose, throat, and respiratory tract. This can cause bronchial and alveolar edema, a loss of air due to respiratory distress or failure. Inhalation of low concentrations can cause coughing, and irritation of the nose and throat. The smell of Ammonia provides an adequate early warning of its existence, but Ammonia can also cause olfactory fatigue or adaptation, and reduced awareness of prolonged exposure to low concentrations. Not only that, TMTD/ $\text{ZnO}$  is similarly harmful to the human body. Also, low concentrated Ammonia, also known as low-Ammonia, is stored in relatively small tanks.

As described above, there is no safety measure to cover gloves, boots, masks, goggles, or full body protection, and such workers are at high risk of exposure to the chemical Ammonia. Even chronic illness can result from this persistent activity.

### **2.7. Risks at latex creping**

Crepe rubber is made by letting a certain percentage of the rubber coming out of the centrifugal machine evaporate over time. To do this, rubber latex mixed water is filled into holes about 6 feet deep. Some such tanks are shown in the Fig. 2.



Fig. 2. redeem tanks of Crepe rubber

The main risk here is the lack of safety fences, which could lead to workers falling into these tanks and causing an accident. Moreover, after freezing like a layer of rubber, workers take those out of the tank, where, if the body is not properly covered, there is a risk of various accidents, as described earlier, due to the chemicals entering the body. If an employee's hand or body part gets into the rubber creping machine due to carelessness or ignorance, there is a high risk of a major accident.

### **2.8. Disposal of waste water**

During the wastewater treatment process, the water is pumped into several tanks, respectively, and the final tank releases clean water free of harmful chemicals. These filter tanks are very deep and have a large capacity. Maintaining those tanks is very risky. Falling into such a huge tank can even lead to death. In opposition, if this wastewater is released into the environment without adequate treatment, it can be a serious threat to the people living in that area as well as the environment.

## **3. OCCUPATIONAL SAFETY AND HEALTH ACTIVITIES CURRENTLY PROGRESS IN THE RUBBER INDUSTRY.**

Considering the occupational safety and health activities currently progressing in Sri Lanka are generally in a satisfactory position. The main responsibility has been given by the law to the Industrial Safety Division acting under Sri Lanka labour department. The main purpose of the establishment of this division is to ensure the safety, health, and welfare of the workers. The actions that have been operating now are as follows.

- Inspection of factories
- Approval of building plans

- Attend Coroners court to give expert evidence
- Investigation of complaints
- Investigation of accidents
- Institute legal actions
- Analysis of accidents
- Appointment of Authorized Officers
- Issue of certificates under the Factories Ordinance
- Making Safety posters, Leaflets, and short films
- Conduct Safety awareness programs to prevent accidents
- Enforcement and implementation of Factories Ordinance

Since this research is all about occupational safety and health activities some of the above functions are skipped and attention is given to the necessary facts.

### 3.1 Policies

Enforcement and implementation of Factories Ordinance Amendment section 68 of Factories Ordinance. Establishes that overtime worked by women shall not exceed sixty hours per calendar month. Overtime worked by a young person between the age of eighteen and every youngster shall not exceed fifty hours per month.

According to the Factories (Amendment) Act, No 4 of 2021 passed by the Parliament says that any person should not exceed more than 12 hours per day and within that duration starting of work should not begin before 6.00 in the morning and the same way ending of work should not over after 8.00 in the night

Further, it has been published that the minimum wage of a person should not be less than 12,500 Rs per month and if someone works under a daily wage it should not be less than 500 Rs per day.

One of the most impressive benefits in this field is the EPF and ETF scheme. Under EPF Act No 15 of 1958 all permanent workers who are not entitled to a pension scheme are entitled to this. It is a must to have members of their workers. Once the worker got matured at the age of 55, he can claim the money.

The mandatory minimum contribution rate for the members of the Fund at present is 20 percent of the gross monthly earnings of their employment. The employers and the employees (members) are required to contribute a minimum rate of 12 percent and 8 percent of the member's monthly gross earnings, respectively to EPF.

After 10 years or when the account balance is complete 300000 Rs that person can claim some amount in case of an emergency like critical illness.

An employer shall not engage in overtime for a pregnant woman during her pregnancy; and a nursing mother, for a period of one year calculated from the date of the birth of the child, and a woman delivered of a stillborn child, for a period of three months calculated from the date of such stillbirth. For every woman, maternity leaves entitle to her and feeding her baby. Generally, 12 weeks are given. Two weeks before and ten weeks after confinement. These restrictions are there to protect children and women that prejudicially affect their health of them.

Further, the Factories Act No 19 of 2002 describes if any labour engages in overtime the management should provide restroom facilities and night shifts should provide transport.

The sanitary conveniences shall be so arranged as to be conveniently accessible to the persons employed at the factory. A suitable number of conveniently accessible water taps or receptacles containing water shall

be provided near each set of conveniences.

Urinal accommodation shall be provided for the use of male workers and shall not be less than two feet in length for every 50 males. For female workers, sanitary facilities should provide separately. It should be well covered. (Factory Ordinance; sec80-Chap 128)

In case of an emergency or minor accident, the factory should maintain a first aid box or cupboard for the use of workers with the following appliances prescribed by First Aid Regulation No 1 of 1995. Ensuring that using, handling, storing, and transporting chemicals, fertilizers, and other waste materials are carried out safely and that risks to health are controlled or minimized.

In addition to this, the workers who are working in the field collecting latex are provided rubber boots (to protect their feet from snakes, thorns, and roots of trees), gloves (protect hands from chemicals and minor injuries), eye guards (to protect eyes from harmful chemicals), nose guards (protect from inhaling harmful chemical gasses) are provided. For occupational safety, the government has established an estate hospital or dispensary in the estate with basic medical facilities for some factories having large extents.

Providing the information, instruction, training, and supervision at all levels necessary to ensure that workers are aware of the risks at their workplace, especially in case of unexpected fire, how to behave, how to protect their own lives, and how to escape other workers from this type of emergency. They are trained for utilizing fire extinguishers and correct ones for relevant fire types.

The fire alarms and smoke detectors must be fixed in proper places and the activities of those should be guaranteed by periodic maintenance. Annual fire training is given to a few selected works. Similarly, first aid training is given to some workers on how to protect themselves from strong acids, bases, and other chemicals when they are working. This type of training protects them from a lot of tragedies.

But unfortunately, in some working places, the management does not pay much attention to the above matters and there are not even basic precautions. It is an illegal such a working place.

Giving adequate information on relevant risks to any persons whose health and safety might be affected by them. Monitoring the safety performance of contractors who work for the company or industry.

Providing workers friendly background and necessary infrastructures yields growth in production. In Sri Lanka, in most of the rubber estates, the management has provided small houses with a small piece of land to families who are working under them. Not only that but factory vehicles are also provided free of charge in case of emergencies such as critical illness or childbirth. Giving adequate information on relevant risks to any persons whose health and safety might be affected by them. Monitoring the safety performance of contractors who work for the company or industry.

Along with that, a communication device such as a mobile phone or an equivalent device is given to the selected person on behalf of a particular group of workers who are working together for letting them know in an emergency case. Finally, all the workers are having some pieces of training about the safety and health procedure every six months. [7]

#### General knowledge of safety

- Proper instructions are given for all to act in emergency situations.
- Be informed about the location of the nearest hospital for the working people.

#### General requirement

- Managers are monitoring the safety measures of laborers frequently.
- Mobility to enter the hospital hurry in an emergency.

Further for the sake of the safety of the working woman and young person under Act No 47 of 1956, the “Hazardous Occupations Regulations” was published by an extraordinary gazette banding a category of nearly 70 no of occupations.

### 3.2. WASTE MANAGEMENT POLICY

Waste management is very important when considering Occupational Health and Safety. It is the cycle of collection, transport, processing, recycling or disposal, and monitoring of waste materials. The term usually relates to waste materials due to human activity and is generally undertaken to reduce their effect on health management concerns solid, liquid, gaseous, or radioactive substances, which requires different methods and expertise, the environment, or aesthetics.

Waste Management strategies are as follows. (3 R)

1. Reduce waste by improving the processes
2. Re-cycle waste for alternative use (compost, polythene, etc.)
3. Re-use

## 4. ACCIDENTS, INJURIES, AND DEATHS RELATED TO THE RUBBER INDUSTRY IN SRI LANKA.

### 4.1. Five dead in ‘ammonia tank’ accident in rubber factory at Horana, Sri Lanka. (Fig. 3.)



Fig. 3. Ammonia tank accident in rubber factory at Horana.

The incident took place in Horana, 50 km from the capital Colombo at around 1.30 pm on 19th April 2018. It was reported that the factory employee fell into the tank which contained liquid ammonia while attempting to clean the tank that collects Ammonia waste. Meanwhile, a colleague and three residents had attempted to rescue the worker and they also fell into the tank and died due to breathing in the toxic gas. Another 13 persons have been admitted to the Base Hospital Horana for treatment [9].

### 4.2 Fire at a rubber factory in Galle (Fig.4.)





Fig.4. After burning the rubber factory in Galle

A fire has broken out at the rubber factory in Bogahagoda, Galle at around 12 noon on 8th February 2018. The incident happened in the open-air section of the factory where rubber products including tires were stacked in there. The strong winds also spread to a building near the factory and damaged the equipment there. Several machines were damaged, but no one was injured had been caused by the fire, and police suspect that the fire was caused by an electrical leak [8].

#### 4.3 Rubber factory closes due to environmental issues.

The rubber factory in Bulathsinhala has been closed due to the direct discharge of wastewater and other pollutants into the environment. Leach materials can be in the wastewater that may kill aquatic life such as algae, zooplankton, snails, and fish. The toxic nature of rubber mulch and its mineral content has posed a serious risk to the environment.

#### 4.4 Harmful effects on the human body due to Ammonia and TMTD/ZnO.

Working with ammonia and TMTD/ZnO is very risky for rubber company employees. Ammonia irritates or burns the skin, causing permanent scars. The skin wax may turn white or yellow color (Fig. 5). In severe cases blisters, tissue death, and infection may develop exposure to high concentrations of Ammonia in the air by employees while working can cause immediate burns to the eyes, nose, throat, and respiratory tract, leading to blindness, lung damage, or death. There have also been reports that ammonia liquid was drunk, being thought of as water because the texture of Ammonia is such as water.



Fig. 5. The skin on hands and feet damaged by ammonia



## 5. OCCUPATIONAL INJURIES THAT OCCUR AMONG RUBBER TAPPERS



Fig. 6. Rubber tapping by a woman

A significant number of injuries are reported among Sri Lankan rubber tappers every year. Rubber tapping (Fig. 6) Injuries usually include hand injuries, eye injuries, and animal bites. Often the main cause of injuries is tapping with a two-handed approach, the symptoms of depression and informal workers. The female maid is also more likely to be injured.

## 6. SUGGESTING RISK ASSESSMENT AND ANALYSIS METHODS

When considering these facts, we can see there are many risks, accidents, unsafety places, and unsafe activities in this industry. To achieve zero risk, mainly all activities should be monitored by supervisors. Because when workers work, they do not care about safety and health issues. If all ways someone monitors their activities, they try to work correctly. Then can get the actions to achieve zero risk under the categories below.

### 6.1 Latex Collection and Chemical distribution

#### 6.1.1 Safety lid and valves for bousers.

If there is a system to indicate the leakage and state of the lid and valves then the workers and supervisors can focus on that. When there is leakage or loosen the lid or valve just, and they can fix that problem.

#### 6.1.2 Safety chemical distribution system.

When distributing the chemical there is no 100% safe method at a low budget. But if there is a tank specifically designed to distribute the chemicals such as Ammonia and TMTD without human intervention, it can be a safe method.

If can use sealed galloons and funnels to distribute and fill the bottles, it also will be safe.



Fig. 7. Sealed galloons and funnels

When distributing the chemical, it should be wearing safety goggles, gloves, and face masks. (Fig. 8, Fig. 9)



Fig. 8. Face masks and safety goggles



Fig. 9. Gloves

### 6.1.3 Use a sealed Ammonia cylinder

An unsealed Ammonia cylinder is used for storing and distributing, it is very dangerous. If a sealed tank can be used then the risk can be decreased (Fig. 10).



Fig. 10. Sealed Ammonia cylinder

## 6.2 Latex Centrifuging and Storing.

### **6.2.1 Use the Japanese 5S Concept when storing**

When storing and managing the goods in the workplace, it can use the 5S concept of Japanese, then goods storing is safe, clean, and easy to manage the workplaces and stores.

### **6.2.2 Use safety fences to cover insecure places.**

If can cover insecure places such as pits, and tanks using the safety fence then can protect the employee's safety.

## **6.3 Latex Crepe**

### **6.3.1 Safety tanks**

There are crepe rubber redeem tanks, but it's not covered. Therefore, it is dangerous. If can cover using a fence, then can decrease the risk.

### **6.3.2 Automatic safety system for crepe machines.**

The crepe machine is very dangerous. If can create an automatic safety system to stop when dangerous situations it is very useful and it can decrease the risk to employees and machines.

## **6.4 Disposal of Water**

As described before in that process also use the fence to cover the tanks.

### **6.4.1 Use the sensor to check the state of water.**

There are wastewater tanks. Sometimes lots of chemicals mix in that tank. It is very dangerous. Because that water is released to the environment to finally. If there are chemicals, it is harmful. If a system can be used to check the state of water, it is the solution to that problem. It can be controlled by using sensors such as PH sensor (Fig. 11) and heat sensor etc. [10].



Fig. 11. PH sensor

## **CONCLUSION**

In Sri Lanka, most Rubber Industries do not follow an occupational health and safety plan which increases work-related accidents and employee dissatisfaction. The main goal of this research is open the eye to hidden risks in rubber industrial processes such as latex collecting, chemical distribution, latex centrifuge, storing, latex creping, and disposing of the wastewater. By following the above-proposed procedures accurately, Rubber industries will be able to achieve zero risks.

## REFERENCES

- [1] vietnamnews.vn. 2022. Rubber exports in June increased strongly. [online] Available at: <https://vietnamnews.vn/economy/522786/rubber-exports-in-june-increased-strongly.html> (Accessed 2 February 2022).
- [2] Arias M and van Dijk P (2019) What Is Natural Rubber and Why Are We Searching for New Sources?. *Front. Young Minds.* 7:100. doi: 10.3389/frym.2019.00100(Accessed 30 January 2022).
- [3] Lalangroup.com. 2022. Glove Manufacturers | Lalan Rubbers | Lalan Group Sri Lanka. [online] Available at: <https://lalangroup.com/sectors/gloves/> (Accessed 31 January 2022).
- [4] “FindSourcing – Rubber,” Rubber. [Online]. Available: <https://www.findsourcing.com/articles/components/rubber>. (Accessed: 31-Jan-2022).
- [5] “Why source rubber from Sri Lanka?,” Sri Lanka Rubber Industry - Competitive Advantage - EDB Sri Lanka. [Online]. Available: <https://www.srilankabusiness.com/rubber/buyer-information/rubber-products-in-sri-lanka.html>. (Accessed: 31-Jan-2022).
- [6] Savvy Rest. 2022. What is Natural Latex? Is it Toxic?. [online] Available at: <https://savvyrest.com/blog/what-natural-latex-it-toxic> (Accessed 1 February 2022).
- [7] Rubbers, L., 2021. POLICIES. LALAN RUBBER AGRI DIVISION. [online] Lalan rubbers, pp.4-45. Available at: <https://lalanrubbers.com/wp-content/uploads/2021/10/a58e5d26-policies-lalan-rubbers-pvt-ltd-2021.pdf> (Accessed 28 January 2022).
- [8] News.lk. 2022. IFAD assistance to revitalize Sri Lanka’s small tea and rubber plantations. [online] Available at: <https://www.news.lk/news/business/item/10709-ifad-assistance-to-revitalize-sri-lanka-s-small-tea-and-rubber-plantations> (Accessed 1 February 2022).
- [9] Business & Human Rights Resource Centre. 2022. Sri Lanka: Authorities to investigate Horana rubber factory incident over alleged violations of workplace safety resulting in deaths & injuries - Business & Human Rights Resource Centre. [online] Available at: <https://www.business-humanrights.org/en/latest-news/sri-lanka-authorities-to-investigate-horana-rubber-factory-incident-over-alleged-violations-of-workplace-safety-resulting-in-deaths-injuries/> (Accessed 30 January 2022).
- [10] Teck, L., 2022. Rubber Industry Waste and Its Management. (Accessed 2 February 2022)