

Industrial Accidents in Sugar industries of Nepal



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Executive Summary

Occupational Safety and Health (OSH) is a discipline with a broad scope involving many specialized fields. In its broadest sense, it should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention among workers of adverse effects on health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of workers in an occupational environment adapted to physical and mental needs; the adaptation of work to humans (ILO).

Occupational accidents are an unexpected and unplanned occurrence, including acts arising out of or in connection with work which results in personal injury, disease or death; Occupational accidents and disease remain the most appalling human tragedy of modern industry and one of its most serious forms of economic waste.

The objectives of the study are to list out the industrial accident in ten Sugar Industries of Nepal. This study also emphasizes the causes of accident happening in sugar industries. The study recommended the potential options to prevent and control the industrial accident in sugar industries of Nepal.

Sugar industries are the agriculture based seasonal industries. Most of the sugar industrial are the located in the region where sugarcane grown. Sugarcane is the main raw materials for sugar mills and it also needed varieties of chemicals for processing and purification. It is considered as a large scale mechanized industries. .

Cane Preparation, Juice Extraction, Clarification of Juice, Evaporation, Syrup Sulphitation, Boiling, Crystallization and Centrifugation are the major process steps followed in Nepalese sugar industries. White sugar is the main product of these industries but industries utilized their process waste as a byproduct like Bagasse, Mollases and Filter cake. Most of the sugar industries are using their bagasse as fuel to generate electricity by cogeneration process. Most of these industries are having the cogeneration of electricity from their own byproduct bagasse. For the cogeneration industries having the 20 to 60 TPH boilers installed which are operated at more than 21 kg/cm².

As per the CBS 2011/12 there are 54 sugar industries are in operation in Nepal. Among them most of the sugar industries are smaller in size and recognized as Khandsari Industries. Among 54 sugar industries only 13 large scale sugar industries are in operation in Nepal. Most of the sugar industries are in located in terai region due to availability of main raw materials i.e. sugarcane. Few of the industries are also importing the sugarcane from neighboring state of India. These industries are located in Province 1, 2 and 5 namely Morang, Sunsari, of Province 1; Siraha, Mahottari, Sarlahi, Rautahat, Bara, Parsa of Province 2 and Nawalparasi, Rupandehi and Banke of Province 5.

Among the 13 large scale industries 10 industries were visited for this study. During the visit three fiscal years of accidental data collected. The collected data are the based on the provided by the management. Most of the industries have not availability of recorded data. Data recording system is very lagging in these industries. During the

visit process, storage yard, maintenance activities and others areas were studied and find out the most potential causes of accidents in sugar industries. The capacity of visited industries varied from 800 to 5000 tons of day sugarcane crushing. These industries are employees 2044 workers including 135 female workers. There are no any specific safety department is allocated in any visited industries to take care the safety and health activities. There is no any Safety Officer or Safety engineer is recruited for the safety and health.

Generation of Noise, Heat Stress, bagass dust exposure, lime/sulphur dust exposure and sulphurdioxide gas exposure are main hazards for occupational health of the workers. Being nature of industries risk of accidents was seen in higher side. Heat burn, risk of explosion, slipping and falling, lifting, foreign materials in eyes and cuts/scratches in machineries are the main causes of accidents in sugar industries. Most of the industries have lagging of Safety Policy, Safety Committee, Safety Signage, Safety Slogans, Safety Awareness and Safety related training. These safety concern issues are the root causes of accident in sugar industries.

Total 191 number of accident were happened in FY 2072/73; 196 accidents in FY 2073/74 and 91 accidents in FY 2074/75. Accident trend showed that although in FY 2073/74 accident was increased in compare with FY 2072/73 but in FY 2074/75 remarkably reduced. Government of Nepal Gazetted and implemented the Labour Act and Labour Regulation in FY 2074/75. Accident trend indicated that industries are consious about to reduce the accidents. Mainly minor type of accident was seen in these sugar industries. Few of the major accidents also happened in industries. No any fatal accident was recorded in last three FY.

The actions needed to improve the existing conditions of sugar industries and also reduces the rate of accidents:

- Implementation of Labour Act 2074
- Proper training and refresher training programs should be conducted to educate the workers as well as their supervisors particularly on occupational safety and health.
- All the moving drives i.e. belt drives, rollers and gear drivers should be properly guarded or fenced.
- Adoption of good housekeeping practices by marking with yellow line will improve a lot in sugar industries.
- Introduction of scheduled and preventive maintenance will reduce many accidents.
- Introduction of tight working dress for all workers and banned to wear loose clothes will reduce the many major and fatal accidents.
- Proper and suitable PPE should provide to the workers.

Table of Contents

ACKNOWLEDGEMENT	I
Executive Summary.....	II
List of Tables.....	V
List of Figures	V
List of Abbreviation.....	VI
Chapter - 1.....	1
Introduction.....	1
1.1 Background.....	1
1.2 Objectives of Study.....	2
1.3 Scope of the work	2
1.4 Methodology.....	3
Chapter - 2.....	4
Literature Review	4
2.1 Occupational Accident	4
2.2 Factors for Accident.....	4
2.3 Case of Olam International Sugar Mill in Kolhapur.....	5
2.4 Occupational Health and Safety Issues in Sugar Industries of Nepal.....	5
2.5 Provisions of Safety and Health in National Legislation:	6
Chapter - 3.....	11
Sugar Production Process	11
3.1 General Flow Chart.....	14
3.2 Products and Byproducts.....	15
Chapter – 4	17
4.1 Current Status of Visited Sugar Industries	17
4.2 Accidents Record in Sugar and Chemical Industries, Nepal.....	19
5.1 Causes of Accidents in Sugar Industry	20
5.2 Trend Analysis of Accident.....	22
Chapter – 6.....	24
Result and Discussion.....	24
Chapter – 7	25
Conclusion and Recommendation.....	25
7.1 Conclusion.....	25
7.2 Recommendations.....	25
References:.....	27
Annex 1: Checklist and Data sheet for Study	28

List of Tables

Table 1: Occupational Health and Safety issues in Sugar Industries of Nepal..... 6
Table 2: Visited Sugar and chemical Industries 17
Table 3: Accidents record in Sugar and Chemical Industries 19

List of Figures

Figure 1: Numbers of worker in visited 10 Sugar Industries 18
Figure 2: Total accidents in last three FY 22
Figure 3: Minor, Major and Fatal accidents in last three FY 23

List of Abbreviation

CBS	: Central Bureau of Statistics
FY	: Fiscal Year
GDP	: Gross Domestic Product
hg	: Mercury
ILO	: International Labour Organization
ISO	: International Organization for Standardization
mm	: Milli Meter
OSH	: Occupational Safety and Health
OSHC	: Occupational Safety and Health Center
pH	: Potential of Hydrogen
PPE	: Personal Protective Equipment
SDS	: Safety Data Sheet
SO ₂	: Sulphur dioxide
TOR	: Terms of Reference
TPH	: Ton Per Hour
UN	: United Nation
US	: United States
USD	: United State Dollar

Chapter - 1

Introduction

1.1 Background

Occupational Safety and Health (OSH) is a discipline with a broad scope involving many specialized fields. In its broadest sense, it should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention among workers of adverse effects on health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of workers in an occupational environment adapted to physical and mental needs; the adaptation of work to humans (ILO).

Working condition in the majority of Sugar industries is not satisfactory and may be described as very poor. The workers are exposed to various risky and hazardous operations. Workers are also exposed to excessive noise, dust/fiber, heat stress and harmful chemicals. It has been assuming that the rate of occupational accidents and diseases are very high in industries of Nepal which have been resulting in loss of working periods. Most of the industries do not have availability of basic personal protecting equipments (PPE's) and are ignoring the basic safety-first principles. These industries have lack of adequately trained personnel and show their reluctance to hire experts from concerned field to enhance the betterment of poor working condition. The PPE is not available in most cases and due to low level of awareness among the workers, even available PPE are also not used effectively. Other vulnerabilities like housekeeping and the layout of the workplaces are not managed effectively.

The safety and health of the workers and their efficiency are reciprocal entities. Health and Safety measures not only result in reduced rate of industrial accidents but also raise the work productivity. Occupational injury denotes any personal injury, disease or death resulting from an occupational accident (Laurie, 1998). This has been defined as an occurrence arising out of or in the course of work which results in: (a) fatal occupational injury, or (b) non-fatal occupational injury. Often the term occupational accident is understood as a sudden, external and involuntary event (Hamalaine et al., 2006: 137). In this case, Occupational injury means death, any personal injury or disease resulting from an occupational accident. Occupational accidents are an unexpected and unplanned occurrence, including acts of non-consensual violence, arising out of or in connection with work which results in personal injury, disease or death (Laurie, 1998:44); Occupational accidents and disease remain the most appalling human tragedy of modern industry and one of its most serious forms of economic waste (Somavia, 2004).

According to **Webster dictionary**, *accident is an event occurring by chance or arising from unknown causes*. However, yet another meaning given in the same dictionary is that *accident is an unfortunate event resulting from carelessness, unawareness, ignorance, or a combination of various types of causes*.

Lexicographically, an accident is an event that takes place without foresight and results in some type of personal injury and/or damage to equipment and property (Ghiselli & Brown, 1948).

Hienrich (1959) views accident as an unplanned and uncontrolled even in which the action or reaction of an object, substance, person, or radiation results in personal injury or the probability thereof... Whereas **Haddon et. Al. (1964)** view it as an unexpected occurrence of physical damage to an animate or inanimate structure.

Accident is such a bad-fate which any human never expects to occur. All accidents have been traced to either unsafe acts or unsafe conditions and even unsafe conditions can in some way be attributed to unsafe acts. Accidents have always been an intriguing aspect of human life causing immense loss, pain and misery to humankind. Since accidents have been inevitable phenomena in our daily life, our ancestors have developed the preventive measures to prevent the accidents.

Sugar Industries are the agriculture based seasonal industries. As per the CBS 2011/12 there are 54 sugar industries are in operation in Nepal. Among them most of the sugar industries are smaller in size and recognized as Khandsari Industries. Among 54 sugar industries only 13 large scale sugar industries are in operation in Nepal. Large scale sugar industries are very equipped with heavy and complex machineries. Large scale sugar industries are having the semi-automatic type production system. It produces the different grades of sugar and molasses as a byproduct. Sugarcane is the main raw material of this industry and it also consumes many chemicals for processing and purification of sugar.

Most of the sugar industries are in located in terai region due to availability of main raw materials i.e. sugarcane. Larger capacities of boilers are operating in large scale sugar industries. All the large scale sugar industries are having the Cogeneration system. Sugar industries considered as an accident prone industries but lack of accident records and reporting system no any available data found for this sector. Improvement cannot be achieved without implementation of safety management system. For the preparation of effective safety management system needs to know the accidents trends of the sectors and their real causes. This study will help the sector for knowing the trends of accident and causes of accident.

1.2 Objectives of Study

The main objectives of the proposed study were:

- a. To list out the 3 FY recent data of Industrial Accident in selected Sugar industries of Nepal.
- b. To find out the main causes of accidents in Sugar Industries.
- c. To find trends of industrial accidents in Sugar Industries.
- d. To recommend the potential measured and strategy to control industrial accident in Sugar Industries.

1.3 Scope of the work

The scope of the work as per the TOR was as follows:

1. Collection of three Fiscal Years Industrial accidents data from 10 Sugar industries located in Siraha, Mahotari, Rautahat, Sarlahi, Bara, Parsa, Nawalparasi and Rupandehi districts of Nepal.
2. Collection of available relevant reports and publications from concerned organizations/agencies.
3. Collection of available relevant information from literature study and internet search.
4. Identify the potential causes of industrial accidents in Sugar Industries.
5. Analyze primary and secondary data collected from industries and process to find out trend of accident occurs in Sugar Industries in last 3 years.
6. Provide recommendation of measures and potential strategies to control the industrial accidents in Sugar Industries.
7. Submission of draft report to Occupational Safety and Health Center for comments and feedback.
8. Submission of final report after incorporation of relevant feedback and suggestions provided by the OSHC.

1.4 Methodology

The methodology adopted for the preparation of the report was as follow:

- Literature review done throughout of the study
- This report is based on the primary and secondary available data and information.
- The primary data was collected from 10 Sugar industries of Nepal.
 - Accidental data collection format were developed and filled in all visited industries.
 - General information data sheet also developed for the collection of raw materials, process and other relevant information.
 - Questionnaire developed for the collection of causes of accidents.
 - Collected data and information analyzed in excel sheet.
- International norms and expert opinion also considered for the studies.
- Books, publications, reports, literature and internet sites used for the description of the accident and Nepalese context.
- Submission of draft report to OSHC for feedback and suggestions.
- The comments and suggestions from the OSHC studied and relevant comments and suggestions will be incorporated to finalize the report.

Chapter - 2

Literature Review

The sugar industries are the agriculture based seasonal industries. Most of the sugar industrial are the located in the region where sugarcane grown. Sugarcane is the main raw materials for sugar mills and it also needed varieties of chemicals for processing and purification. It is considered as a large scale and mechanized industries. Occupational Safety and Health situation of these industries is not in satisfactory level. Risk of accident potential is in higher side. Some relevant literature were reviewed and presented below.

2.1 Occupational Accident

In 2012 ILO estimates suggest that around 2.2 million people die due to work-related accidents or illness each year. 350,000 of these deaths are due to accidents and the rest are due to occupational illnesses and diseases. On top of this, the ILO estimates that there are 264 million non-fatal accidents each year that result in a 3+ day absence from work, and 160 million people with work-related illnesses. The ILO believes that the cost of work-related ill health and accidents costs the world 4% of the global GDP or \$1.25 trillion US dollars.

Accidents, however, are thought to account for only 19% of global work-related deaths, the remainder being due to illnesses and diseases. The biggest killers, along with accidents, are cancer, circulatory diseases and communicable diseases.

Many workplace accidents have relatively minor repercussions, which could result in just a paper cut or scratch, others can have more serious and potentially fatal consequences. For instance, there are some industries in which individuals are more exposed to occupational hazards than others, such as the construction and metal industries which had the highest rate of fatal injuries out of all other industry sections. In construction falls accounted for 51% of construction injuries resulting in death.

It was revealed that slips, trips or falls were responsible for more than 50% of serious injuries to employees. Furthermore, the majority of incidents that resulted in employees taking more than three days off work – or affected their ability to perform their usual duties over this period – were caused by handling accidents.

2.2 Factors for Accident

As per the OSH Encyclopedia, the following factors can be causes of accident in sugar industries:

- Lack of organization health and safety policy, structure, work involvement and management system
- Poor safety culture
- Lack of knowledge and lack of awareness of information sources
- Lack of, or poor, government policies, legislation, enforcement and advisory system
- Lack of incentive-based compensation system
- Lack of, or poor, occupational health services
- Lack of research and proper statistics for priority-setting
- Lack of effective training and education

- Over confidence in working procedure.
- Lack of awareness
- Lack of using PPE's

2.3 Case of Olam International Sugar Mill in Kolhapur

A worker at the Olam International sugar mill in Kolhapur (Maharashtra) India was killed by falling sugar bags in a workplace accident on August 8, 2014 which also severely injured two other workers. According to the union representing plant workers, the factory has a long history of workplace accidents. But Singapore-based Olam, a major transnational commodity processor and trader, last year received a USD 120 million loan from the World Bank's private lending arm IFC, whose lending criteria ostensibly include safety, social and environmental safeguards.

The IFC once held an equity stake in Olam but divested its shares in 2007 in response to allegations of illegal logging and environmental destruction in the Democratic Republic of Congo. Now they're back, as lenders. Part of the IFC loan was earmarked for upgrading Olam's sugar operations through a Public-Private Partnership involving the IFC, Solidaridad and the Bonsucro certification program which also includes work safety standards. Migrant construction workers were injured in the course of the work, and the union raised the issue of unsafe conditions at the factory. Nothing was done, and now a worker is dead.

Olam's mills supply to major food transnationals in India, including PepsiCo. PepsiCo has a supplier code of conduct which "expects" suppliers to "provide safe and healthy working conditions". When the union raised health and safety concerns, they were told the plant manager had resigned and there was no one to take responsibility. Are the IFC and Bonsucro certifying a phantom management? Does this arrangement meet PepsiCo's "expectations"?

PepsiCo claimed various "audits" had determined that no human rights violations took place at its West Bengal warehouse operations when workers were sacked after forming a union and then told they could have their jobs back if they signed false statements, declared they would never again join a union and walked on their shredded union cards when they re-entered the warehouses.

Refusal to act in response to union-busting at its Indian ware houses put PepsiCo in violation of the human (Olam International sugar Mills, 2014)right's due diligence requirements of the OECD Guidelines for Multinational Enterprises and the UN Guiding Principles on Business and Human Rights. Their supply chain now includes additional violations. Will these be legitimized through the World Bank and Bonsucro's hazardous "partnership"

2.4 Occupational Health and Safety Issues in Sugar Industries of Nepal

The Occupational Safety and Health in the industry is related to risk of accident, heat stress, baggass dust/fibers, lime dust, sulphur dioxide, ergonomics and housekeeping. It is demands good working environment and good working practice for higher productivity and better health of employees.

Table 1: Occupational Health and Safety issues in Sugar Industries of Nepal

OSH Issues	Location/Areas	Areas of Improvement	Remarks
Dust (Lime, Baggass)	Lime handling, lime juice prep ⁿ , Mill house, Boiler	<ul style="list-style-type: none"> ▪ Safe and scientific storage, Transportation and handling system of lime. ▪ Prevention to scattering of baggass dust/fibers in whole plant. ▪ Close type conveyer and other transporting devices for baggass transfer. ▪ Isolating the mill house from others process. 	<ul style="list-style-type: none"> - Saving of Lime and baggass. - Less exposure of Lime and baggass. - Higher workers productivity.
Sugar dust	Packing	<ul style="list-style-type: none"> ▪ Safe and efficient sugar packing devices. ▪ Attitude of workers and management. 	<ul style="list-style-type: none"> - Sugar Saving - Better health of employee.
Sulphur dioxide	Sulphur burner and distribution line	<ul style="list-style-type: none"> ▪ Leakage controlling. ▪ Preventive maintenance. 	<ul style="list-style-type: none"> - Less exposure to SO₂
Heat and humidity	Boiler	<ul style="list-style-type: none"> ▪ Better ventilation system ▪ Complete Insulation, and maintenance of steam distribution system 	<ul style="list-style-type: none"> - Energy shavings - Higher productivity
Ergonomics	Whole plant	<ul style="list-style-type: none"> ▪ Better working posture. ▪ Sitting facilities. 	<ul style="list-style-type: none"> - Higher workers productivity
Risk of Accident	Whole plant	<ul style="list-style-type: none"> ▪ Good housekeeping practices. ▪ Safety Management system. 	<ul style="list-style-type: none"> - Higher Productivity
Emergency	Whole Plant	<ul style="list-style-type: none"> ▪ Emergency preparedness System. 	<ul style="list-style-type: none"> - Safe and healthy industry and employee
Welfare facilities	Whole plant	<ul style="list-style-type: none"> ▪ Establishment of basic need of welfare 	<ul style="list-style-type: none"> - Motivated workers

Source: ESPS/DANIDA 2004

2.5 Provisions of Safety and Health in National Legislation:

The Labour Act 2074 and Labour Regulation 2075 have covered the Occupational Safety and Health mandatory provisions. All the industry should comply the mandatory provisions to reduce the rate of accident and prevent the occupational diseases.

Formulation of safety and health policy:

It is mandatory under the law that every employer shall formulate a policy on safety and health of the workers and other persons in the workplace. The Policy should be reviewed every year by occupational safety and health committee of the enterprise. The policy should be registered in the labour office and it is the duty of office to monitor it periodically to implement it. It is also mandatory to do self-assessment through audit system under this legislation.

Formation of Safety and Health Committee

Every enterprise having 20 or more workers shall constitute a Safety and Health Committee comprising of representatives of the worker and management. The twenty numbers of workers shall include both the workers employed by the concerned employer.

Prohibited to take any disciplinary action

No employer shall initiate any disciplinary action against any worker for providing any information related to OSH to the Labour Office or assisting to do so or for filing a complaint against employer. Similarly, employer should not take any action in case of stopping the work due to immediate danger on the safety and health of the workers and perform as a member of OSH Committee.

Duties of Employers towards Workers

The Act clearly mentioned about the Duties of employers towards the workers in respect of OSH. These duties are as follows:

- To provide appropriate and safe environment for the workers in the workplace,
- To make sure that there shall be no adverse effect to the health and safety of workers during use, operation, storage and transportation of chemical, physical and other materials,
- To provide necessary information, notice or training on OSH matter to the workers including use or operation of the equipment or material in an appropriate language worker understands.
- To keep workplace safe and secure from any probable danger or emergency situation by providing entrance and exit facility to / from workplace.
- To provide personal protection equipment without any cost to the workers

Responsibilities of Employer towards Non-workers

- Every employer must arrange for the safety and health of every person who walks in and out of the workplace or passes through such workplace.
- In case there is a possibility of having an adverse effect on the safety and health of any person by the operating system of the enterprise, the employer must make an arrangement for giving timely indication or necessary information in that respect.
- It is the duty of employer that she/he manage properly chemical substance or gas or fume and other matter should not affect adversely against any person or environment in general.

Duties of the responsible person for the workplace

- It shall be the duty of the responsible person controlling any workplace or equipment or material to ensure that such place, equipment, or material is safe for the concerned work and is not averse to the health of the workers.
- To determine the responsible person of the enterprises, the person having the ownership or control over the workplace or equipment or material. The word also denotes to the person by an agreement, having ownership or control over it.

Duties of manufacturers, importers, and suppliers

Following shall be the duties of manufacturers, importers, and suppliers of equipment or material used in the workplace:

- Determine suitable way of using or operating any equipment or material without affecting the safety and health of the workers adversely.
- Conduct research, test or to examine the possibility of identifying the risk from the use of such equipment or material or the adverse effect it may have on the safety and health of the workers or the possibility of minimizing or eliminating such risk.
- Provide information in relation to the purpose, use and operation of any equipment or material, the ways of minimizing their adverse effect on the safety and health of the workers and also the suitable method of using any material for the safety and health of the workers.
- The person who manufactures or installs any equipment must ensure that such equipment manufactured or installed for the use of the workplace, if used properly, will not be harmful to the safety and health of the workers.
- If it is found that the equipment or material is not used in accordance with the relevant information or instruction provided by the manufacturer or supplier in relation to their use, such equipment or material, for the purpose of this section, shall be considered to have been used inappropriately.
- The manufacturer, importer or supplier of any chemical substance to be used in the workplace must have material or Chemical Safety Data Sheet related to such chemical substance including other details as prescribed.

Duties of workers

Duties of workers in relation to occupational safety and health shall be as follows:

- A worker must not work carelessly or intentionally whereby the risk of adversely affecting the health of others or his/her own health
- A worker must provide necessary cooperation to the employer or any other person for the fulfillment of the obligations mentioned in the law.
- A worker must operate and use the workplace, equipment or material safely and carefully as per the instructions given.
- Obtain the information in relation to his or her work and use of chemical, material and equipment.
- Use personal safety equipment as provided by employer, violation of which shall be punishable under disciplinary action.

Stoppage of work in case of immediate danger

- Where there is a reasonable ground to believe that if a particular work is not stopped, it may injure any worker or any person or cause risk or may have harmful effect on the health of the workers or may damage any equipment, the worker involved in such work shall inform of the same to the employer or responsible person.
- The concerned worker may halt the work if the employer is not available and inform them as soon as possible.
- Upon receipt of the information the employer shall investigate the matter and accordingly make a suitable safety arrangement to avoid such risk and direct the workers to continue the work if it is possible to do so.
- The employer, subject to the scope of employment contract, may engage the workers in any other risk-free work during the stoppage of work.

Direction to stop the work by Labour Office:

- During the inspection or information received through any other source, the Labor Office may order to stop work in case it is believes that an immediate danger or risk has arisen in a workplace.
- The Office must disclose the causes and basis of such risk while issuing the direction to the employer.
- The Labour Office may issue an order prohibiting the use of such equipment and work place or any part of it may be sealed so that it is not used.

Notice relating to accidents

If any accident takes place in the workplace or any worker or person dies because of the accident or is injured or suffers from occupational disease, the employer must inform the Labour Office immediately.

Provisions related to prevention of communicable diseases

- The employer must make necessary arrangement to prevent communicable disease in the workplace.
- Any worker suffering from any communicable disease may be prohibited from attending the work during the period of medical treatment.
- In case the sick leave is not sufficient for the medical treatment, such worker must be granted additional leave till the period of treatment.
- It is duty of concern worker stay in leave during the treatment period.

Easier work for pregnant worker

- In case any female worker is pregnant, the employer must be informed about it.
- After receiving information, normally, such pregnant worker must not be engaged in the work that adversely affects her pregnancy.

Special provisions related to medical treatment for occupational disease

- In case any worker contracts any occupational disease while working in any enterprise, the medical expense as prescribed or in case if the worker is incapable of working as a result of such disease, the compensation for that must be borne by such enterprise where the worker worked and contracted the disease.
- The establishment shall not be required to bear the medical expense or compensation if the medical expense or compensation as is to be borne by Social Security Fund.

Office may issue directions

- The Office shall conduct a sudden or periodic inspection in order to verify whether the employer has made any arrangement or not in relation to the safety and health of the workers required by the Act or the existing law.
- During the inspection of workplace, if it is found that the employer has failed to arrange appropriately, the office shall provide time frame with a direction to make required arrangement to the employer.
- However, if there is a possibility of immediate danger to the safety and health of the workers or other persons in absence of such arrangement, the Office may issue an order to make such arrangement immediately stating the reasons for the same.

Special Provision relating to some of the establishment:

The concern establishment should arrange safety in accordance with the standard as prescribed in case they are operating following business:

- Protection of eye
- Protection from chemical substance
- Process of operation of pressure plant
- Protection of machine
- Weight lifting standard
- Other related matter

Punishment

In case any person carelessly or intentionally violates the provisions of the Act or the Rules made hereunder in respect to safety and health of the workers and as a result of which any person dies or is incapacitated or injured, the person responsible for such act, the punishment in accordance to the existing law, and if such punishment is not mentioned in any law, the person shall be punished with an imprisonment of up to two years including recovery of compensation to the victim.

In case, any establishment is doing such crime, the imprisonment in normally imposed to the responsible person or such person is not identified, the chief executive office shall be sent to the jail and fine and compensation shall be recovered by the establishment.

Chapter - 3

Sugar Production Process

Sugar Industries are the agriculture based seasonal industries. It produces the different grades of sugar and molasses as a byproduct. Sugarcane is the main raw material of this industry and it also consumes many chemicals for processing and purification of sugar. The following are the producing process of Sugar industries.

Cane preparation

Sugar cane is transported to the factory using private trucks, bullock carts and tractors, which are unloaded to the can carrier. The can preparation unit consists of can kicker controls the feeding orientation and smoothens the can prior to the cane cutter. The cane cutter chops the can stalks into smaller pieces.

Juice extraction

Sugarcane preparation is done through cutters & fibrizer & fibrized sugarcane from the fibrizer drop into the rake elevator and are conveyed into the Donnelley chute pressure feeder. Pressure feeder feeds the fiberized sugarcane into the first mill. By means of intermediate rake carrier, bagasse is conveyed from the first mill to 2nd mill & up to the 4th or 5th or 6th mills. Each extraction mill has three rollers and the mills are driven by single stage steam turbine or individuals electric motors. The extracted juice from the first mill is called primary juice.

Primary & secondary juices are collected in the mixed juice tank after filtering in the DSM screen with the help of juice pump. The fine bagasse removed by the DSM filter is returned to the first intermediate rake carrier. The mixed juice will have pH of 5.2-5.4 juices & before last mills are used as the imbibitions. Beside the extracted juice, imbibitions' water (fresh condensate) at 70-80°C is sprayed on the bagasse in the before last mills in order to increase the efficiency of extraction. Mixed juice, after weighing, sent to the sugar-boiling house for physicochemical reaction, evaporation, massecuite pan boiling & sugar purging. Bagasse from the last mill is sent to the boiler as fuel to generate the high-pressure super-heated steam. Excess bagasse is stored for selling in market in Nepal. Spent bagasse has about 50% moisture content, contains around 2% sugar.

Clarification of juice

Juice is composed of various organic and inorganic compounds in different concentration Mixed juice leaving the mills is greenish-gray to dark green opaque liquid that carries suspended mater such as bagacillo, gums, wax, colouring mater, soil particles etc.

Mixed juice from the supply tank is pumped through shell and tube heaters where it is heated to 70°C. At this temperature, inversion does not occur and mesosphelic bacteria are deactivated. Simultaneously, lime is added and SO₂ is bubbled at about 70°C. The retention time is 8-10 minutes. Lime helps in precipitation of impurities, whereas Sulphur dioxide decolorizes the juice. The final pH of the mixed juice is maintained at 7.0 ± 0.1, the sulphited juice is then heated to a temperature of 100± 2°C using exhaust steam and quintuple 2nd body vapor. It is then fed into Dorr

clarifier for gravity settling, where flocculent is added to aid in the clarification process. The juice is retained for about two and half hours to settle the precipitates the settled sludge (mud) is passed to the mud mixture, where it is mixed with fine bagasse particles (bagacillo) and filtered using vacuum filters. The vacuum filter separates filterable solids from the juice. The filtrate, called muddy juice is recycled and mixes with fresh juice and is reprocessed while the Oliver cake is discharged outside using a conveyor. This mud is excellent manure and thus is collected by farmers to apply in fields. The supernatant clear juice, which is at 95-97°C, is first heated to approximately 105-110°C ± 2 and forwarded to evaporator station for concentration.

Evaporation

The main purpose of the evaporation in multi stages is to concentrate the clear juice from 13-15 Brix to around 45-55 Brix. This requires evaporation of approximately 45-55% of water in the syrup. Except one Semi-Kestner the evaporation station consists of five (quintuple) effect evaporators arranged in series. The clear juice enters the first effect, where it is partially evaporated using exhaust steam. The partially concentrated juice is then fed to the next effect for further concentration. This process is repeated until the juice passes through all the effects in the evaporation stage. The concentrated juice (called syrup) is withdrawn from the last effect. The first unit uses exhaust steam while the succeeding units utilize vapor from the preceding effect. The succeeding effects of the evaporators are under increasing vacuum. The vacuum in the last effect is maintained at 635-660 mm of mercury (hg).

Syrup Sulphitation

The syrup from the last effect of the evaporator set is pumped to a syrup sulphiter unit where Sulphur dioxide gas is bubbled through it. Sulphur dioxide is a powerful bleaching agent and decolorizes the syrup. At the same time, it reduces the viscosity of syrup. The pH of sulphited syrup is maintained at 4.9-5.2.

Pan Boiling

Pan boiling is the heart of the sugar manufacturing process. Generally, pan boiling is carried out in three stages (A, B and C). This boiling is done under vacuum to reduce the boiling temperature of syrup. The vacuum maintained inside the pan is around 635-660 mm of Hg (25-26"Hg). A sugar is the final product and is bagged. B sugar is developed from the molasses obtained from purging A massecuite.

B sugar is converted into melt that is used in A pan boiling. Dry seed from sugar grader is used as a seed and used in A pan boiling. The molasses obtained from purging B sugar is used for C massecuite. C-sugar is re-melted and fed into A pan for re-boiling.

Three different pan boiling A, B and C have their own parameters as well as footing (materials) for boiling. The material boiled in A pan is called A massecuite and correspondingly B massecuite and C- massecuite in B and C pans respectively. A massecuite is formed from a footing of syrup and re-melted sugar and dry seed

magma from Sugarhouse. A-light molasses may be partially added at the end stage of boiling to regulate the parity of A massecuite. B massecuite is formed from A-heavy while C-massecuite is formed from B -molasses. Seed for B-massecuite and c-massecuite are generally formed from a suitable footing. Seeding with sugar slurry performs the graining.

Massecuite boiling:

A massecuite having a purity of 80-84 is formed by the footing of magma (purity 92-95) and the syrup (purity 80-82) with the topping of A light molasses (purity 80+). The boiling time is generally 2-4 hrs depending on the steam condition and syrup brix. B-massecuite of purity 67-69 is formed by B-grain (purity 72-75) and A heavy molasses. Sometimes A- light molasses is also used as topping to regulate the purity or when the purity of the A light molasses is below 80. The boiling time is generally 5-6 hrs. C massecuite of purity 53-55 is formed from C- grain (purity 61-63) and B-molasses (purity 50-52) obtained from purging of B massecuite. The C- massecuite is normally purged in two stages. The molasses obtained from first purging is called final molasses his is discarded as by- product to be used in distillery while the second molasses (C-light) is used in C massecuite boiling. The boiling time is generally about 6-8 hrs.

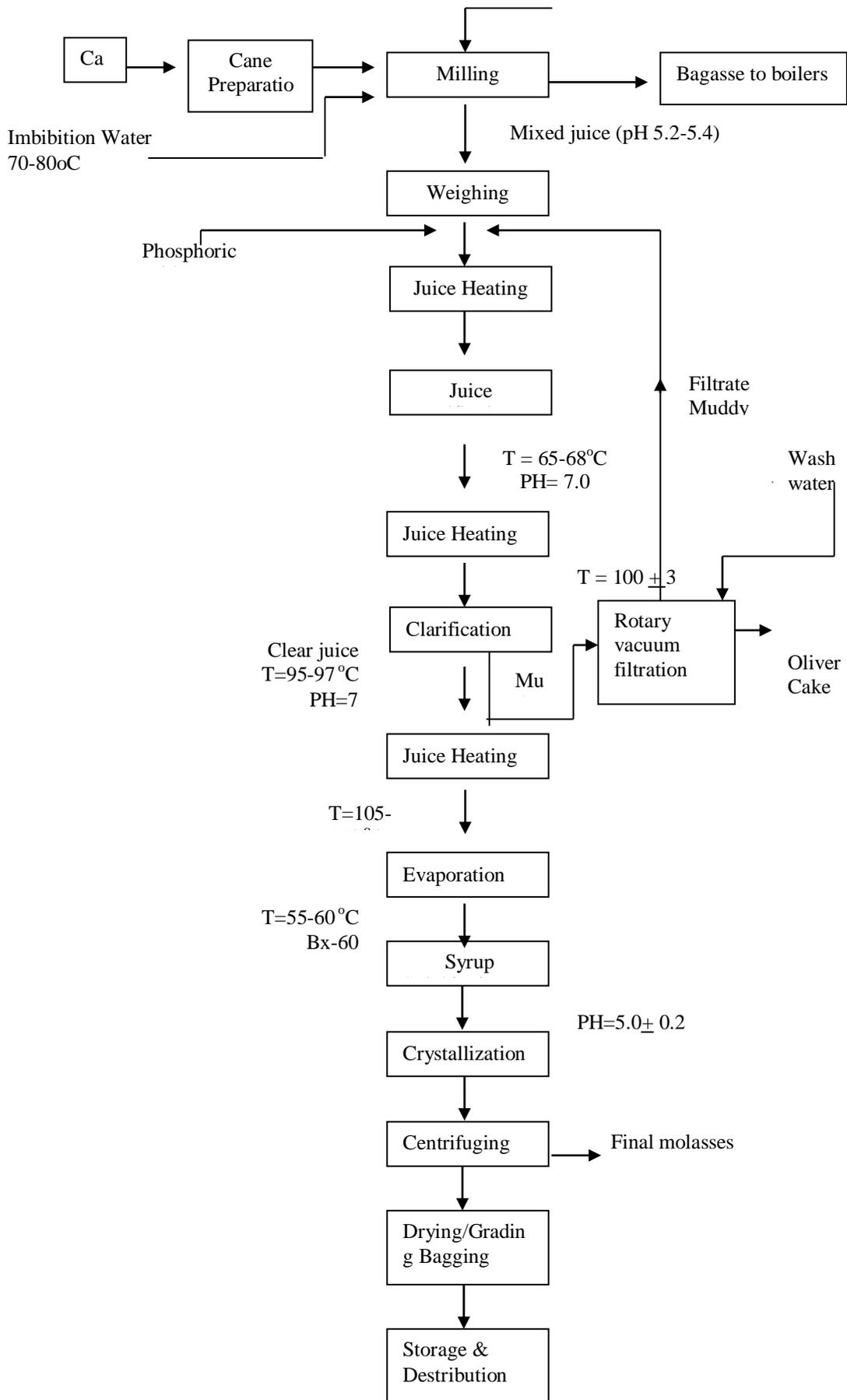
Crystallization

After pan boiling A, B and C massecuites are sent to the respective crystallisers for initial cooling and further crystal growth. A massecuite is cooled in air-cooled crystallisers while B and C massecuites employ water-cooled crystalliser. As the massecuites cool in these crystallisers, further sucrose deposition in the crystals formed during pan boiling is achieved and the crystals grow in size. While, it is advantageous to cool all grades of massecuite. But A and B massecuite generally cured hot. However cooling of C massecuite is significant to control the purity of final molasses and hence reduce the sugar loss. C massecuite is initially cooled to 42°C-43°C in the crystalliser and reheated to Saturation temperature prior to curing in the centrifugal machine.

Centrifugation

Centrifugal machines are of two types: Batch and continuous. Batch types are generally used for A massecuite curing and continuous types are used for B and C massecuite curing. These machines rotate at high speed and employ centrifugal force to separate crystals from mother liquor. These machines are equipped with combined electrical and mechanical control systems. The final product A sugar is directly discharged in to sugar hopper. After drying and grading, the sugar is bagged and stored. The following diagram schematically summarizes the pan boiling and centrifugal separation steps.

3.1 General Flow Chart



3.2 Products and Byproducts

Sugar is produced from sugarcane. Sugar industries are also producing the waste like bagasse, molasses, and filter cake which are using as a byproduct. Bagasse, the residual dry fiber of the cane after cane juice has been extracted, is used for several purposes: Fuel for the boilers and kilns; as raw materials for Production of paper, paperboard products, and reconstituted panel board and as a raw material for production of chemicals.

Products

Different grades of white sugars are the main product of these industries.

By Product

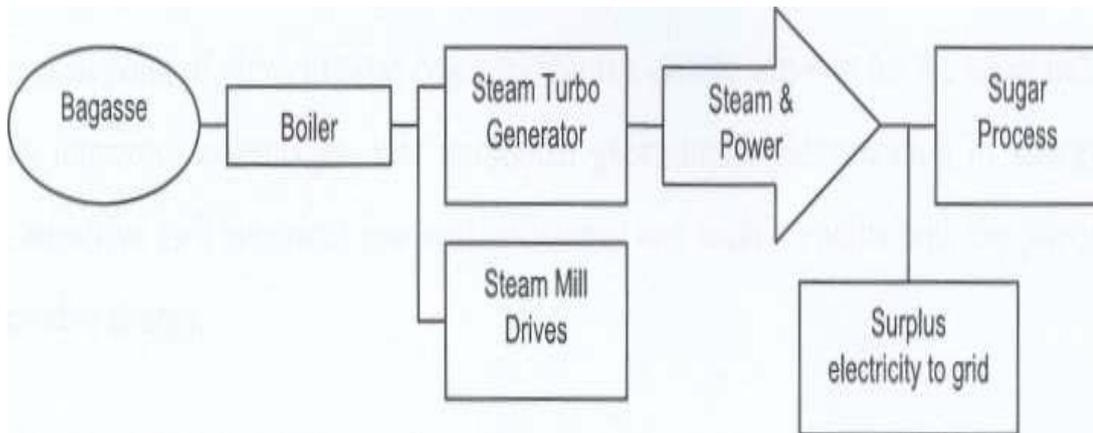
Bagasse, Molasses and Sugar Cake are the byproduct which is used for the many purposes.

Bagasse

The primary use of bagasse and bagasse residue is as a fuel source for the boilers in the generation of process steam in sugar plants. Biomass has always been an important energy source for the country considering the benefits it offers. It is renewable, widely available, carbon neutral and has the potential to provide significant employment in the rural areas. Biomass is also capable of providing firm energy. For efficient utilization of biomass, bagasse based cogeneration in sugar mills and biomass power generations have been taken up under biomass and cogeneration program me.

Sugar industry has been traditionally practicing cogeneration by using bagasse as a fuel. With the advancement in the technology for generation and utilization of steam at high temperature and pressure, sugar industry can produce electricity and steam for their own requirement. It can also produce significant surplus electricity for sale to the grid using same quantity of bagasse. The sale of surplus power generation though optimum cogeneration would help a sugar mill to improve its viability, apart from adding to the power generation capacity of the country. Dried filter cake is used as a fertilizer, and source of sugarcane wax.

Bagasse, otherwise a refuse, if used as cogeneration fuel, is proved to have been technically feasible, economically viable for the competitive industrial environment of sugar industries, environmentally friendly because of greenhouse neutral emissions and acceptable regarding social matters.



Molasses

Molasses is a dense, viscous byproduct obtained from the processing of sugar cane and sugar beet into table sugar. It derives its name from the Latin word for honey, *Mel*. Its viscosity and thick texture gave rise to the famous designation of something or someone being “slow as molasses” for any slow-moving thing.

Historically, molasses was produced in the Caribbean, where the cultivation of sugarcane and sugar beet was highest. From there, it was imported to the United States during the early 20th century. Today, it is produced on a large scale in Thailand, India, Taiwan, Brazil, the Philippines and the United States. Along with its usage as a sweetener in food products, it also offers health benefits and is used for treating a wide range of ailments.

Molasses is also using for production of Alcohol and Sprit.

Filter Cake

Filter cake is using as a fertilizer in agriculture sector.

Chapter – 4

Visited Sugar Industries

4.1 Current Status of Visited Sugar Industries

As per the CBS 2011/12 there are 54 sugar industries are in operation in Nepal. Among them most of the sugar industries are smaller in size and recognized as Khandsari Industries. Among 54 sugar industries only 13 large scale sugar industries are in operation in Nepal. Most of the sugar industries are in located in terai region due to availability of main raw materials i.e. sugarcane. Few of the industries are also importing the sugarcane from neighboring state of India. These industries are located in Province 1, 2 and 5 namely Morang, Sunsari, of Province 1; Siraha, Mahottari, Sarlahi, Rautahat, Bara, Parsa of Province 2 and Nawalparasi, Rupandehi and Banke of Province 5. Among the 13 large scale industries 10 industries were visited for this study. During the visit three fiscal years of accidental data are collected. The collected data are the based on the provided by the management. Most of the industries have not availability of recorded data. Data recording system is very lagging in these industries. During the visit process, storage yard, maintenance activities and others areas were studies and find out the most potential causes of accidents in sugar industries.

The capacity of visited industries varied from 800 to 5000 tons of day sugarcane crushing. These industries are employees 2044 workers including 135 female workers. There are no any specific safety department in any visited industries to take care the safety and health activities. There are no any safety officer or Safety engineer is recruited for the safety and health.

Table 2: Visited Sugar and chemical Industries

SN	Name of Industries	Location	Sugarcane Crushing Capacity TPD	Number of Workers			Have safety department	Safety person
				M	F	Total		
1	Annapurna Sugar and General Industries	Dhankaul, Sarlahi	2500	201	10	211	No	No
2	Bagmati Khadsari Sugar	Kudiya, Nawalparasi	1250	170	2	172	No	No
3	Eastern Sugar Mills	Amahibela, Sunsari	2500	156	40	196	No	No
4	Everest Sugar and Chemical	Gaushala, Mahottari	5000	280	5	285	No	No
5	Himalaya Sugar Mills	Choharwa, Siraha	2500	140	25	165	No	No
6	Indira Sugar and Agro Ind.	Nawalparasi	800	75	23	98	No	No
7	Indu Shankar Chini Uydog	Hariban, Sarlahi	4500	409	2	411	No	No
8	Lumbini	Sunwal,	1000	110	15	125	No	No

A Study Report on Industrial Accident in Sugar Industries

	Sugar Mills	Nawalparasi						
9	Reliance Sugar and Chemical	Kalaiya, Bara	2500	183	3	186	No	No
10	Shree Ram Sugar Mills	Garuda, Rautahat	2500	185	10	195	No	No
Total			25050	1909	135	2044		

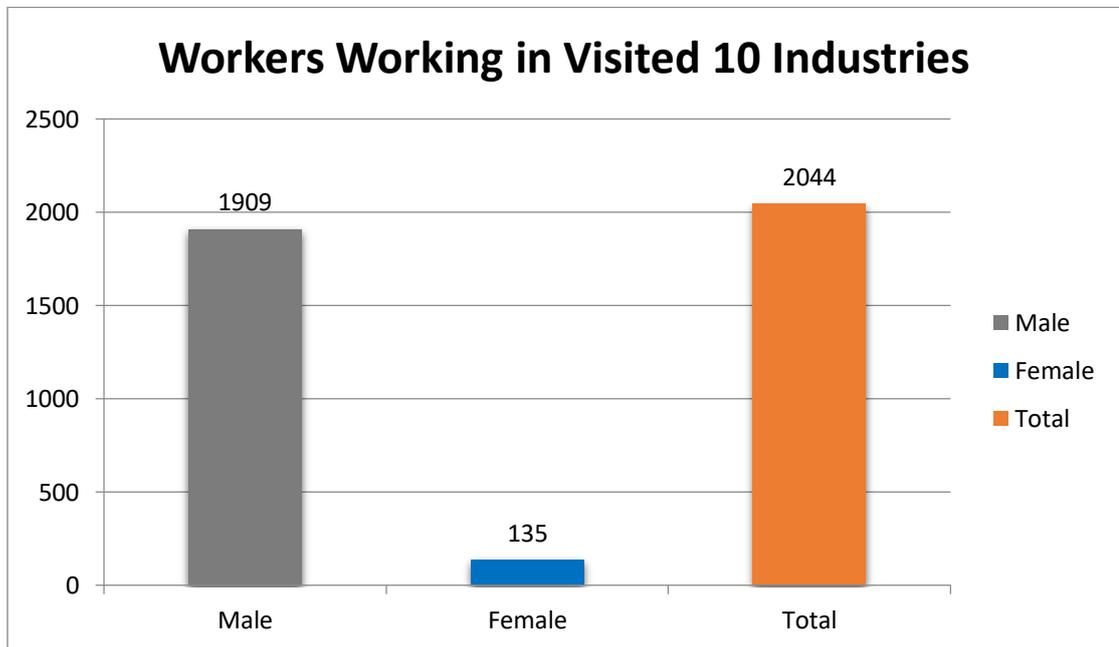


Figure 1: Numbers of worker in visited 10 Sugar Industries

4.2 Accidents Record in Sugar and Chemical Industries, Nepal

During the study 10 industries were visited to collect the data of accident happened in last 3 fiscal years. Sugar industries are considered as an accident-prone industry but during the study record of the accident not found in systematic manner in any industries.

Table 3: Accidents record in Sugar Industries

Sugar Industries	FY 2072/73				FY 2073/74				FY 2074/75			
	Minor	Major	Fatal	Total	Minor	Major	Fatal	Total	Minor	Major	Fatal	Total
Annapurna Sugar and General Industries	12	1	-	13	10	1	-	11	7	1	-	8
Bagmati Khadsari Sugar Mills	12	3	-	15	9	2	-	11	11	2	-	13
Eastern Sugar Mills	19	2	-	21	17	1	-	18	10	1	-	11
Everest Sugar and Chemical	19	1	-	20	18	2	1	21	12	2	-	14
Himalaya Sugar Mills	18	1	-	19	15	1	-	16	3	-	-	3
Indira Sugar and Agro Ind.	17	1	-	18	14	2	-	16	7	1	-	8
Indu shankhar Chini Udhyog	14	1	-	15	11	3	-	14	3	-	-	3
Lumbini Sugar Mills	21	4	-	25	20	1	-	21	11	1	-	12
Reliance sugar and Chemical	20	1	-	21	30	10	8	48	3	-	-	3
Shree Ram Sugar Mills	19	5	-	24	17	3	-	20	14	2	-	16
Total	171	20	-	191	161	26	9	196	81	10	0	91

Note: **Minor:** minor accidents cured by first aid and medical leave not needed accidental cases; **Major:** Major accident after first aid hospital/doctor treatment needed and medical leave needed accidental cases; **Fatal:** victim found unconscious, immediate hospital needed, long medical leave needed and after treatment victim get disable and Death accidental cases.

Chapter – 5

Analysis of Findings

The overall OSH conditions were found unsatisfactory in visited industries. None of the industries have the safety and health committee or any standardization of safety like ISO 45001. None of the industries were found the written record of accidental data. Among the ten visited industries none of the industry has awareness program about OSH. None of the worker was found using PPE's in visited industries. These industries are using the various chemicals such as Caustic Soda, Sulphuric acid, Phosphoric Acid, Sulphur and Lime. All these chemicals are hazardous to health and environment.

5.1 Causes of Accidents in Sugar Industry

Sugar Cane is the main raw material in these industries. These industries are large scale industries and heavy machineries are installed to complete the process. Most of these industries are having the cogeneration of electricity from their own byproduct bagass. For the cogeneration industries having the 20 to 60 TPH boilers installed which are operated at more than 21 kg/cm². Generation of Noise, Heat Stress, bagass dust exposure, lime/sulphur dust exposure and sulphurdioxide gas exposure are main hazards for occupational health of the workers. Being nature of industries risk of accidents was seen in higher side. Heat burn, risk of explosion, slipping and falling, lifting, foreign materials in eyes and cuts/scratches in machineries are the main causes of accidents in sugar industries. Most of the industries have lagging of safety policy, safety committee, Safety Signage, Safety Slogans, Safety Awareness and Safety related training. These safety concern issues are the root causes of accident in sugar industries.

Slipping and Falling: A large percentage of the accidents reported are caused by slipping and falling. It is impossible to keep floors perfectly dry and in most cases the workers hurry without giving consideration to the hazards involved. These accidents occur mainly at the sugarcane sheds and on filter-press stations. A large number of accidents that are caused by tools slipping while working on equipment could be classified in this group. This is particularly true during the inter-campaign period when equipment is being overhauled. These accidents are not the result of faulty tools, but are caused by the employee not taking the time to use tools properly.

Strains While Lifting: A large number of accidents are the result of strains while lifting and usually are caused by the worker standing in the wrong position while he lifts a weight. In a few instances the workers are not physically fit for heavy lifting, but the majority of the accidents are the result of improper practice either as to the proper manner of lifting or in attempting a load too great. Accidents of this type occur mainly in the sugar and pulp warehouses, lime kiln, and in connection with handling of supplies.

Burns: There are a fairly large number of burns reported each year, although accidents of this nature are not as high in number as they used to be. During operations these are caused by hot water while cleaning and brushing against steam lines, and there are some chemical burns from handling acid, caustic, and lime. Industries have had a few burns caused by heating process and steam pipelines. There are a number of burns incurred in welding operations.

Eye Injuries: This type of injury is frequent in occurrence but mainly of a minor nature. The bulk of them are the result of airborne objects being blown into the eye. Goggles and shields are provided and during recent years there has been a reduction in the number and severity of this type of accident. The accidents of this nature occur mainly in the yards and lime kiln, handling supplies, and during the cleaning of tanks and equipment.

Electrical Hazards: Short circuit and electrocution are the major effect of electrical hazards in any workplace. Electrical distribution and installation seem unmanaged in many Sugar industries. Cable size plays vital role for the cable heating and ignition of fire but during the study none of the industries have the drawing and design of cabling system. Loose connection was seen many places of the industries. Most of sugar industry can found unnecessary lighting and open cable in case of light. Most of cables are secure but some industries don't have proper management of electrical control room.

Chemical Hazards: The Sugar industries are using the Caustic soda, Lime, Sulphur and Phosphoric acid as process chemicals which are highly corrosive in nature. During the handling of corrosive chemicals, no any Safety Data Sheet (SDS) followed. Storage and handling of chemicals are not doing in proper way where high risk of chemical burns in skin and eyes.

Personal Protecting Equipment (PPE): Personal Protecting Equipment (PPE) is the last control techniques for the prevention of accident. Sugar industries are the labor-intensive industries. Most of the workers in this industry coming from agriculture and most of them are unskilled and semiskilled. Very limited workers were only sustaining for longer years in Sugar industries mainly due to hazardous in nature. During the study it was found that some workers were very new to the Sugar industries. Workers were not provided with proper and suitable PPE. Workers were working with slippers in slippery floors, safety boots not available in any industries. Workers working in more than 6 feet height but they are not provided with safety belt. Workers were working without gloves while handling of chemicals and hot materials. Safety goggles most necessary PPE for boiler and bagasse handler workers but not provided.

Miscellaneous: The accidents that are classified in this group consist of cuts and bruises, sugar boils, and those that do not fit into the groups listed above. They are of a minor nature and medical attention and expense is mainly the result of carelessness on the part of the employees in not having their injuries properly attended to and infection results.

Safety Culture and Attitude: Humans are notoriously lazy, so taking shortcuts is a rather common practice in all walks of life, not necessarily work alone. However, when workers take shortcuts at work, especially when they are working around dangerous machinery, they are only exposing themselves to a potential catastrophe. Simply put, shortcuts that are taken on the job are not actually shortcuts. They are simply increasing risk of injury, or worse, death. Confidence is always a great thing to have, but there is also such a thing as too much confidence. The quickest way to get a job done is to do it right the first time. Worker has a life outside of the workplace, and sometimes life can take dips and turns that affect your emotions and your mood

negatively. Workers working in sugar industries were not seen as a prime objective of them, most of them worked mainly due to near to home, lack of other opportunity, coming with friends, and not skilled required. Most of the workers not encourage to makes their carrier in sugar industries. High Noise and dust exposure are main factors to make workers annoying and uncomfortable. Most of the workers were seen as working in stress. While anybody working in stress may do the wrong decision in many times so, risk of accident is very high.

The worker's attitude towards various types of stresses is a new concept in the studies of the working class. The employer and sometimes the worker consider the stress as a part of work and day-to-day life. The individual worker has been asked to give his opinion about various problems faced in the work place which are causing different kind of physical discomforts (i.e. stresses). The workers generally relate the discomforts and the causes behind them.

It can be concluded that safety culture practice not found in these industries. Lack of strong legislative provision and implementation of OSH provisions and lack of management willingness for safety and productivity safety culture not developed in this sector. Uneducated, unskilled and agriculture-based workers are other causes to not develop safety culture. Many accidents are happening due to lack of safety culture practices.

5.2 Trend Analysis of Accident

Total 191 number of accident were happened in FY 2072/73; 196 accidents in FY 2073/74 and 91 accidents in FY 2074/75. Accident trend showed that although in FY 2073/74 accident was increased in compare with FY 2072/73 but in FY 2074/75 remarkably reduced. Government of Nepal Gazetted and implemented the Labour Act and Labour Regulation in FY 2074/75. Accident trend indicated that industries are consious about to reduce the accidents.

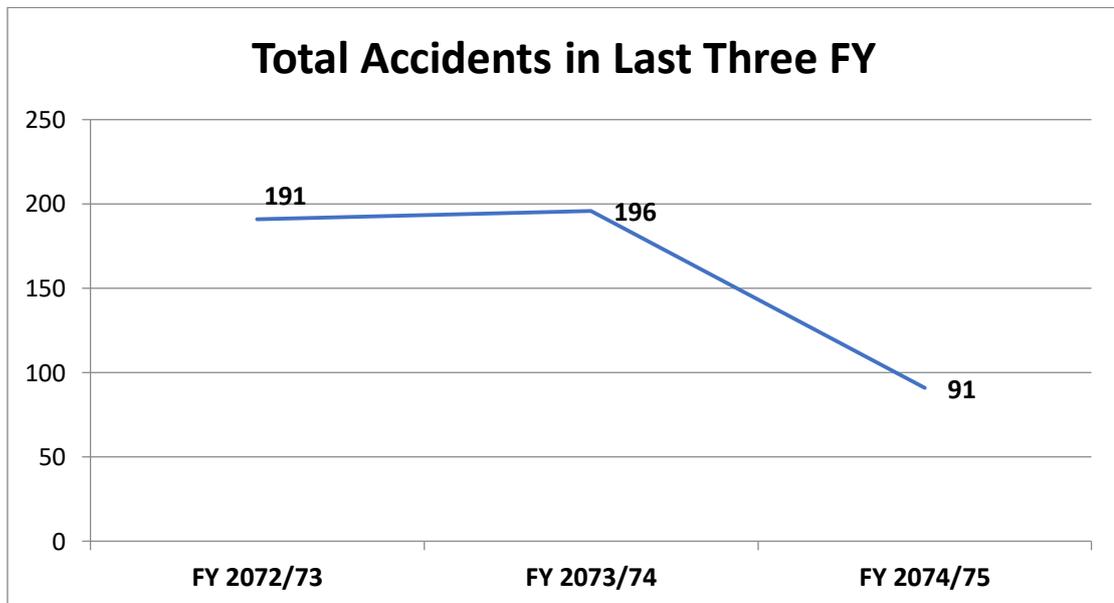


Figure 2: Total accidents in last three FY

Mainly minor type of accident was seen in these sugar industries. Few of the major accidents also happened in industries. No any fatal accident was recorded in last three FY.

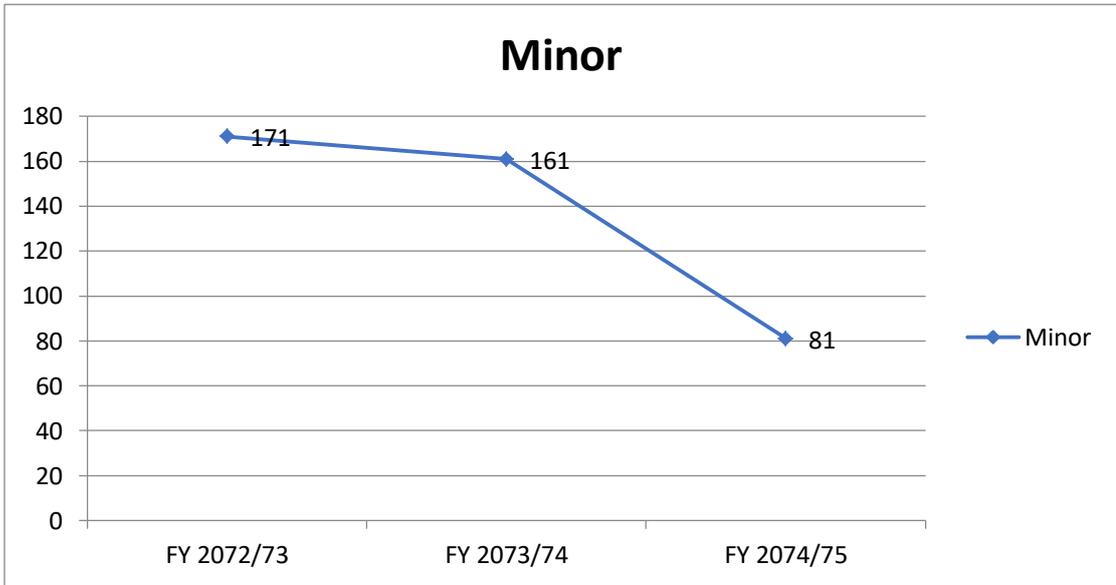


Figure 3: Minor accidents in last three FY

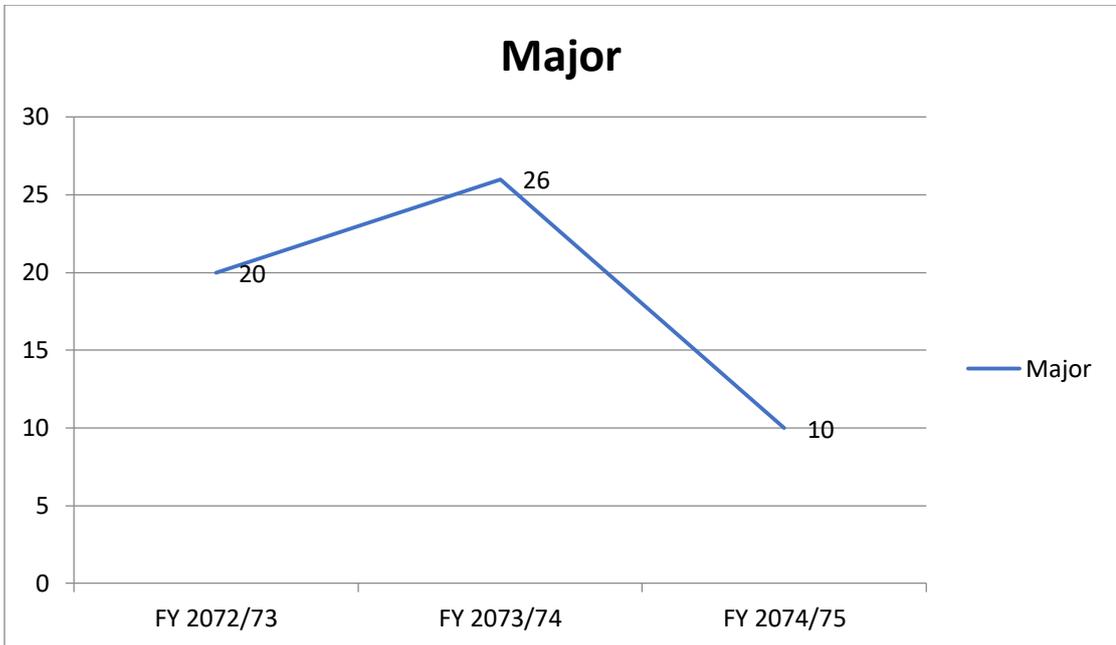


Figure 4: Major accidents in last three FY

Chapter – 6

Result and Discussion

The above collected data not represent as an actual data because most of the accidents are not recorded by the industries. None of the Sugar industries have proper management system for occupational safety and health. These data were provided by the industries management. It is found after interviewing of workers that due to accident prone nature of industries workers has fear to work in these industries. None of the sugar industries have any safety department and safety committee whereas Labour Act 2074 have provision for Safety Policy and Safety Committee if more than 20 employees working in industries.

The study shows none of fatal accident happening in any Sugar industries in last three fiscal years. Only few accidents are major types of accident and almost all accident are minor accidents. The above data also represents the rate of accident decreasing in recent FY, it signifying that new upcoming industries are adopting automatic and latest technology where worker's involvement minimized. It is seen that newly established sugar industries have new machineries and some kinds of management practiced. Reduction of number of workers, increasing awareness level on safety and health and some automation are the major contributor for decreasing trend of accident in all Sugar industries.

Total 191 number of accident were happened in FY 2072/73; 196 accidents in FY 2073/74 and 91 accidents in FY 2074/75. Accident trend showed that although in FY 2073/74 accident was increased in compare with FY 2072/73 but in FY 2074/75 remarkably reduced. Government of Nepal Gazetted and implemented the Labour Act and Labour Regulation in FY 2074/75. Accident trend indicated that industries are conscious about to reduce the accidents.

Sugar industries are also less fire sensitive industries except bagasse storage yard. Few small fires were happened in last three fiscal years but no any fire disaster were happened in any Sugar industries. Although Boiler system and other high heat is produced but there is no fire accident recorded.

The workers are also not fully aware about safety and health issues they are not using any types safety precaution measures during the work. Instead of using the safety measures they said that, all these PPE's are time taking and these are lengthy; they are not feels comfortable working with using PPE's. The worker claims they are working like this from several years and believe that they don't have any issues regarding the working procedure.

Few of the sugar industries demonstrated the safety related posture and signage for awareness of the workers. It is not seen enough to reduce the rate of accident remarkably year by year. Industries need to demonstrate the pro-activeness to reduce the rate of accident. Safety Policy declaration and Safety Committee will encourage the management and workers to work safe and healthy condition.

Chapter – 7

Conclusion and Recommendation

7.1 Conclusion

“Safety First” is fundamentally important for human life but not adopted in these industries. Sugar Industries considered as a hazardous and accident-prone industries but industries not taken safety consideration seriously. Slip, trips, falls, burns and foreign body in eyes were the major accidents found in these industries mainly due to bad housekeeping. Risk of explosion and fire are also very significant in these industries. None of the industries have the system adapted to manage safety and health in Sugar industries. New, unskilled workers are mainly victim of accidents in industries. Awareness and training regarding safety and health were in very poor stage.

Labor Act 2074 has provisions for the safety of workers including safety policy, safety committee, safety audit and responsibility of management and workers towards the safety. Many specific provisions made mandatory by Labor Act 2074 and Labour Regulation 2075. Compliance of labour act and regulation will reduce the rate of accidents in all sugar industries of Nepal.

7.2 Recommendations

The Following Recommendations will help the sugar industries for prevention of accidents:

7.2.1 Implementation of Labour Act 2074

“Safety First” is the thought which fundamentally important for human life. The Labor Act 2074 has various provisions for the health and safety of workers. All the sugar industry should implement the all the provisions of safety prescribed in the act immediately.

- Industry should have safety and health policy.
- Industry should form the Safety and Health Committee including management and workers representatives.
- Industry should made provision of safety for vendor while importing, purchasing any machineries.
- Industry should fulfill the responsibility of management by implementing the all control measures provisions related to safety in Act.
- Industry should prepare procedure to stop the work in case of immediate danger found in the industry.
- Industry should inform the all accident cases in Labour Office.
- Industry should provide proper and suitable PPE to the all workers.
- Workers should also follow the company rules and regulation regarding safety.

7.2.2 Engineering Recommendations

Besides the implementation of Act 2074, the Implementation of following recommendation may help to reduce the rate of accident in Sugar industries.

- The machinery should be regularly checked and maintained.
- All the moving drives i.e. belt drives and gear drivers should be properly guarded or fenced.

7.2.3 Administrative Recommendations

Besides the implementation of Act 2074, the Implementation of following recommendation may help to reduce the rate of accident in Sugar industries.

- Declaration of Safety Policy and Safety Committee.
- Formation of Safety Department
- Periodic Risk Assessment
- Introduction of Safety Audit system
- Display the safety signage for hazard communication
- Proper training programs should be conducted to educate the workers as well as their supervisors particularly on occupational safety and health.
- Adoption of good housekeeping practices by marking with red and yellow line.
- Introduction of tight cotton made working dress for all workers and banned to wear loose clothes will reduce the many major and fatal accidents.
- Fire prevention plan and suitable fire extinguishing system should be compulsory install in industries.
- Compulsorily introduce induction training for all new workers.

7.2.4 Prevention from Slips, Trips and Falls

The following recommendations will minimize the slips, trips and falls

- Clean the bagasse and prevent from scattered
- Keep work places tidy
- Use the scrap and dirt bins where provided
- Tidy stacking and tidy layout prevent injuries
- Good housekeeping leads to greater safety
- Control the spillage of oil.
- Regularly washed the floor with hot water or high-pressure stem.
- Put tools and other equipment where they cannot possibly fall or be knocked on to someone below.
- Clearly mark, fence or cover all openings in floor, roof or ground.
- Keep gangways, paths, roads and stairways clear of obstacles
- All excavations in the plant should be surrounded with a handrail
- Provide all scaffolds and platforms with toe boards and railings.
- When working overhead remove all loose material such as bolts, screws, tools, timbers, fittings, etc. when the job is finished.
- Never throw tools or materials, always pass them from hand to hand.
- A nut or bolt falling from a height can kill a person.

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Annex 1: Checklist and Data sheet for Study

Occupational Safety and Health Condition in Sugar Industries of Nepal

1. General Information

Name of Industry		
Year of Establishment		
Address		
Scale	Large:	Medium: Small:
Products		
Name of contact person		
Contact		
Email		
Number of Employees	Male:	Admin:
	Female:	Production:
	Engineering:	QA/QC:
Total operating Hours		
No. of Shifts		
Have Safety Department		
Safety Officer Name		
Safety Officer Contact		
Safety Officer Email		

Accident Data Record Sheet

Accidents records in last 3 years:

Fiscal Years	Minor	Major	Fatal	Causes for Major Accidents	Causes for Fatal Accident	Total
2074/2075						
2073/2074						
2072- 2073						