



Occupational Health and Safety Practices in Paper, Pulp & Board Industry of the Punjab

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List of Abbreviations

OSH:	Occupational safety and health
BOS:	Bureau of statistics
PIDC:	Pakistan Industrial Development Corporation
R&D:	Research & Development
db:	Decibel
PPEs:	Personal protective equipment
NGVS:	No guideline value set
PEQS:	Punjab Environmental Quality Standards
LOTO:	Lockout/Tagout
OSHA:	Occupational safety and health administration

1. Introduction

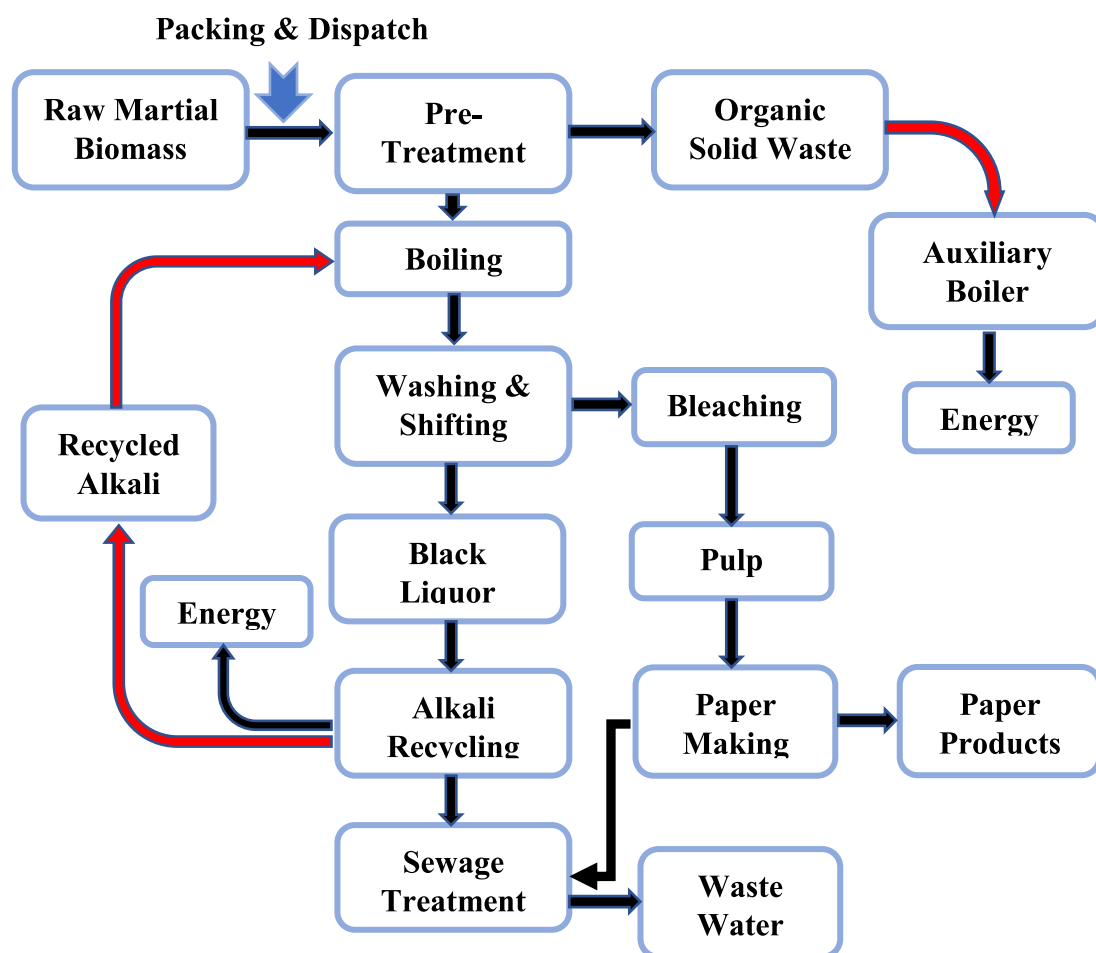
Being used in Ancient China since the 2nd century BC, paper made little impact until inventor Cai Lin managed to refine its production process, enabling the beginning of the true revolution of paper products all across China. His technique was used to reliably and quickly create small sheets of paper from heated wood chips, rags, cotton and fishnets [1].

Pulp and paper are among the rapidly growing industries. The production of paper is occurring in a vast amount to fulfill need of the masses. It is one of the highly polluting industries, most depicted energy and water exhaustive industrial sectors globally. Consequently, a significant quantity of water waste, solid waste, and gaseous waste discharge is happening from this industry. An extensive amount of ravage is formed throughout the pulp and paper process in which pulp and bleaching processes together produce solid waste and wastewater. Various gases like nitrogen oxides, hydrogen sulfides, sodium sulfide, methyl mercaptan, chlorine dioxide, and sulfur compounds are released into the air from solid waste. The utilization of wood and agricultural waste is mainly the sole raw materials for the production of paper. The recycled waste paper is used as a raw material for the production of newsprint grade paper. The effluents of paper mills are generated during the processing of pulp making and finishing of the paper. The characteristics and categories of waste depend upon the process of raw materials, bleaching and washing of the pulp and wood [2].

In 1947 when Pakistan came into existence, there was no single plant to manufacture paper. All the requirements of the paper in the country had to be met through imports. Pakistan Industrial Development Corporation (PIDC) was set up to establish different industries, including paper mills in the public sector. Now, this industry has different units across the country producing various grades of papers using local and imported raw materials. These units produce Writing and Printing Paper, Wrapping and Packing Paper, White duplex coated, uncoated boards, chipboard and other boards [3]. According to the Punjab Development Statistics 2020, 273 Paper and Paper products manufacturers are in Punjab [4].

The Paper and pulp industry of Pakistan is essential and serves the domestic market primarily. This sector involves process innovation, and these companies need to improve their technologies in the manufacturing process. Therefore, companies are continuously improving their products by spending vast amounts on R&D.

Paper plays a vital role in the social, economic, and environmental development of any country. Paper manufacturing is based generally on the use of renewable natural fibers. The best renewable raw materials for papermaking are wood, non-wood, and recycled fibers [5].



Process flow diagram for pulp and paper production

Pulp and paper manufacturing can also be hazardous due to massive weights and falling, rolling, or sliding pulpwood loads. Workers may be struck or crushed by loads or suffer lacerations from the misuse of equipment, particularly when machines are misused or without proper safeguards [6].

The pulp and paper industry workers are exposed to different chlorine, sulphur, and paper dust compounds. Workers with repeated exposure peaks to chlorine, e.g., bleachery workers, seem to have impaired lung function and increased respiratory symptoms. Likewise, exposure to high levels of paper dust ($>5 \text{ mg/m}^3$) causes impaired lung function. Therefore, exposure to respiratory irritants is an important and probably overlooked occupational risk among certain pulp and paper manufacturing workers [7].

2. Objectives

The main objectives were as follows:

- To conduct occupational safety and health risk assessment of paper and pulp sector in Punjab.
- To formulate an analysis report on occupational diseases and to suggest control measures.

3. Methodology

The technical team of SAA Centre for the Improvement of Working Conditions & Environment (SAACIWCE) and Directorate General Labour Welfare Punjab, Labour and Human Resource Department, Lahore carried out industrial visits of the selectorial establishment of Pulp and Paper to do risk assessment and testing on occupational safety and health using a modified National Institute of Occupational Safety and Health (NIOSH) questionnaires and checklists to identify hazards and suggest their control measures.

Following tests and methods were used to accomplish the tasks.

- Noise Level Testing
- Audiometry Testing
- Total Dust measuring (personal dust exposure)
- Spirometry Testing
- Illumination Testing
- Stack Emission Testing

4. Field Testing for Data Collection in Sampled Enterprises:

Different instruments were used to collect the required data with the help of checklists and proformas. All tools and instruments calibration was ensured before performing the test. This data was analyzed and interpreted to demonstrate the impact of measured parameters on workers' health and environment.

4.1 Noise Level Monitoring

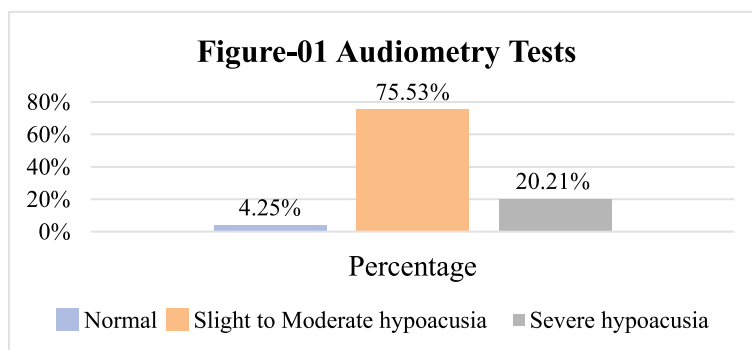
The noise level monitoring was carried out to find the Noise level in the workplace and noise exposure to the employees. Noise level measurements were carried out with Casella Precision Sound Level Meter Type 2100.

Table-I Noise Level Monitoring in Pulp and Paper Industries					
Sr. No.	Departments/Sections	Noise Level dB (A)	Sr. No.	Departments/Sections	Noise Level dB (A)
1.	Workshop	67.0	12.	Pulp house	92.6
2.	Finishing hall	79.7	13.	Workshop	80.0
3.	Electrical workshop	74.3	14.	Raw material yard	80.1
4.	Bleaching section	86.6	15.	Boiler area	87.5
5.	CD Plant area	71.2	16.	Fabrication area	74.0
6.	Sulphide plant	76.1	17.	Vacuum pump section	100.6
7.	Machine hall basement	105.2	18.	Inside instrument section	92.6
8.	Machine hall upper floor	96.3	19.	Bleaching section	85.6
9.	Near generator	92.3	20.	Raw material yard	70.1
10.	Pulp house	88.1	21.	Feeding area of a continuous digester	75.5
11.	Machine hall	90.1	22.	Continuous digester plant	90.5

*There is no set value for noise exposure limit in local Labour Legislations, so OSHA standard was used to compare noise level. The reference standard for OSHA permissible limits is 85 dB(A) for eight hours work-shift. Therefore, the noise level mentioned in the above table exceeds the 85dB(A) OSHA standard limit. These are high noise sections that require control measures.

4.2 Audiometry Testing

Audiometry tests were conducted randomly selected workers from different sections of the industries using a Sibelmed Audiometer. Testing data showed 4.25% of workers were having normal audiometry, 75.53% had slight to moderate hypoacusia, and 20.21% had severe hypoacusia.





Audiometry Testing of workers

Therefore, those workers must be properly checked by a medical doctor for further medical treatment.

4.3 Monitoring of Total Dust (Personnel Exposure)

Exposure monitoring of total dust (personnel exposure) was carried out in different enterprise of the enterprises using a personal dust sampler. The workers in the industry were exposed to dust and fumes during their routine activities. Summary of the test results is summarized below.

Table-II Monitoring of Total Dust (Personnel Exposure) in Pulp and Paper Industries					
Sr. No.	Departments/Sections	Total Dust (mg/m³)	Sr. No.	Departments/Sections	Total Dust (mg/m³)
1.	SPP Section	2.28	13.	Loading Section	2.69
2.	Main Lab	1.10	14.	Mechanical Workshop	6.75
3.	RPP Section	3.35	15.	Welding section	0.41
4.	Finishing Hall	1.71	16.	Instruments	0.78
5.	Instrumentation Section	0.23	17.	Fabrication section	6.28
6.	Bleaching Section	1.15	18.	Mechanical section	2.47
7.	Roller Section	0.28	19.	CD Plant	0.57
8.	Rewinder Cutter Section	0.73	20.	Electrical Workshop	1.46
9.	Electrician Maintenance	0.90	21.	Pulp House	0.78
10.	Pulp House	6.76	22.	Machine house	0.79
11.	Boiler House	4.17	23.	Maintenance section	1.57
12.	Admin	2.72	24.	Machine Hall	0.41

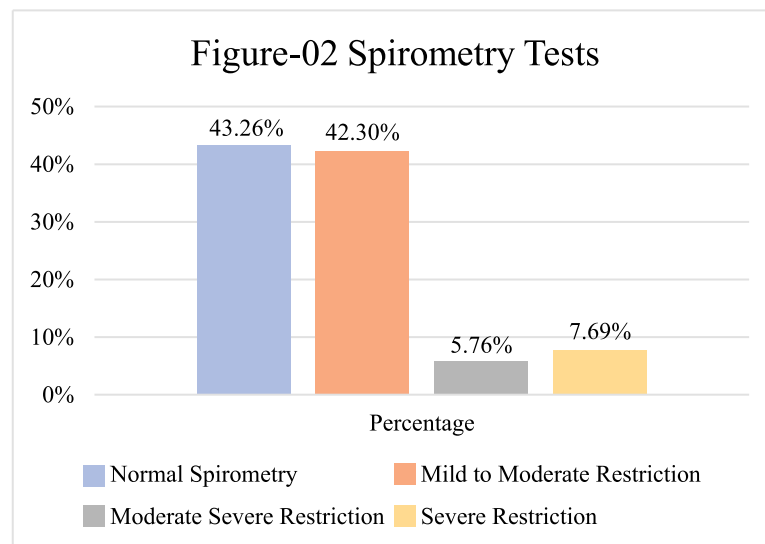
*As per ACGIH, the total dust threshold limit value is 10 mg/m³

During the Pulp and Paper industries visit, dust samplers (having filter in cassette for collecting dust sample) were attached to 20 workers of different sections from each industry for two hours while

working their job activity at the workplace. After two hours, dust samplers were removed from workers, and their samples were collected. As a result, the maximum concentration value of total dust was observed, which was less than the threshold limit of 10mg/m^3 per American Conference of Governmental Industrial Hygienist (ACGIH) standards.

4.4 Spirometry Testing

Spirometry testing of randomly selected employees from various sections of the industries were performed by using MIR Spirodoc Spirometer to assess respiratory ailment among the target groups Spirometry testing of randomly selected employees from multiple sections of the enterprise. The graph below shows the percentage distribution, with 43.26% having normal spirometry, 42.3% mild to moderate restrictions, 5.76% moderate-severe restrictions, and 7.69 % with severe restrictions.



Spirometry testing of workers

Spirometry tests indicated some of the workers had mild to severe respiratory problems that might be attributed to smoking or exposure to dust/chemicals. Therefore, a pulmonologist must properly check such workers.

4.5 Illumination Testing

The illumination level monitoring was carried out to measure the illumination in different sections. The measurement was carried out by Lux Meter (EXTECH, Color LED Light Meter LT-45). From the workers' perspective, poor lighting at work can lead to eye strain, fatigue, headaches, stress, and accidents. On the other hand, too much light can also cause safety and health problems such as "glare" headaches, and stress. Furthermore, both workplace situations can lead to mistakes at work, poor quality, and low productivity [8].

The section-wise light intensity was calculated as the average of values taken at the workplace.

Table-III Illumination Level Testing in Pulp and Paper Industries					
Sr. No.	Departments/Sections	lux Level	Sr. No.	Departments/Sections	lux Level
1.	Workshop	4700	8.	Pulp house	233
2.	Finishing Hall	125.2	9.	Workshop	1899
3.	Electrical Workshop	42.7	10.	Fabrication area	150
4.	Lab (Machine Hall)	107.1	11.	Inside instrument section	23.3
5.	Machine hall (Basement)	80.1	12.	Sulfide plant	214
6.	Machine hall (Ground Floor)	127.3	13.	Machine house basement	98.3
7.	Machine hall	275	14.	Pulp house	32.3

Legal Provision

The Factories Act 1934, According to section 19 (Lighting);

(1) In every part of a factory where workers are working or passing, there shall be provided and maintained –

- (a) sufficient and suitable lighting, natural or artificial, or both; and
- (b) emergency lighting of special points in the work-room and passages to function automatically in case of a failure of the ordinary electric system.

The Sections 19, 33-J and 39 of the "Punjab Factories Rules 1978" state that "As long as any worker is present in a factory in latrines, passages, stairs, hoists, factory ground and other parts of the factory in so far as the entrance of the said places is not closed, shall be lighted in a such manner that safety

is fully secured in passing through or remaining in the same. Section (2) (a) the general illumination over these interior posts of the factory where persons are regularly employed shall not be less than 6 feet candles measured in the horizontal place at a level of 3 feet above the floor; provided that in any such part in which the mounting height of the light sources for general illumination necessarily exceeds 25 feet measured front the floor or where the structure of the room or the position or construction of the fixed machinery of plant prevents the uniform attainment of this standard the general illumination at the said level shall be less than 3 feet candles, and where work is actually being done the illumination shall not be less than 8 feet candles or the greatest reasonably practicable illumination below 8 feet candles.

Table-IV Illumination Level according to “The Punjab Factories Rules 1978”	
Illumination Level (feet candles)	Illumination Level (lux)
08	86.11

*The reference standard DIN was used to compare illumination levels.

Different countries and professional organizations recommend different levels of illumination in the workplace. Moreover, a range of illumination levels is recommended for different kinds of activities. For example, different types of precision work require high illumination, while packing areas and corridors may need less illumination. The permissible limit for rough assembly work or machining, precise assembly work or specific machining tasks and bookkeeping/office work is 250 (lux), 1000 (lux) & 500 (lux), respectively, for eight hours work shifts [9].

4.6 Stack Emission

Stack emission monitoring was carried out during the general shift using calibrated Flue Gas Analyzer Testo 350. The measurement was carried out by inserting an instrument probe in the orifice of the stack of boilers. These values are taken per Punjab Environmental Quality Standards for industrial gaseous emissions [10].

Table-V Stack Emission Testing in Pulp and Paper industries				
Parameters	Unit	PEQS	Boiler 1	Boiler 2
Capacity	Tons per hour	-	10	60
Load	Tons per hour	-	05	25
Fuel	-	-	Rice husk	Poultry waste
O ₂	%	NGVS	10.94	15.83
CO	mg/Nm ³	800	201.2	3287.5
NO _x	mg/Nm ³	NGVS	239.88	8.22
NO	mg/Nm ³	NGVS	236.8	8.02
NO ₂	mg/Nm ³	NGVS	3.08	0.20
CO ₂	%	NGVS	9.96	4.97
SO ₂	mg/Nm ³	1700	0.0	0.0
H ₂ S	mg/Nm ³	10	19.4	0.0
Eff. N	%	-	91.1	89.3
Eff. G	%	-	87.0	82.5
Final Temp	°C	-	106.0	89.3
Smoke	% or Ring Lemann Scale	40% or 2	40% or 2	40% or 2

*The sum of NO and NO₂ values used for the calculation of NO_x value.

*The mixed fuel is used for boiler

*NGVS: No guideline value set

*PEQS: Punjab Environmental Quality Standards

Legal Provision:

The “Punjab Factories Act, 1934” section 16 (Dust and fumes) states that (1) In every factory in which, because of the manufacturing process carried on, there is given off any dust or fume or another impurity of such a nature. To such an extent as is likely to be injurious or offensive to the workers employed therein, adequate measures shall be taken to prevent its accumulation in any work-room and its inhalation by workers. If any exhaust appliance is necessary for this purpose, it shall be applied as near as possible to the dust, fume, or another impurity point of origin. Such point shall be enclosed so far as possible.

(2) No stationary internal combustion engine shall be operated in any factory unless the exhaust is conducted into the open air and exhaust pipes are insulated to prevent scalding and radiation heat. Furthermore, no internal combustion engine shall be operated in any room unless effective measures

have been taken to avoid such accumulation of fumes therefrom as are likely to be injurious to the workers employed in the work-room.

5. Data Collection and Interpretation

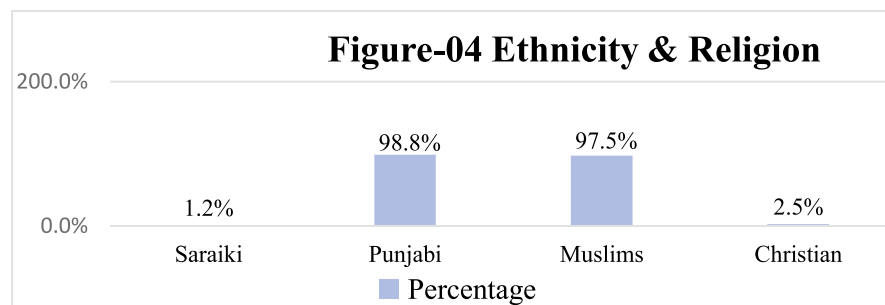
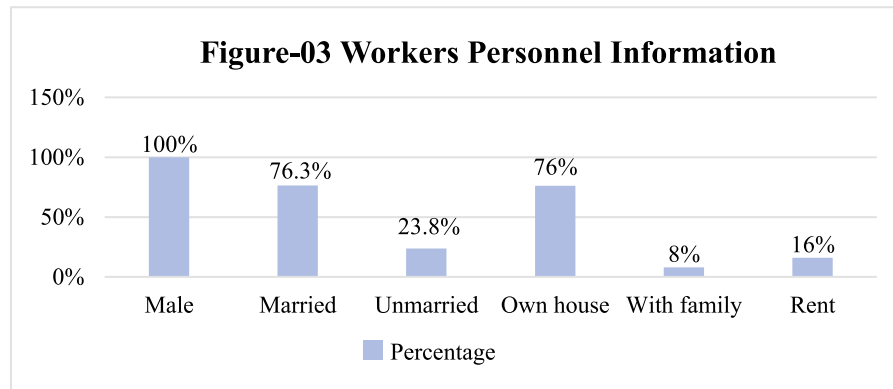
As per planned methodology, the field data of site workers was collected during site visits. For this purpose, various site workers and management staff categories were selected from the sections of Pulp and Paper Industries. Workers were interviewed, and a set of prescribed questions were asked from each worker. This self-reported data by each worker was analyzed and presented in subsequent sections.

5.1 Workers Personnel Information

The socio-demographic data of workers shows that the age of workers was between 18 years to 69 years. The family size was 2 to 11 persons, the number of children ranged from 0 to 7 while the number of earning family members ranged from 1 to 6 persons.

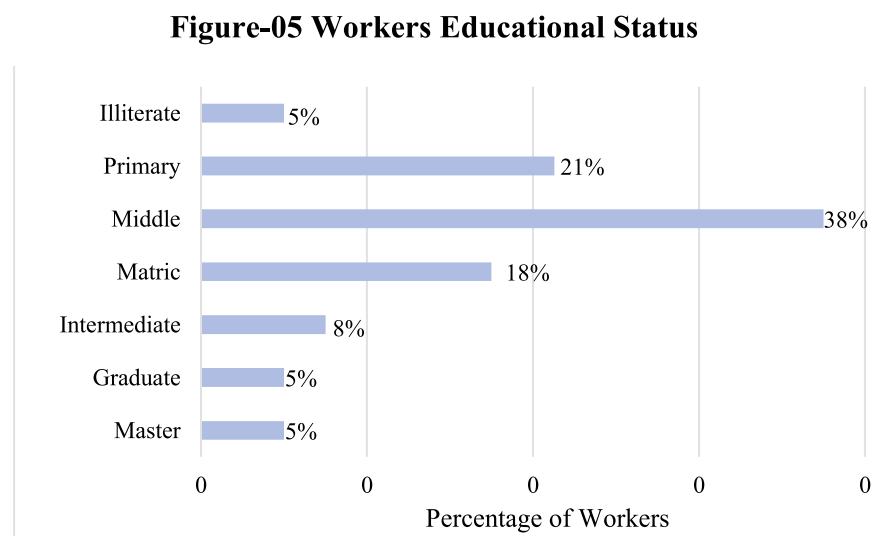
Table-VI Descriptive statistics – Workers Personnel Information			
	N	Minimum	Maximum
Age of Employee	105	18	69
No. of family members	105	2	11
No. of children	97	0	7
No. of earning hands	100	1	6

In this sector, male workers were found, 76.3% were married and 23.8% unmarried while 76% had their own house, 16% were on rent, and 8% were living with their family (Figure-03). In addition, the data showed that 98.8% were Punjabi while the rest were Saraiki and 97.5 % were Muslims, and 2.5% were Christian (Figure-04).



5.2 Workers Educational Status

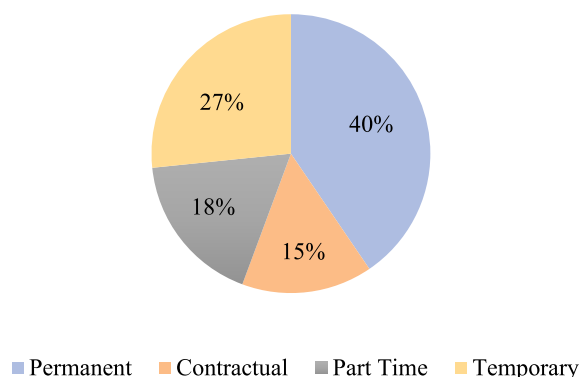
The educational status shows that 5% were master, graduate and illiterate. On the other hand, 38% of workers were middle, 18% matric and 8% had intermediate education.



5.3 Workers Job Status

Regarding workers' job status, 40% were permanent, 15% were contract-based, 27% temporary, and 18% worked part-time.

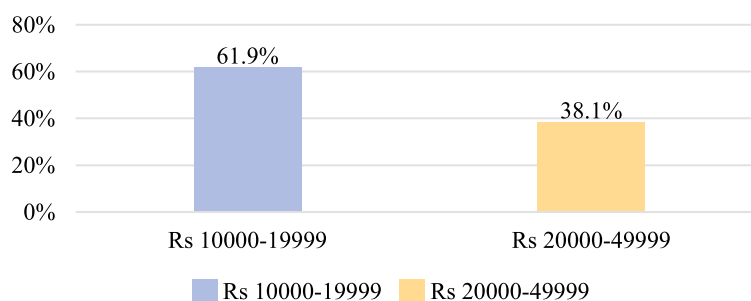
Figure-06 Job Status



5.4 Workers Wages

The payment status of workers depicted that 61.9% of workers having a salary between Rs.10,000 to Rs. 19,999 while 38.1% of them were being paid in the range of Rs. 20,000 to Rs. 49,999.

Figure-07 Employee Salary Range

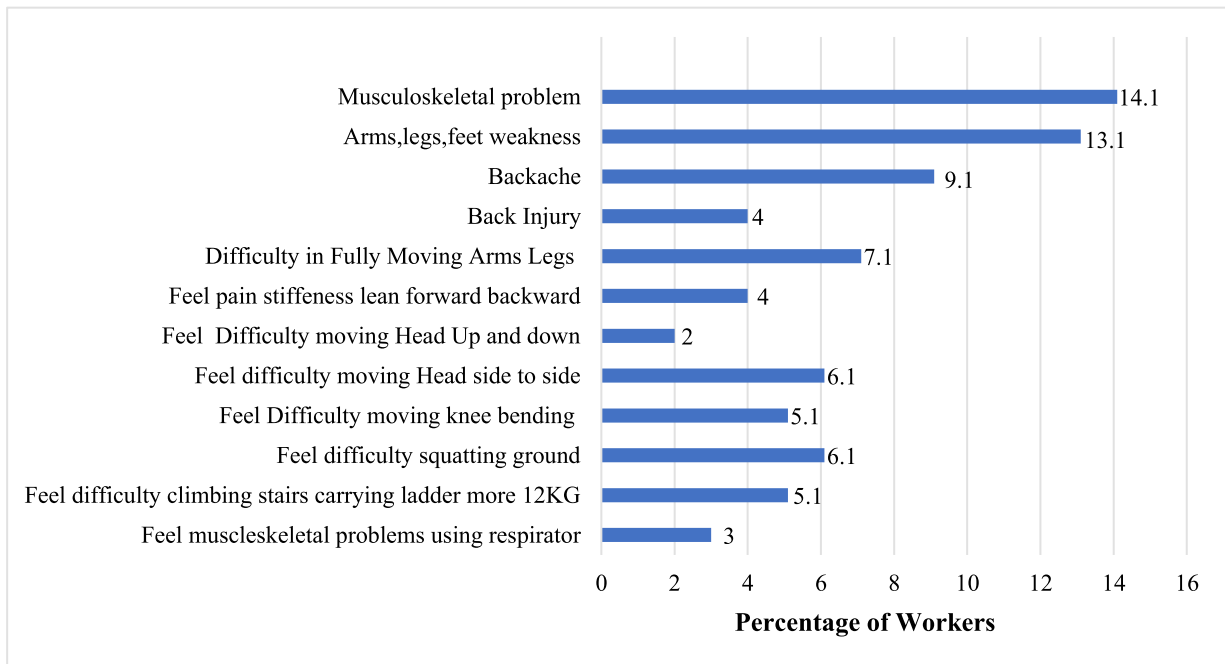


5.5 Effect of Occupational Work Activities on Worker's Health

Data related to occupational site work activities' effect on workers' health was collected and graphically presented in Figure-08. As self-reported by workers, it was noted that musculoskeletal disorders (MSD) were observed in workers based on their activities.

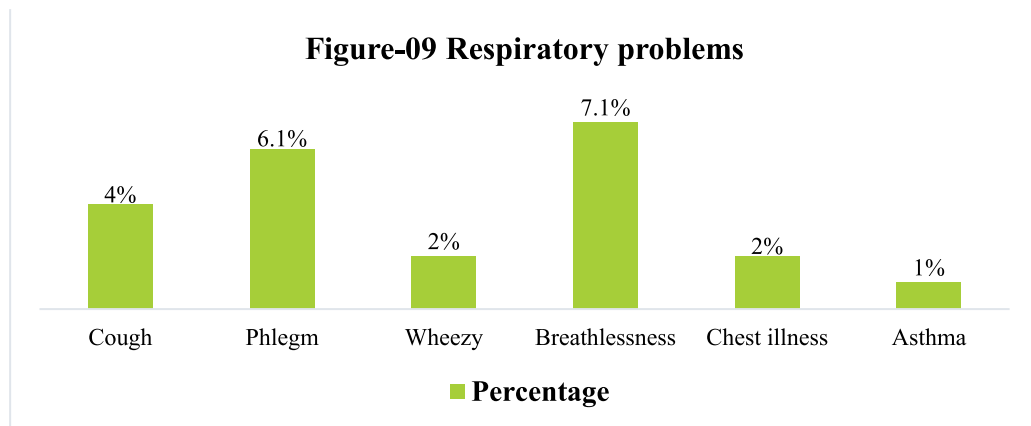
Data showed that 14.1% of workers were aware of the musculoskeletal problems at the workplace, 4% reported back injuries, 13.1% had weakness in their joints. In comparison, 9.1% had backache, 7.1% felt difficulty in fully moving arms and legs, and 4% felt pain leaning forward and backwards. Two percent of them felt trouble in moving the head up and down. At the same time, 6.1 had a problem tilting the head, 5.1% felt difficulty in knee bending, 6.1% felt difficulty in squatting ground, 5.1% had difficulty climbing stairs while carrying the load more than 12kg, and 3% had a problem while using a mask.

Figure-08 Musculoskeletal Disorders



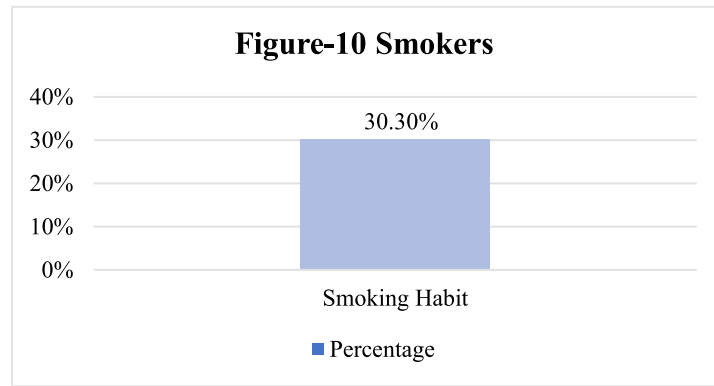
5.6 Respiratory problems

Figure-09 shows that 4% had a cough, 6.1% phlegm, 2% wheezy, 7.1% of workers suffering from breathlessness problems when walking, 2% workers having chest illness, and 1% reported an asthma history.



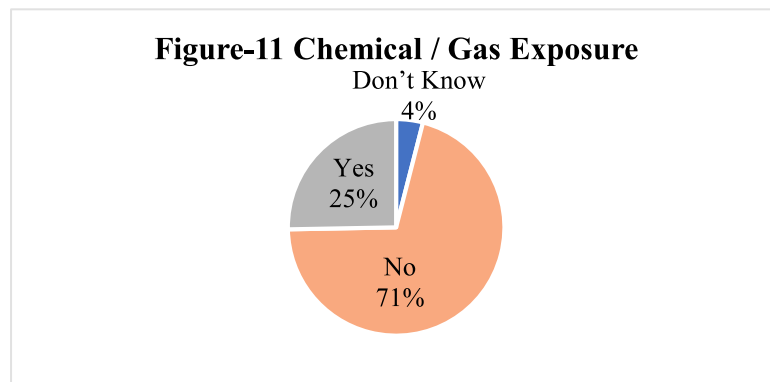
5.7 Smokers

Figure-10 shows that 30.3% of workers were smokers.



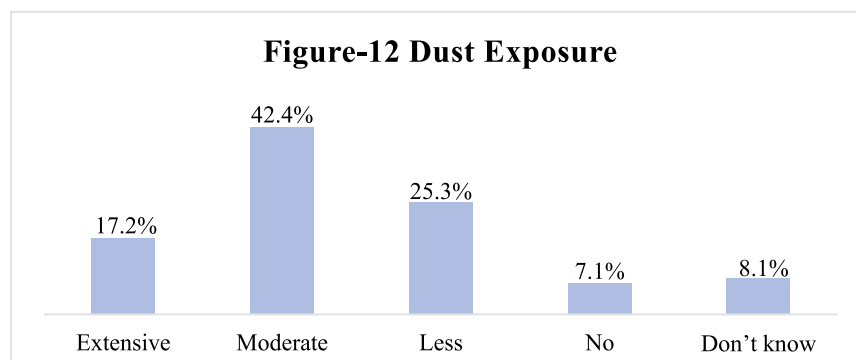
5.8 Chemical / Gas Exposure

Figure-11 shows that 25% of workers were exposed to chemical gas during work.



5.9 Dust Exposure

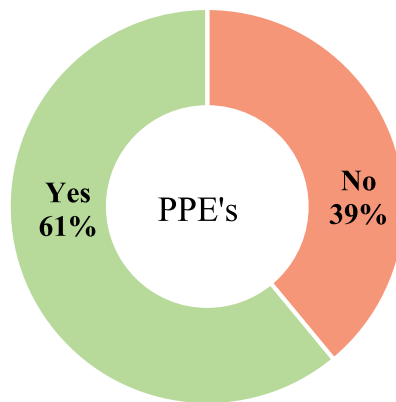
Figure-12 shows that 17.2% of workers had extensive dust exposure, 42.4% moderate, 25.3% low, while 8.1% were unaware they had any dust exposure. 7.1% of workers reported they had no dust exposure in their job history.



5.10 Use of Personal Protective Equipment

Figure-13 shows that 61% of workers reported they had been provided with PPEs. It was observed that workers were not using PPEs at the workplace. Loose dress, open shoes (chappal) were observed during site visits.

Figure-13 PPEs



6. Hazards Identification & Risk Assessment

Field visits (Annexure-I) to various pulp and paper worksites were conducted to identify different health and safety hazards and perform a detailed risk assessment. Risk assessment was carried out using prescribed proforma wherein the intensity of risks was categorized based on International Risk Matrix. Recommendations were provided to minimize the risk(s) for the safety and health of workers & the environment. These reports were shared with enterprises for improvement of their working conditions. The brief of different identified hazards and their control measures are summarized below.

6.1 Biological Hazards

Contact with wastewater from the washing of pulp can result in skin irritation. Biological agents, including microorganisms such as bacteria, fungi, and viruses, some of which may be pathogenic, were noted among the workers. Microorganisms develop particularly in paper machines, closed-loop systems, biological treatment plants for mill wastewaters, and water-cooling towers.



Biological Hazards

6.2 Unguarded Machines and Power Transmission Apparatus

Unguarded machines & Power transmission apparatus in Machine Hall, Workshop & Boilerhouse were observed.



Mechanical Hazards (Unguarded Machine and Power Transmission Apparatus)

6.3 Unguarded Conveyors

Conveyor belt/rollers found unguarded may cause entanglement/draw in or trap hazards between rollers/belts. Unguarded or inadequately guarded machines are a source of numerous serious accidents or even fatalities. Exposed parts of machinery must be fully guarded to prevent any contact with the rotating parts. Many accidents happen at the workplace due to unguarded machines and conveyors for which accident investigation and reporting were carried out, while some are unreported by the industries.



Unguarded Conveyors belt

6.4 Sharp Surfaces

Hand injuries are the most common injuries associated with sharp surfaces. Sharp edges can cause cuts and severe injury. Sharp-pointed parts can cause skin stabbing or puncturing, and rough surface parts can cause friction or abrasion.



Sharp surfaces of Machine in mechanical workshop

6.5 Hot Surfaces

Hot surface hazards were a common problem in the paper manufacturing facility because they produce heat, friction, and movement. Skin burns were noted among the workers.



Burn hazard due to hot surface of Equipment

6.6 Pressure Vessels Inspection

An authorized third-party certification body did not conduct some pressure vessels inspection and maintenance in the Paper and Pulp Industry.



Pressure Vessels maintenance and inspection was not carried out

6.7 Physical Hazards

Slip, trip and fall hazards were observed in the workplace that could cause injuries.



Slip, trip and fall hazards

6.8 Housekeeping

Poor housekeeping was observed in many plant areas due to waste products. For example, an unbarricaded wastewater channel was found in the CD plant area. Poor housekeeping practices lead to messy, disorganized work areas and increase the number of workplace hazards.



Poor housekeeping

6.9 Noise Hazard

High noise levels were observed in Machine Hall (Basement & Ground floor), Near Generator, Pulp House, Bleaching section, Machine Hall, Pulp Workshop, Vacuum pump section, Continuous digester plant and Boiler area mentioned in **Table-I**.

6.10 Chemical Hazards

Papermaking facilities use a wide range of chemicals, including hazardous chemicals. Chemical dust and vapours were observed in the Bleaching section and Pulp house. Improper storage of chlorine gas cylinders was kept in the Bleaching Section of the enterprise. High bagasse dust and wheat straw dust was observed in the Plants, especially in the feeding area of the continuous digester and raw material yard while sulfur was stored openly in Sulfur Section. Many pulp and paper mills workers use chlorine as a bleaching agent to produce high-quality white pulp. The high organic content of mill waste, coupled with chlorine, results in the production of many highly toxic chlorinated organic compounds.



Unsafe Storage of flammable chemicals



Unsafe storage of lubricants and fuel

6.11 Airborne Particles

High rice husk and wheat straw dust etc., were observed in plants, especially in CD Plant Area.



Dust particles exposure to the workers

6.12 Confined Spaces Hazards

In Pulp and Paper industries, it was observed that confined spaces were not declared in the enterprises, so required confined space protocols were not fulfilled during the site visits. As a result, workers were working alone in the confined Pulp Area (bottom section) for maintenance work, which might cause serious injury, electrical hazard, mechanical hazard, insufficient illumination and oxygen, toxic fumes & gases, flammable or explosive atmospheres, excessive heat, etc. Confined space scenarios are common in the pulp and paper industry. Inside paper mills or factories, workers come across confined spaces inside storage chests, dryer cans, water chests and tanks, conveyor belts, pulper vats without confined space protocols.



Confined space hazard near conveyors

6.13 Electrical Hazards

There were hanging electric wires and corroded cable trays that may expose employees to electric shock, electrocution burns, fires and explosions due to naked electrical cables. Sparks from electrical equipment can serve as an ignition source for flammable or explosive vapours. An explosion may be caused by unsuitable electrical apparatus or damaged electrical wire and equipment.



Electrical wires without Cable trays

6.14 Fire Hazards

Fire extinguishers were found empty and expired in different sections of the enterprises. Paper is a combustible material, easily ignitable and can cause fire and explosion risks. There was a high risk of fire explosion in the Sulfur storage area and Pulp storage area. In addition, wood dust is a potential concern in the wood handling area (e.g. in semi-mechanized chippers) and in the initial pulping stages.



Fire hazards



Sulfur storage section

Legal Provision:

The Section 25 (Precautions in case of fire) of the “Factories Act, 1934” states that:

(3) In every factory, the doors affording exit from any room shall not be locked or fastened so that they can be easily and immediately opened from inside while any person is within the room, and all such doors, unless they are of the sliding type, shall be constructed to open outwards or where the door is between two rooms, in the direction of the nearest exit from the building and such door shall not be locked or obstructed while work is being carried on in the room and shall at all times be kept free from any obstruction.

(4) In every factory, every window, door, or other exit affording means of escape in case of fire, other than means of exit in ordinary use, shall be distinctively marked in a language understood by the majority of the workers and in red letters of adequate size or by some other effective and clearly understood sign.

(7) In every factory wherein more than ten workers are ordinarily employed in any place above the ground floor, or explosive or highly flammable materials are used or stored, effective measures shall be taken to ensure that all the workers are familiar with the means of escape in case of fire and have been adequately trained in the routine to be followed in such case.

6.15 Inadequate Illumination

Poor lighting was observed in the Finishing Hall, Electrical workshop, Lab (Machine Hall), Pulp house, Fabrication area, Instrument section and Machine house as mentioned in **Table-III**.

6.16 Ergonomics Hazards

Ergonomics hazards include awkward postures and body movements (bending, forcing, repetitive & twisting) observed in Sheet cutter, Paper counting section, and Finishing hall. Also, improper workstation height kept in Main workshops, Plate grinding machine, Sheet cutting point, Packing Area, and Machine Hall may lead to fatigue and musculoskeletal disorders. Maintenance workers perform tasks that involve high forces, awkward postures, and working in areas with inadequate clearance and space for the worker and their tools. These jobs are physically demanding, with moderate to high forces and awkward postures.



Awkward Body Posture

6.17 Personal protective equipment

Machine operators were operating machines without PPEs. Loose clothing and (open shoes) were observed at the worksite. It was recommended to provide workers with suitable PPEs; workers must not work without proper PPEs. Proper usage of PPEs should be mandated.

7. On-site training on Occupational Safety and Health

On-site training sessions on the basis of aforementioned risk assessment activity were conducted for awareness about occupational health, safety, and the environment at the workplace. Workers, including management staff from various sections of the enterprise, actively participated in the sessions. It was focused that preventions and control measures are mandatory to mitigate the risk factors. Therefore, it was emphasized during training sessions that the use of required personal protective equipment (PPEs), work permits, machine safety, chemicals safety, fire safety measures, good housekeeping, periodical medical examination of the workers, etc., are mandatory to avoid any possible hazard/accident at the workplace.



Occupational Safety and Health training

8. Recommendations as per Risk Assessment

Detailed recommendations are given below against each identified hazard to mitigate their effect on the welfare of workers and improvement in the work environment.

- In order to ensure compliance on safety and health under the existing labour legislation, engineering, administrative and personal protective devices should be used at workplace.
- Regular training and supervision must be provided to workers for awareness about occupational safety and health (OSH).
- Periodic medical examination of the workers must be ensured in light of existing Labour Laws.
- Machines must have adequate safeguards to protect operators and other employees in the immediate work area from hazards. All rotating parts should be effectively guarded. In addition, all components of mechanical systems which transmit energy, including flywheels, pulleys, belts, connecting rods, coupling, spindles, chains and gears, must be guarded.
- Workers in high noise areas must be rotated and allowed to work in less noisy areas for at least half of their shift.
- Machines must be well maintained and lubricated to stem the unnecessary noises and vibration. Employers must provide hearing protection to workers.
- Surrounding type fixed guard must be installed around conveyor belts/rollers. In addition, emergency control switches must be installed where applicable.
- Lockout/Tagout (LOTO) procedures must be implemented if any machine guard is removed or before any maintenance or repairs are conducted.
- Safeguards must be fully covered on hot surface machines to avoid direct contact with workers/visitors. Visible “Hot Surface” signs must be displayed on safeguards.
- All Pressure vessels inspection/maintenance must be carried out, and third-party certification must be ensured. Tanks and pipelines inspection must be carried out, and replacement/repair of corroded parts must be provided. In addition, damaged insulation must be replaced.
- Cylinders should not be placed in exit/access. Cylinders should be carried through a suitable cylinder trolley, appropriately chained, and transported upright. Ensure the last date of cylinder testing is mentioned on the cylinder. Verify for correct content as per colour code.
- Extreme caution should be exercised when using any type of welding equipment. Injury can result from fire, electric shock, explosions or harmful agents.
- Ensure thorough inspection of boilers by a qualified boiler inspector/engineer. Use boiler operating log sheets, maintenance records, and manufacturers’ recommendations to establish a preventive maintenance schedule based on operating conditions and past maintenance, repair, and replacement performed on the equipment.
- Good housekeeping must be ensured at the workplace.
- Machine operators must always wear safety glasses and slip-resistant / safety shoes.

- All workers, visitors and staff members must be aware of the escape routes. Make sure that emergency exit doors are not wedged open. Combustible material must not be stored near emergency exit doors/escape routes.
- Minimum fire protection requirements such as fire alarm, fire extinguishers, emergency response plans and fire drills must be in place as soon as possible.
- Install fire sprinkler system and other firefighting equipment to control the fire at the time of erection of a unit.
- Follow all electrical safety precautions so that short circuit hazards can be eliminated. Use the correct cable connectors and use electrical cable ducting. Damaged electrical cable trays must be replaced. Electric wires must be routed appropriately through cable trays.
- Lifting equipment must be thoroughly examined on regular basis before being put into service.
- Workstation height must be improved. Manual handling can be reduced through automation or engineering control with training. In addition, height-adjustable stools with back and footrest must be ensured for the workers. There must be provision of good quality stools to prevent the worker from musculoskeletal disorders.
- Proper usage of PPEs should be made mandatory for every worker.
- Undertake risk assessments and pre-operational inspections of the workplace.
- A Permit-to-work system must be implemented to ensure that work is done safely and efficiently.
- Develop, implement and maintain a service regime. Preventive maintenance and inspection system must be implemented for machines/equipment/electrical appliances.

10. Annexure-I

Glimpses during site visits



Photo-I Bagasse storage area



Photo-II Raw material storage



Photo-III Chemical storage section



Photo-IV Electrical hazards



Photo-V A pulp and paper unit in Punjab



Photo-VI Papers Rollers



Photo-VII Paper Rollers



Photo-VIII Paper Rollers

11. Annexure-II

Risk Assessment Checklist (Fire Safety)

Enterprise name: _____

Date _____

Sr #	Hazard identification	Yes	No	Remarks
1	Have you identified all potential ignition sources?			
2	Have you identified all potential fuel sources?			
3	Are the LPG and flammable chemicals on-site stored safely?			
4	Have you carried out a fire drill recently?			
5	Is the boiler room free from flammable and combustible materials?			
6	Is all waste kept to a minimum and away from the buildings?			
7	Do you have an emergency plan with complete details?			
8	Are portable heaters safely used on-site with adequate ventilation?			
9	If smoking is allowed and restricted to a safe, designated area on-site?			
10	Are safety signs and equipment regularly checked & maintained at the workplace?			
11	Are all fire doors, escape routes, and associated lighting and signs checked regularly?			
12	Are all fire detectors of the right type and in appropriate locations?			
13	Can the means of warning be cleared, heard, and understood by everyone throughout the building when initiated from a single point?			
14	If a fire detection and firefighting system is electrically powered, does it have backup power?			
15	Are the suitable extinguishers located close to the fire hazards, and can users get to them without exposing themselves to risk?			
16	Are fire extinguishers mounted at a reasonable height and kept clear from obstructions.			
17	Do you regularly check the equipment provided to help maintain the escape routes?			
18	Is a warning sign posted at each lift station (on each floor) indicating "DO NOT USE THE LIFT FOR EVACUATION DURING A FIRE"?			
19	Did training provide to employees on the importance of an emergency evacuation plan?			
20	Do the employees have an emergency assembly area point outside?			

Name & Designation of Assessor _____

12. Annex-III

Risk Assessment Checklist (Machine Safety)

Enterprise Name: _____

Date: _____

Sr #	Question	Yes	No	Remarks
1.	Is there a training program to instruct employees on safe methods of machine operation?			
2.	Is there adequate supervision to ensure that employees are following safe machine operating procedures?			
3.	Is there a regular program of safety inspection of machinery and equipment?			
4.	Are all machinery and equipment kept clean and properly maintained?			
5.	Is sufficient clearance provided around and between machines to allow for safe operations, set up and servicing, material handling and waste removal?			
6.	Are equipment and machinery securely placed and anchored when necessary to prevent tipping or other movements that could result in personal injury?			
7.	Is there a power shut-off switch within reach of the operator's position at each machine?			
8.	Are all pulleys and belts that are within 7 feet of the floor or working level properly guarded?			
9.	Are all moving chains, sprockets, gears, belts, flywheels, pulleys, shafts, spindles and chain drives properly guarded?			
10.	Are splash guards mounted on machines that use coolant to prevent the coolant from reaching employees?			
11.	Are methods provided to protect the operator and other employees in the machine area from hazards created at the point of operation, ingoing nip points, rotating parts, flying chips, and sparks?			
12.	Are machinery guards secure and so arranged that they do not offer a hazard in their use?			
13.	If special hand tools are used for placing and removing material, do they protect the operator's hands?			

14.	Are provisions made to prevent machines from automatically starting when power is restored after a power failure or shutdown?			
15.	If machinery is cleaned with compressed air, is air pressure controlled and personal protective equipment or other safeguards used to protect operators and other workers from eye and body injury?			
16.	Is Lockout / Tagout procedures followed for maintenance and repair?			
17.	Are starting and stopping devices clearly marked and within reach of the operator?			
18.	If there is more than one operator, are separate controls provided?			
19.	Is Emergency lighting operable?			
20.	Are Machine vibrations controlled?			
21.	Are tools, instruments and machinery shaped, positioned and handled so that tasks can be performed comfortably?			
22.	Are protective goggles or face shields provided and worn where there is any danger of flying particles or corrosive materials?			
23.	Are protective gloves, aprons, shields, or other means provided against cuts, corrosive liquids and chemicals?			
24.	Are hard hats provided and worn where the danger of falling objects exists?			
25.	Is appropriate foot protection provided where there is the risk of foot injuries from hot, corrosive, poisonous substances, falling objects, crushing or penetrating actions?			

Name & Designation of Assessor: _____

چیک لسٹ (خطرہ تشخیص) برائے کیمیکلز

نام فیکٹری

تاریخ

نمبر شمار	سوال	ہاں	نہیں	عملی اقدامات
1.	کیا کیمیکلز کے بہاؤ اور ناگہانی اخراج کی صورت میں انہیں بحفاظت تلف کرنے کا انتظام موجود ہے؟			
2.	کیا کیمیکلز سے متعلق ہدایات پر مبنی چارٹ جائے کار پر آویزاں ہیں اور ورکروں کی رہنمائی کیلئے موجود ہیں؟			
3.	کیا ورکرز کیمیکلز کے استعمال دیکھ بھال اور بحفاظت ذخیرہ سے متعلق تربیت یافتہ ہیں؟			
4.	کیا ورکرز خطرناک کیمیکلز کے استعمال، دیکھ بھال وغیرہ سے متعلق پوشیدہ خطرات سے واقفیت رکھتے ہیں؟			
5.	کیا کیمیکلز کو ذخیرہ کرنے والے ڈرم پر لیبل چسپاں تھا جو ان کے متعلق تمام معلومات مہیا کرتا ہو؟			
6.	کیا تمام ورکرز خطرناک کیمیکلز کو استعمال کرتے ہوئے ذاتی حفاظت کے آلات استعمال کر رہے ہیں؟			
7.	استعمال نہ ہونے کی صورت میں کیا خطرناک کیمیکلز بند ڈرموں میں محفوظ طریقہ سے رکھے گئے ہیں؟			
8.	کیا کیمیکلز کی ترسیل کیلئے استعمال ہونے والی پائپ لائنوں کو مناسب طریقے سے ہدایات سے آویزاں کیا گیا ہے؟			
9.	کیا کام کرنے کا مناسب طریقہ کار (SOP) موجود تھا اور کیمیکلز بہہ جانے کی صورت میں کوئی طریقہ کار وضع کیا گیا ہے؟			
10.	کیا ایمر جنسی کی صورت میں آلات تنفس وافر مقدار میں موجود ہیں؟			
11.	کیا آلات تنفس کے استعمال سے متعلق کوئی تحریری دستاویز اور طریقہ کار موجود ہے؟			
12.	کیا ورکرز کو خطرناک کیمیکلز کے استعمال اور موجودگی والی جگہ پر کھانے سے منع کیا گیا ہے؟			

نام آفیسر بمحہ عہدہ

چیک لسٹ (خطرہ تشخیص) برائے (بائیولوجیکل)

نام فیکٹری _____ تاریخ _____

نمبر شمار	سوال	ہاں	نہیں	عملی اقدامات
1.	کیا جائے کار پر پھپھوندی اور فگس کے اطلاق کے حالات موجود ہیں؟			
2.	کیا کام کی جگہ پر خون اور دیگر جسمانی رطوبتیں (بلغم، پسینہ، پیشاب وغیرہ) موجود ہے؟			
3.	کیا تمام کارکنوں کو حفظان صحت کا کارڈ مہیا کیا گیا ہے؟			
4.	کیا ملازمین کو حفاظتی ٹیکے لگائے جاتے ہیں؟			
5.	کیا جائے کار پر صاف اور گندے پانی کی نکاسی کا باقاعدہ نظام ہے؟			
6.	کیا ہوا میں موجود جراثیم جائے کار پر کارکنوں کے انفیکشن کا باعث بنتے ہیں؟			
7.	کیا کاٹنے والے زہریلے حشرات جائے کار پر موجود ہیں؟			
8.	کیا کیڑے مار ادویات کا باقاعدگی سے استعمال کیا جا رہا ہے؟			
9.	کیا جائے کار پر خطرناک اور زہریلے نباتات موجود ہیں؟			
10.	کیا جائے کار پر جانوروں یا پرندوں کے باقیات یا بیٹ (droppings) موجود ہے؟			
11.	کیا جائے کار پر وبائی بیماری کے پھیلاؤ کے حالات موجود ہیں؟			

نام آفیسر بمعہ عہدہ _____

چیک لسٹ (خطرہ تشخیص) برائے مشین سیفی

نام فیکٹری

تاریخ

نمبر شمار	سوال	ہاں	نہیں	عملی اقدامات
1.	کیا ملازمین کو مشین پر کام کے لیے محفوظ طریقوں سے آگاہی کیلئے کوئی تربیتی پروگرام بنایا گیا ہے؟			
2.	کیا ملازمین کو مشین چلانے کے محفوظ طریقہ کار پہ یقینی عمل پیرا ہونے کیلئے مناسب نگرانی مہیا کی گئی ہے؟			
3.	کیا مشینری اور آلات کے حفاظتی معائنہ کا باقاعدہ پروگرام بنایا گیا ہے؟			
4.	کیا تمام مشینری اور آلات صاف اور مناسب طریقے سے برقرار ہیں؟			
5.	کیا مشینوں کو چلانے و مرمت کے لیے سامان کو رکھنے اور کچرے کو ٹھکانے لگانے کیلئے مشینوں کے گرد اور ان کے درمیان مناسب فاصلہ ہے؟			
6.	کیا سامان اور مشینری کو محفوظ طریقہ سے اور اچھی طرح نصب کیا گیا ہے تاکہ گرنے یا دیگر نقل و حرکت کی صورت میں ملازمین کو چوٹ سے بچایا جاسکے؟			
7.	کیا ہر مشین پہ پاور شٹ آف سوئچ آپریٹر کی پہنچ میں ہے؟			
8.	کیا تمام پلیاں اور بیلٹ جو کہ سطح زمین سے سات فٹ کی بلندی تک ہیں، ان پر مناسب حفاظتی حصار لگائے گئے ہیں؟			
9.	کیا تمام متحرک زنجیریں، گراریاں، بیلٹ، فلائی ویل، پلیاں، شافٹیں، سپنڈل پر مناسب حفاظتی حصار لگائے گئے ہیں؟			
10.	ایسی مشینیں جن میں کولنٹ کا استعمال ہے کیا ان پہ اسپلش گارڈ (حفاظتی شیلڈ) نصب ہے؟			

11.	کیا مشین ایریا میں آپریٹر اور دیگر ملازمین کو کام کے دوران پیدا ہونے والے خطرات، نپ پوائنٹس، گھومنے والے پرزے، اڑتے ذرات اور چنگاریوں سے بچاؤ کیلئے طریقے کار مہیا کئے گئے ہیں؟		
12.	کیا مشین گارڈ (حفاظتی حصار) محفوظ اور بہتر طریقے سے لگائے گئے ہیں؟		
13.	اگر مواد رکھنے اور ہٹانے کیلئے خصوصی دستی اوزار استعمال کئے جاتے ہیں تو کیا وہ آپریٹر کیلئے محفوظ ہیں؟		
14.	کیا بجلی کے اچانک بند ہونے یا شٹ ڈاؤن کے بعد بجلی بحال ہونے پر مشینوں کو خود کاری سے روکنے کیلئے بند و بست ہے؟		
15.	اگر مشینری کو کپریٹڈ ہوا سے صاف کیا جاتا ہے تو کیا کارکن اور اس کے ساتھیوں کو آنکھوں اور جسمانی چوٹ سے بچانے کے لئے خود حفاظتی آلات یا دیگر حفاظتی حصار استعمال کئے جاتے ہیں؟		
16.	کیا مشین کی سروس و مرمت کیلئے لاک آؤٹ / ٹیگ آؤٹ طریقہ کار کی پیروی کی جاتی ہے؟		
17.	کیا مشین کو چلانے و بند کرنے کے بٹن واضح طور پر نشان زدہ ہیں اور کارکن کی رسائی میں ہیں؟		
18.	اگر ایک سے زیادہ آپریٹر موجود ہیں تو کیا ان کو علیحدہ علیحدہ کنٹرول مہیا کئے گئے ہیں؟		
19.	کیا ایمر جنسی لائٹنگ لائق عمل ہے؟		
20.	کیا مشین کی تھر تھراہٹ قابو میں ہے؟		
21.	کیا اوزار، آلات اور مشینری کو اس طرح سے بنایا، رکھایا استعمال کیا گیا ہے کہ کام کو آرام دہ طریقے سے سرانجام دیا جاسکے؟		



**Under ADP Scheme “Capacity Building of Occupational Safety and Health (OSH)
Regime to Promote Safer Working Conditions at Workplaces”**

Centre for the Improvement of Working Conditions & Environment

Directorate General Labour Welfare Punjab

Labour & Human Resource Department Government of the Punjab

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