

# GAP ANALYSIS FOR SAFETY IMPROVEMENTS IN CHEMICAL HANDLING

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**Abstract** - The objective of this project is to identify the safety improvements need to be done for the chemical handling in watch manufacturing industry. There are 210 active chemicals used widely inside this plant for various process of manufacturing some chemical having properties like highly flammable and toxic in nature. Chemical handling in various stages like Unloading / Loading, Storing, Transporting, Usage and Disposal having its own significant risks. Through this project comparison between the current Methods and Practices with the standard and best industrial practices. In this project GAP analysis method was used as a tool for identify the safety improvements in chemical handling process. By using GAP analysis method one workbook was created and the chemical handling activities followed in sequence of the process. The current methods and practices were noted down and the suitable standards and best industrial practices was recognized for all individual chemical handling activity. By using the GAP analysis workbook, the comparison was done and the recommendation given in the hierarchy of Elimination, Substitution, Engineering Control, Administrative Control, and PPE.

**Key Words:** GAP analysis, chemical handling,

## 1. INTRODUCTION

In this watches division mainly focus on producing wrist watches and wearables. Watch Manufacturing process involves with few toxic and flammable chemicals it having some significant risks during chemical handling it may cause harmful to the workers. This project mainly focused on the safety improvements need to be done for reducing the risk for the workers. GAP analysis is a suitable tool for identifying safety improvement and best practices by comparing the current method and practices with the standard and best industrial practices. The main areas focused was given bellow

1. Receiving and storing Chemicals in the storage area,
2. Transporting chemicals from storage area to work area,
3. Storing chemicals in the work place,
4. Usage of chemicals for the process,
5. Disposal of used chemicals and its wastes.

## 2. LITRATURE REVIEW

[1] Legislation associated with chemical management in India were studied. In this paper author listed the all legislation associated with the chemical management process like

1. Import, 2. Export, 3. Production, 4. Storage, 5. Transportation, 6. Recycling, 7. Use, and
8. Disposal. By using this list, the process wise the legislation was listed. Using the list, I choose the legislation which all are applicable for the process of chemical handing.

[2] Tamilnadu factories rule 1950 SCHEDULE-XVI

Part - II General Requirements,

Part - III Fire and explosion risk

Part - IV Risk of Toxic substances were studied. General requirements need to be fulfilled for carryout chemical works to avoid the chemical related risks.

[3] GAP analysis study on HSE management system were studied. In this paper Author discussed the way to evaluate the effectiveness of the implementation on the existing HSE management system and find the gaps with respect to recommendations of OSHA standards and best international practices in HSE management system. From the analysis the deviation and good engineering practices was given the hierarchy of Elimination, Substitution, Engineering control, Administrative Control and PPE the same method was taken into account and the recommendation was given in the same hierarchy control.

[4] GAP analysis method and its methodology were studied. In this journal author discussed how to proceed the GAP analysis method for the improvement of management system for his organization. It is having the procedure to create the workbook for the GAP analysis by using that procedure I am created a workbook for the safety management system to analysis the gap between the ideal and current state.

[5] The Hazardous chemical transportation on road was studied. In this paper author discussed about not only the hazardous chemical transportation on load and also the loading and unloading of hazardous chemical in the vehicle and its risks in it and the precautions to be taken to reduce the danger interventions.

[6] Manufacture, Storage and Import of Hazardous chemical rule 1989 was studied. The study about the chemical based on the toxic chemical, flammable chemical, Explosives, list of toxic chemicals and the specification about the flammable range of chemical, Requirements for chemical storage, Import of hazardous chemical.

[7] Hazardous waste management Rule 2016 was having the detailed description about the responsibility of the occupier for the management of hazardous and other wastes. The details about the hazardous and other wastes created due to various chemical usage.

[8] Technical EIA guidance manual for isolated storages handling Hazardous chemicals were studies. In this book containing the detailed information about the impacts of handling hazardous chemicals, preventive measures were discussed.

[9] Hazardous waste management in present scenario was studied in this paper author discussed about the Hazardous waste management in India was discussed and the present scenario and the practical difficulties in waste disposal was discussed.

[10] Policy, Legal and other statutory framework on industrial safety and health was studied. In this paper Author discussed about the Policy requirements, Legal compliances and other Statutory Frameworks on industrial safety and health was discussed. It having the legal and other requirements list and its description was given.

### 3. METHODOLOGY

#### 3.1 GAP ANALYSIS

A way to compare current condition and practices in order to identify gaps and areas in need of improvement with regards to compliance to the relevant standards and good engineering practices among the industries. GAP analysis is a formal way to identify the current gaps between desired levels and actual levels of performance it can be apply for all kind of industries and organization to analysis from certain process to whole system performance.

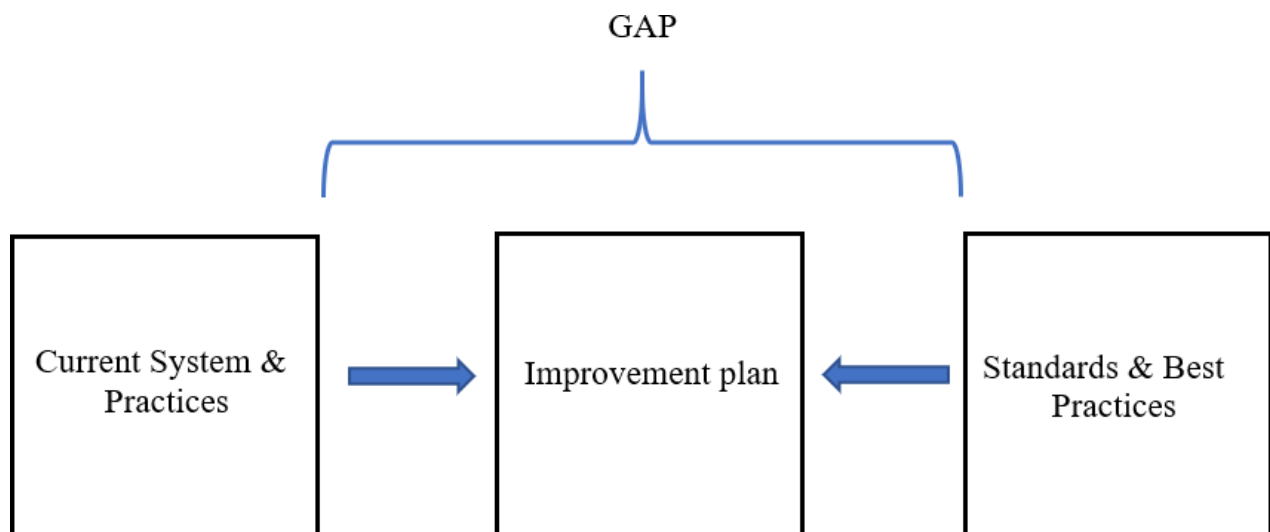


Figure 2.1 GAP analysis terminologies

GAP analysis was the most suitable method for this project execution to compare the current system and procedure with the standard system and Industrial best practices. The gap represents the safety performance improvements we need to focus on to improve the safety by reducing the risks.

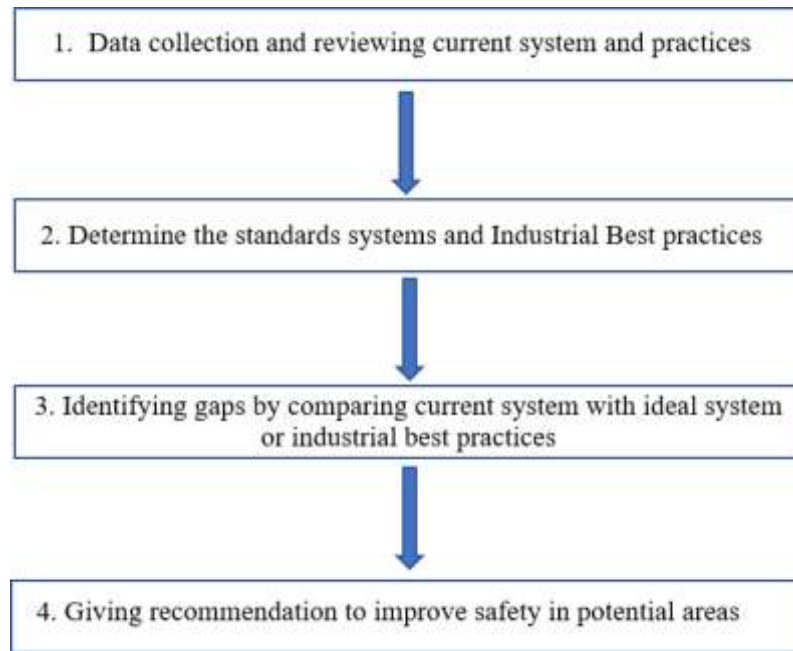


Figure 2.2 GAP analysis methodology

**2.2.1 Data collection and Reviewing current system and practices**

Data collection phase the chemical usage list and its MSDS, Applicable legislations, current practices, existing safety devices and PPE’s details were collected. Then the chemical handling process like receiving chemicals from the truck and kept in its dedicated storage area, transporting chemicals from storage area to workplace, storing materials in the Workplace, Usage of chemicals, disposal of used chemicals and its wastes were followed in the sequence of process and the current methods and procedures was noted.

**2.2.2 Determine the standards systems and Industrial Best practices**

By using the Legal requirements, MSDS and international best practices for chemical handling details was collected to find the ideal state can be determined.

**2.2.3 Identifying gaps by comparing current system with ideal system or industrial best practices**

From the workbook the comparison was done to the current state with the ideal state to identify the gaps we need to be fulfilled. The comparison was between the current practices, existing safety devices and PPE’s with the standard ideal state and Industrial best practices in chemical handling.

**2.2.4 Giving Recommendation to improve safety in potential areas**

Recommendation for the gap fulfilment was done by hierarchy of Elimination, Substitution, Engineering Control, Administrative control, and PPE.

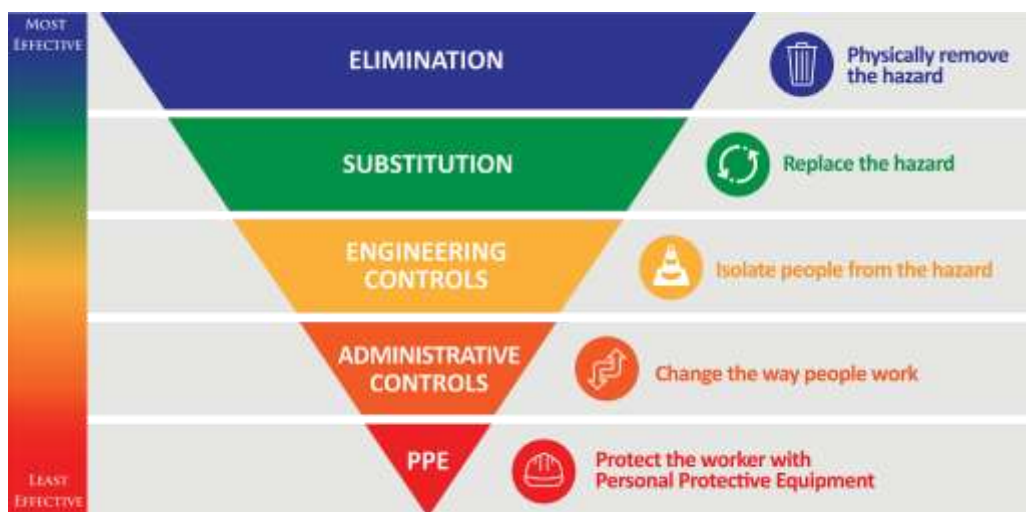






















Figure no: 2.3 Hierarchy of Control








**4. RESULT AND DISCUSSION**

By using GAP Analysis method each and every activity which is involved in the chemical handling process was covered for the Effluent treatment plant and Sewage treatment plant. The Safety gap was identified by comparing the recommended standard with our current practices. Workbook used for the GAP analysis was given below.

GAP ASSESSMENT FOR CHEMICAL HANDLING		Doc No. :	Rev :	
LOGO	DEPARTMENT	Date :	PAGE 1 OF 1	
	SAFETY		REFERENCE	
Department: Engineering Device		Location :Effluent Treatment Plant, Sewage treatment plant		
TRANSPORTING				
Sl.No	Work description	Current Practices	Safety GAP	Recommendation
1	Unloading 200 litter chemical barrels from the Vehicle	For small Vehicle tyre was used and for big Vehicles Forklift was used to unload the chemical barrels. 	No equipment's or methods Available for unloading the chemical barrels from truck to storage area	Due to unavailability of space dedicated drum handling equipment's can be used for unloading the chemical barrels from the truck 1. Drum handler and tilter 2. Drum Lifter using Forklift 
2	Transporting chemical barrels from store to remote storage areas using Pallet Trucks	Pallet trucks were used to transport the chemicals from storage area to STP or ETP 	During transportation there may be a chance of barrel fall due to uneven surface of the roads due to unavailability of locking mechanism.	1. Locking Mechanism can be provided for the pallet trucks. 2. Drum handling equipment's can be used for transporting the chemical barrels. 
3	Transporting 50 litter chemical cans from Store to Chemical storage area	Manual handling of 50 litter chemical cans for transporting or storing chemicals in storage area 	1. During transportation of 50 litter chemical cans workers feel discomfort and backpain. 2. Corrosive chemicals like HCl container with a capacity of 11.5 liters (2- 1/2 gallons) or more of a corrosive substance shall be placed in receptacle or crate and then carried by more than one person at a height below the waist line unless a suitable rubber wheeled truck is used for the purpose	1. Two workers can be utilized for transporting the chemical cans 2. Ergonomic trolleys can be used for transportation 
4	Transporting of Sludge waste	Forklift were used for the transporting the hazardous chemical wastes. 	Due to unavailability of locking mechanism the hazardous chemical barrels may fall anytime.	Drum handling equipment's can be used for Transporting the hazardous waste barrels 1. Drum handler and tilter 2. Drum Lifter using Forklift 

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	SAFETY			CLASSIFICATION	REFERENCE
Department: Engineering Device				Location :Effluent Treatment Plant, Sewage treatment plant	
STORING					
Sl.No	Work description	Current Practices	Safety GAP	Recommendation	
1	Storing of 200 litter Chemical barrels in storage area	Manual handling of 200 litter chemical barrels for transporting or storing chemicals in storage area 	Difficult to grasp, Load is too Heavy, Load is too large so manual handling can lead to damage of Barrels or Ergonomic problems	Dedicated Ergonomics trolleys can be used for storing the chemical barrels on the pallets. It can reduce the Ergonomic issues and barrel damage.	
2	Chemical storage area	Ordinary Florescent lamp fitting provided in the chemical storage area 	POLYELECTROLYTE - MAGNOFLOC 10, CITRIC ACID-COMMERCIAL 25 KG PACK, Mono ethylene glycol chemicals were having flammable in nature if we store under normal electrical fitting during any electrical accident it will combust the chemical	Flameproof fitting shall be used for the chemical storage area	
3	Handling of chemicals	MSDS not displayed in the chemical storage area	MSDS shall be displayed in such a way to access it freely.	MSDS shall be displayed in the chemical storage area during emergency it will help to take emergency actions against accidental contact, spill, leakage or fire fighting.	
4	Storage of Calcium hydroxide chemical	Calcium hydroxide stored in a secondary containment but not stored in a air tight container. 	Calcium Hydroxide we have to store in a air tight container tightly closed. Store in a cool, dry, well-ventilated area. Because it was Air sensitive, Moisture sensitive chemical.	Calcium hydroxide should be stored in a closed container instead of open storage.	
5	Storage of hazardous wastes	Hazardous wastes were stored in the Shed.	Hazardous wastes shall be stored in the weather proof and well ventilated area. Hazardous wastes near the shed was mixing and over fill during heavy rainy conditions.	Weather proof sheds shall be provide to Avoid contact with the rainwater	

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Department: Engineering Device				Location :Effluent Treatment Plant, Sewage treatment plant	
STORING					
Sl.No	Work description	Current Practices	Safety GAP	Recommendation	
6	Storage of chemicals	-	Fire detectors not available in the chemical storage area	Suitable alarm and effective alarm systems giving audible and visible indications, shall be installed at the chemical storage area.	
7	Storage of chemicals	There is no restrictions for the entry into the chemical storage area.	Access not restricted so all persons enter and using the chemical storage area for various purpose.	In the chemical storage area need to restrict only for authorised persons only.	
8	Storage of chemicals	chemicals were stored in the concrete floors	Corrosive chemicals shall be stored in the impervious floors to avoid environmental protection	Floors shall be altered near the corrosive chemical like HCL etc..	
9	Storing of chemicals inside the Storage area	Chemicals were stored near the Electrical panel	POLYELECTROLYTE - MAGNOFLOC 10, CITRIC ACID - COMMERCIAL 25 KG PACK, Mono ethylene glycol chemicals were having flammable in nature if we store under normal electrical fitting during any electrical accident it will combust thechemical	Need to provide at least 1 meter gap for all electrical sources	

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Department: Engineering Device				Location :Effluent Treatment Plant, Sewage treatment plant	
HANDLING AND STORAGE					
Sl.No	Work description	Current Practices	Safety GAP	Recommendation	
1	Siphoning of Concentrated HCL from 50 litter container to small container for process usage	Manual handling was done for handling the chemicals from 50 litter container to small container 	Corrosive substances shall not be handled by bare hands but shall be handled by means of a suitable scoop or other device 	Dedicative chemical handling equipment can be provided for safe handling of chemical.	
2	Handling of chemicals	Workers using plastic box to handling the calcium hydroxide chemical 	1. Not using proper tool for handling the chemical 2. Improper house keeping in the storage area (due to handling of chemicals in the Plastic box there was an chemical spill happened it was not cleaned properly it may lead to an accident because if the calcium hydroxide was moisture sensitive if it is mixed with the water it will create a slippery floor in the storage area.	1. need to use proper tool for handling the chemical 2. Good house keeping practice among the workers	
3	Handling of chemicals	Workers using the used empty chemical container for handling the chemicals	No chemicals or solvents or empty containers containing chemicals or solvents shall be permitted to be used by workers for any purposes other than in the processes for which they are supplied.	Empty container properly labelled and disposed it must not used for the other works	
4	HCL handling for the process of ETP & STP	During HCL chemical handling workers were using the dust mask	During HCL chemical handling workers not using the canister mask instead they are using dust masks it will not protect the HCL fume	Canister mask shall be used during handling of HCL chemical	

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Department: Engineering Device				Location :Effluent Treatment Plant, Sewage treatment plant	
HANDLING AND STORAGE					
Sl.No	Work description	Current Practices	Safety GAP	Recommendation	
5	Unloading hazardous chemical barrels from forklift to Hazardous waster container	Workers manually pull down the 200 kg barrels from forklift by standing on the hazardous waste container with bare hands 	Difficult to grasp, Load is too Heavy, Load is too large so manual handling can lead to damage of Barrels or Ergonomic problems	Dedicated drum handling equipment's can be used for transporting the Hazardous waste barrels Drum handler and tilter 	
6	Access for eye and body wash shower	Due to construction work near the chemical storage area the access for the eye and body wash tower was restricted	No access found for emergency Eye wash and Body wash shower	Temporary arrangement need to provided for eye and body wash shower or access need to be clear to ensure free access	
7	Unloading of chemicals from Chemical barrel to safety cans	Hand pump is used for unloading chemical from 200 litter barrel to safety cans	While using handpump it will produce static electricity on the pumping process it may lead to fire accident. Pegasol 1425 is comes under category of highly flammable.	Grounding shall be provided for the Safety cans and the total system or using antistatic handpumps can be used for pumping the chemical. 	

**5. CONCLUSION**

In this watch manufacturing industry involves with the 210 active chemicals all chemical having its own potential hazards so chemical handling was one of the major activities. By using GAP analysis method sewage treatment plant and Effluent treatment plant area of the watch manufacturing industry all activities were covered witch all are involved in the chemical handling process. In the process of chemical handling having some safety gaps it may lead to hazardous situations for the workers by reducing the gap and increasing the safety in the workplace was the overall objective of this project. From the collected data's the gap was identified by comparing the current state with the ideal state. As per the hierarchy of control Safety gaps, hazards, unsafe act and conditions were recommended with the engineering solutions or the industrial best practices among the globe.



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