

CHEMICAL SAFETY ANALYSIS IN WATCH CASE PLANT MANUFACTURING INDUSTRY

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Abstract:

The goal of the projects is to analyze the chemical usage in various department and divisions in watch manufacturing industry. In watch manufacturing industry there are numerous numbers of chemicals has been used inside the premises comprises of various department and divisions along with it. There are 303 major chemicals has been used inside the premises. Every chemical used inside the industry has a toxicity and fire risk potential effects to the workers who handled and used the chemical in daily basics. Among the departments, case plant has a major contribution of chemical handling in watch manufacturing industry. About 53 percentage of chemical handling and usage has been done in case plant. To find out the chemical toxicity and fire risk, the recommended analysis has been carried out to find out the vulnerable chemical has been used inside the industry. Fire and explosion index and fire risk assessment has occupied a vital role throughout the analysis and help to identify the vulnerable chemicals. Through the analysis, we obtain the results of what are the safety gaps (or) deviations present inside the industry and recommend the solution based on it. This paper also provides a recommendation for the fire risk assessment of chemicals and ensure to establish and can manage fire safety and toxic safety effectively.

Keywords:

Toxicology, Fire risk, Chemical safety, and Potential risk

INTRODUCTION

In watch and manufacturing industry, watch and wearable division mainly focus on the manufacturing of watches and other accessories. Through the manufacturing process it involves with toxic, flammable and potential risk chemicals, it is having some significant risks during chemical usage and handling. In the watch and wearable division there are number of chemicals for the process usage. The project focused primarily on improving the safety that needs to be done to mitigate the risk to workers when dealing with and using chemicals in the watch and wearable sector. Case plant is one the department used for manufacturing watch outer case plant and it has 7 divisions that has various process in different aspects.

The mainly focused category of chemical point is

- Toxicity
- Fire risk

METHODOLOGY

The most widely used analytical and relative ranking hazard indexes are Dow's Fire Explosion Index (R & EI) and Mondo's Toxicity Index (TI), collectively referred to as the Fire Explosion and Toxicity Index (FETI) In this paper FETI analysis occupies major section to find the vulnerable chemical for workers. Apart from that, front line analysis has been used to classify the chemical based on the properties

Steps to Conduct the Methodology:

The major steps used for the process:

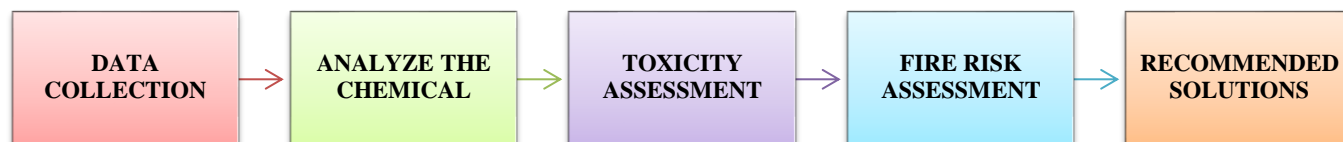


Fig. 1: Steps of methodology

The data collection of the chemical has taken as per the procurement data from the industry and quantity of chemical has also noted down from the procurement data collection. The chemicals analyze has taken by step by step as per the front analysis methods. The analysis process categories are considering throughout the analysis process.

The parameters are:

- ❖ Physical state
- ❖ Chemical properties
- ❖ According to NFPA rating
- ❖ Fire and explosion index
- ❖ Fire and toxicity index

Toxicity Assessment:

The purpose of this analysis is to realistically quantify the potential damage from potential fire and explosion events. To identify equipment that may contribute to the creation or escalation of an incident. Communicate potential fires and explosions to design teams and plant personnel. The considered category for performing the analysis is

- General process hazard
- Special process hazard

In general process hazard:

- ❖ Exothermic chemical reaction
- ❖ Endothermic processes
- ❖ Materials handling and transfer
- ❖ Access of emergency equipment
- ❖ Drainage and spill control

In special process hazard

Special process hazards are factors that show that experience contributes to the potential for damaging events. Toxic materials

- ❖ Sub-atmospheric pressure
- ❖ Operation in or near flammable range
- ❖ Dust explosion
- ❖ Leakage

Fire & Explosion Index: $(F \& EI) = MF \times (GPH) (SPH)$

Toxicity Index: $Th + Ts (1+GPH+SPH)$

Where, MF = Material Factor

SPH = Special Process Hazard

GPH = General Process Hazard

Th = Toxicity factor based on the NFPA hazard index (0 – 4)

Ts = Correction factor (additional penalty) for toxicity based on Maximum Allowable Concentration (MAC) value in ppm.

DATA ANALYSIS :

Analysis can be based on various perspectives such as properties, chemical groups, physical conditions, and by NFPA assessment

As Per Physical State:

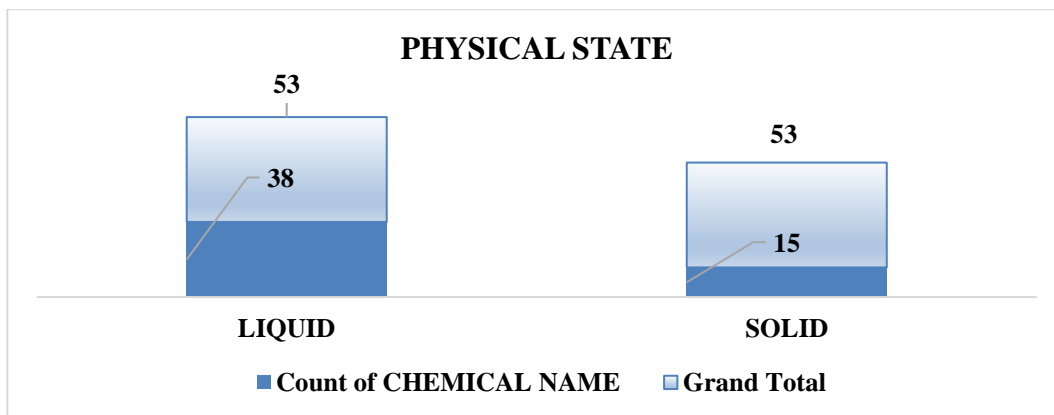


Fig 2: Physical State

As Per Chemical Properties:

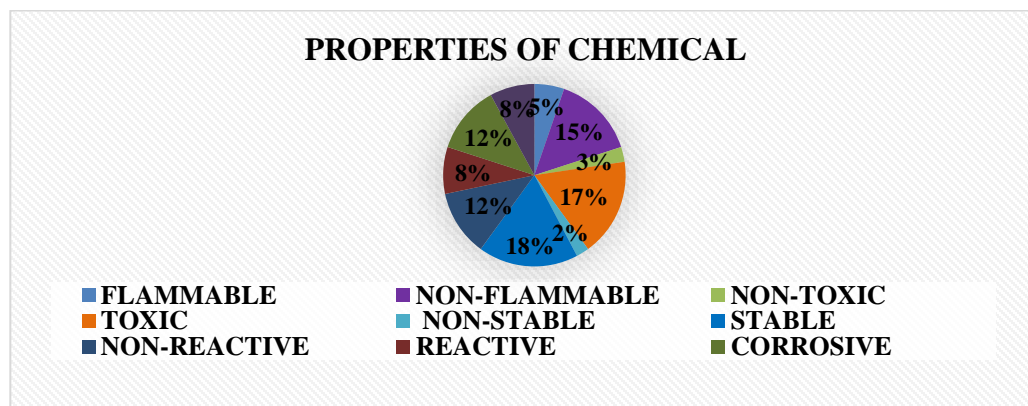


Fig 2: Properties of chemical

PROPERTIES OF CHEMICAL	NUMBER OF CHEMICAL
Flammable	14
Non-flammable	39
Non-toxic	7
Toxic	46
Non-stable	6
Stable	47
Non-reactive	31
Reactive	22
Corrosive	32
Non-corrosive	21

Table 1 : Properties vs Number of chemicals

As Per NFPA Rating

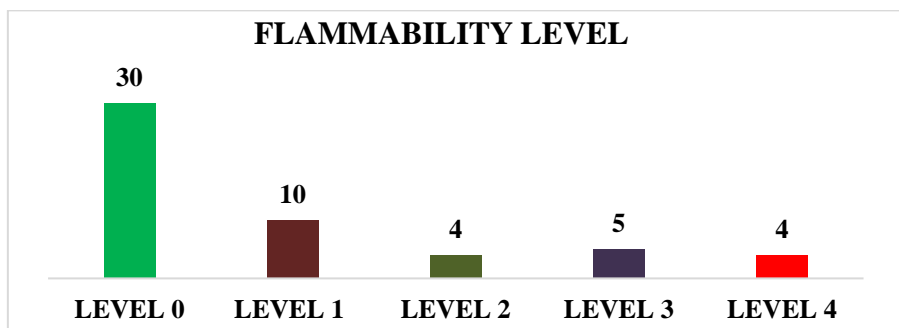


Fig 3: Flammability

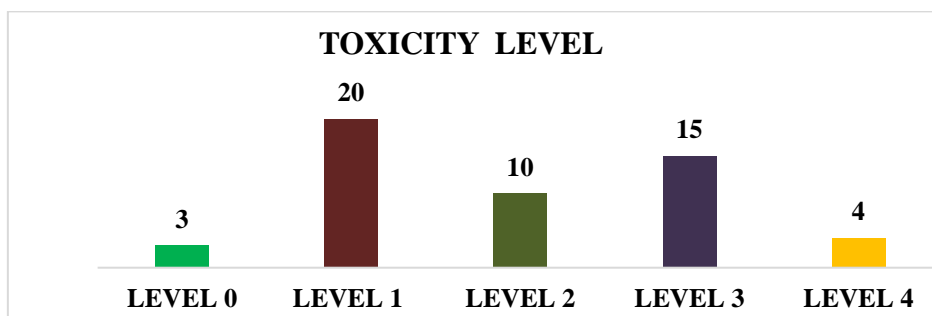


Fig 4 : Toxicity

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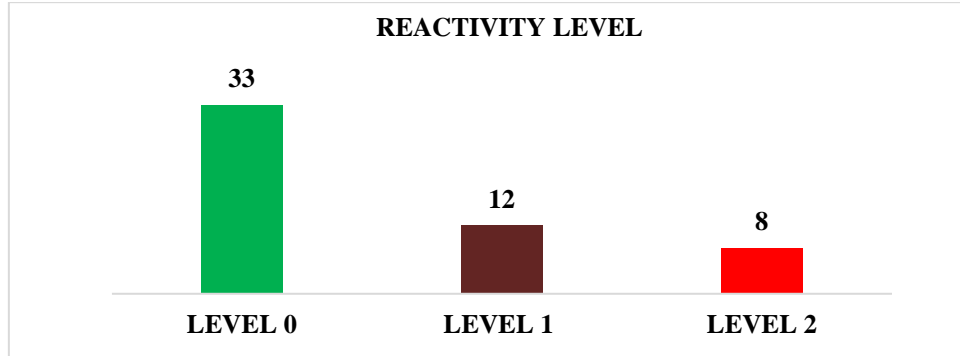


Fig 4 : Reactivity

F&EI	General process hazard (f1)	Special process hazard(f2)	Material factor	Degree of hazard
Trowel W32 Detergent	0.45	2.1	21	Heavy
Nickel Additive – 22	2.35	2.7	21	Heavy
Ethyl Methyl Ketone	3.40	2.7	16	Heavy

Table 2: Potential chemicals from fire and explosion index

FIRE RISK ASSESSMENT:

- ❖ This Risk Assessment has been developed in accordance with the four steps procedure which is generally and basically applicable to effectively access and manage risk
- ❖ The objective of this Risk Assessment is to ensure that all identified hazards associated in BBC and Subcontractor’s activities and workplace will be assessed and managed accordingly

The steps which considering effective for the fire risk assessment



Fig 5 : Methods of fire risk assessment

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Risk Assessment Guideline :

LIKELIHOOD		SEVERITY					
		Insignificant	Minor	Moderate	Serious	Major	Catastrophic
1	1	1	2	3	4	5	6
	2	2	4	6	8	10	12
	3	3	6	9	12	15	18
	4	4	8	12	16	20	24
	5	5	10	15	20	25	30
	6	6	12	18	24	30	36
24 - 36	Extreme	Immediate action required, Activity should not to proceed in current form					
	High	Prompt action required, including interim actions. Activity should be modified to include remedial action and planning.					
	Medium	Schedule action including any interim countermeasures e.g., implement safe work procedures, signage, instructions					
	Low	Activity can operate subject to management and or modification,					
	Very Low/ Negligible	Risk almost certainly acceptable, no action required unless escalation of risk is possible					

Table 3: Severity vs Consequences

Hazard	Hazard Category	Consequence	Risk Level			Risk Control Measures
			PR	S	E/H/M/L/N	
Fire due to Hot Works	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	3	5	H	<ul style="list-style-type: none"> Competent operatives to be appointed for all hot work operations. Hot work permit must be obtained prior to start any hot work operations in the site. All precautions mentioned in the permit and any extra precautions required also to be taken to carry out hot work. Supervisor must monitor the hot work operation continuously. Fire watch as recommended in the PTW to be carried out after completing the hot work. (Time to be extended according to the Risk involved in the area.) All hot work equipment must be disconnected prior to leave the area. Dry powder extinguisher with bucket full of water should be kept nearby hot work area

Fire due to electricity	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	3	5	H	<ul style="list-style-type: none"> • Competent supervisor and operatives to be appointed to carry out electrical installation, maintenance and repair on site. • All electrical installation and wiring should be complying with Local Authorities standard. • Do not use damaged electrical equipment, cables and accessories. • Proper grounding of all electrical equipment and tools. • All electrical installations and equipment must be inspected prior to use and periodically. • All live electrical cables to be protected to avoid damages. • Dry powder & CO2 extinguishers with sign board should be kept nearby Electrical Generators, DB, Offices etc.
Fires caused by combustibles and improper storage of combustibles.	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	3	5	H	<ul style="list-style-type: none"> • Designated storage area to be provided for flammable and combustible materials. • All hazardous (Flammable) items to be stored & handled as per MSDS. • Do not store flammable items at work place, to be return to store after work. • Proper training as per MSDS to be given to all those who are working with flammable items. • Ensure flammable storage areas are equipped with adequate fire protection systems. Dry powder & CO2 extinguishers with sign board should be kept nearby chemical / flammable/ material storage area
Fire due to Smoking	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	3	5	H	<ul style="list-style-type: none"> • Include non-smoking Policy in Induction training, Tool Box / Safety Awareness Talk. • Designated smoking areas only to be used for smoking. • Do not bring the smoking material inside the site / work area.

Fire due to Poor Housekeeping	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	3	5	H	<ul style="list-style-type: none"> All combustible wastes to be removed on a daily basis. Empty chemical containers to be disposed as per MSDS. Dip trays to be provided to all stationary plants and equipment to contain fuel or oil spillages and the tray must be cleaned daily. Fire extinguishers to be kept within 30meter radius, with sign boards and methods of how to use extinguishers
Fire due to Lightning.	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	2	5	M	<ul style="list-style-type: none"> Sufficient Lightning arrestors to be installed as per standard. Standard electrical wiring system with proper earthing. ELCB, RCD, MCB etc. to be installed in the electrical circuits. All electrical circuits to be deactivated while in thunder storm / lightning.
Lack of Fire Detection, Fire warning and Fire Fighting Equipment.	People and assets	Suffocation, Burn, Serious Injury, Fatality, Property Damage.	3	5	H	<ul style="list-style-type: none"> Sufficient Fire Fighting equipment (Extinguisher, hose reels, water buckets etc.) to be provided in all areas according to the risk. Fire detection and extinguishing systems to be installed in the offices. Fire sprinkler system to be activated in the Basement storage areas. Do not misplace the Fire Fighting Equipment from Fire Points.

Table 4 : Fire Risk Assessment**CONCLUSION:**

In watch manufacturing industry, there are 303 chemicals has been used inside the premises and 53 chemicals are used inside the target department (case plant). The amount of toxicity and fire risk has been high from starting stage before carried out the risk assessment. Both fire and toxicity risk had been carried out by the procurement data gathered by the authorised personnel and toxic and fire risk in chemical has been high in the existing layout. The toxicity rate has decreased low by the chemical storage layout presented above described by the standard in various norms. The recommended solution has been prescribed in risk; assessment and in every stage the hierarchy of controls has been validated and implemented.

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