7.1. PUBLIC CONSULTATION

The proposed project site is situated in MIDC Industrial Area, P.O. Dhatav, Taluka: Roha. Hence, as per Environmental Impact Assessment (EIA) Notification No.S.O.1533 (E)" dated 14th September 2006; and amendment there at the proposed project does not requires conducting of public hearing. The EIA report has been complied by incorporating required information with regards to the project as mentioned in the Terms of Reference (TORs) issued by EAC to **M/s. Arjun Food Colorants Mfg. Pvt. Ltd.**, **(AFCMPL)** 22/1-B, MIDC Industrial Area, P.O. Dhatav, Taluka: Roha, Dist.: Raigad during 32nd EAC meeting held on 21st December 2017.

7.2. RISK ASSESSMENT REPORT

The study of risk assessment report in respect of proposed project was done by **empanelled Functional Area Expert (FAE) Mr. Vinod Sahasrabuddhe**.

7.3. BRIEF DESCRIPTION REGARDING PROJECT

AFCMPL's management has planned to go for establishment of Food colours, Lake Colours and Sulphanilic Acid manufacturing unit. It involves number of equipments like reactors, condensers and distillation columns. The process involves solvents like Methanol, Ethanol, Acetic Acid, Ethyl Acetate and Piperidine. The process types are mainly of Bromination, Sulphonation Condensation and neutralization reactions.

7.4. OBJECTIVE OF THE RISK AND HAZARD ANALYSIS

1) Identify hazards and nature of hazard in the process, storage and handling of hazardous chemicals.
2) Carry out Qualitative risk analysis for the process and suggest mitigation measures.
3) Carry out Quantitative risk analysis of the storage of hazardous chemicals and estimate the threat zones for Most Credible and Worst case scenarios
4) Suggest mitigation measures to reduce the risk/probability of the accident to the minimum.
5) Incorporate these measures for ensuring safe operations and safe layout and for effective preparation of On-site and Off-site emergency plans
6) Suggest Guidelines for on-site and off - site emergency plan

7.5. METHODOLOGY

A] Identify hazards based on

- Manufacturing Processes
- Identify Hazardous Chemicals handled and stored.
- Inventory of Hazardous chemicals
- Proposed storage facilities for hazardous chemicals
- Plant layout
- Safety measures to be adopted by the company

B] Hazard Assessment

- By Qualitative Risk Assessment
- By Quantitative Risk Assessment by Hazard index calculations and estimate threat zones by using ALOHO.

C] Recommendations

- Recommend mitigation measures based upon the above
- Recommending guidelines for the preparation of On-site Emergency plan.

7.6. HAZARD IDENTIFICATION

7.6.1. Risk Prone Areas

Based on classification of chemicals the hazard prone areas have been identified as follows-

- Reaction and separation Sections of production unit
- Storage of chemicals in tanks or respective vessels
- Handling of the materials or the process equipment by the operator or worker.
- Transportation of the products and raw materials.

A) Qualitative Risk analysis

7.7. Reaction and Separation Sections of production unit

The reactions carried out in batch reactor, separation and recovery of solvents (used as reaction media), un-reacted component, neutralization, followed by separation and purification of the product. In the production plant, major hazards observed in the reaction section and separation sections. Major hazard in this section is of fire, explosion leading to toxic release. Fire, explosion and release of toxic gases of serious nature are result of accident particularly in reactors or distillation/solvent recovery units in the production plant. The accidents can occur due to wrong operation, failure of utilities and failure of safety systems installed.

- **Mitigation measure**

Minimum risk is of most importance and this can be achieved by selecting an intrinsically safe process and optimizing operating process parameters near to the atmospheric conditions. But this is not possible most of the time. Hence, it is necessary to install safe guards and build in perfect operating procedure that will minimize chances of accident to the minimum. Also types of reaction taking place during the process are of prime importance. It may be exothermic or endothermic.

HAZOP studies will be carried out for potentially dangerous and hazardous reactions in the manufacturing of products. The sulfonation and bromination are two dangerous or hazardous reactions will be carried out. All the recommendations of HAZOP study particularly for exothermic reactions will be strictly implemented in the plant.

- **Major Hazard in Reactions**

The major reactions like sulfonation and bromination will be carried out. These reactions are dangerous and hazardous. It is known that Sulfonation is highly exothermic reactions and even less exothermic reactions, like bromination can lead to the uncontrollable rise in temperatures and pressures in the reactors and ultimately to the conditions of run-away reaction, (mostly in highly exothermic reactions and which use solvents as reaction media or and flammable and explosive chemicals) and this results in catastrophic explosion and fire. The major reason for occurrence of uncontrollable rise in temperature is accumulation of un-reacted reactants.

- For controlling exothermic reactions and to eliminate the possibility of uncontrolled reaction following safety measures would be adopted-

1. Setting up a Standard Operating Procedure (SOP) for all critical operations, reactions and separations.
2. Once the SOP and operating parameters have been finalized, strictly following it, 24X7, particularly for batch operations without any change of procedure.
3. Must have in built system to check that the procedures (SOP) are not violated at any time, and no short cuts are taken in batch processes.
4. Have following alarm and interlock system (essential for highly exothermic reactions and alarms recommended for all exothermic reactions)
   - Utility failure alarm
   - Agitator failure alarm
   - High temperature alarm
   - Alarm for High rate of addition of limiting reactant which is added at controlled rate.
   - Raw material (limiting reactant) addition rate should be controlled by flow control loop. (FT, FIC, FCV). Controlling parameter being reactor temperature.
   - FCV and/or On-Off valve should be interlocked with the reaction mass temperature and agitator tripping.

- **Hazards causes from leakages of gases during manufacturing process**

Release of hazardous or toxic gases like HCL fumes from the reaction involving use of 37% HCl, Bromine and HBr fumes from bromination reactions and SO_3 fumes involving from storage of Oleum and sulfonation. The exposure to these gases can be harmful, in case of leakage, through flange joints to the workers in the plant and to the environment, if these are released into the atmosphere.

Table 7.1 TLV and IDLH values

Sr. No	Chemical	TLV	IDLH
1	Bromine	0.1-0.3ppm	3ppm
2	HBr	3ppm	30ppm
3	HCl	2 ppm Ceiling	50ppm
4	Sulphuric Acid	1 mg/m^3	15 mg/m^3
5	Oleum 23%	0.2 mg/m^3	15 mg/m^3

- **Mitigation measures to control the leakages of gases**

1. Installation of efficient scrubbers/absorbers and ensuring proper operation as per design conditions.
2. The appropriate PPEs and breathing devices should be readily available and all the operators and staff should be trained in use of these PPEs.
3. Emergency instructions, in local languages should be displayed prominently near the work place.
4. It is also recommended to install gas leak detectors for highly toxic gases at appropriate locations.

7.8. STORAGE AND HANDLING OF HAZARDOUS RAW MATERIALS

7.8.1. Hazard Identification:

This is another area of major concern for fire, explosion and exposure to and release of toxic liquids and gases and there is risk of persons, outside the factory limits getting affected.

The aim for RH analysis is

1. To identify the hazardous materials handled and stored at the plant site. Based on the hazardous properties, conditions of storage.
2. Quantify the hazards in case of major fire, explosion or toxic release by visualization of Maximum Credible Accident Scenarios.
3. Incorporate the results of QRA for safe layout of hazardous chemicals storage in tank farm as well as in the warehouse and factory layout, in addition to the requirements of statutory rules and regulations.
4. Suggest mitigation measures to reduce the risk/possibility of the accident to the minimum.
5. Incorporate all these measures to arrive at Safe Disaster Management Plan, On-site and Off-site Emergency preparedness plan, if there is any possibility of off-site emergency. For storage and handling of the potentially hazardous material also.

7.8.2. Storage of Hazardous Chemicals

The Following solvents will be stored:

Table 7.2 List of Flammable solvents Stored in Warehouse

Sr. No	Name of the Chemical	NF Value	Flammable Limit	Max. Qty Stored	Drums	Number of Drums
1	Methanol	3	LOWER: 6%	9000 liters	200 liter 45drums	45
2	Ethyl Acetate	3	LOWER: 2.2% UPPER: 9%	9600 liters	200 liter	48
3	Ethyl Alcohol	3	LOWER: 3.3% UPPER: 19%	10000 liters	200 liter	50
4	Piperidine	3	----	350 liters	50 liter	7

7.8.3. Main Hazards in Storage of Chemicals

The main hazards from the storage of flammable liquids are fire and explosion, involving either the liquid or the vapour given off from it. Fires or explosions are likely to occur when liquid or vapour is released and comes into contact with a suitable ignition source, or alternatively, when a heat or fire source comes into contact with the container.

- **Common causes or contributory factors of such incidents include:**

1. Lack of awareness of the properties of flammable liquids.
2. Operator error, due to lack of training.
3. Inadequate or poor storage facilities.
4. Hot work on or close to flammable liquid containers.
5. Inadequate design, installation or maintenance of equipment.
6. Decanting flammable liquids in unsuitable storage areas.
7. Exposure to heat from a nearby fire.
8. Dismantling or disposing of containers containing flammable liquids.

- **Combustion of liquids:** Combustion of liquids occurs when flammable vapours released from the surface of the liquid ignite.

The extent of a fire or explosion hazard depends on the amount of flammable vapour given off from a liquid which is determined by: A) temperature of the liquid. B) The volatility of the liquid. C) How long the liquid is exposed for; and the air movement over the surface.
Other physical properties of the liquid give additional information on how vapour/air mixtures may develop and also on the potential hazards. These physical properties include: flashpoint; auto-ignition temperature; viscosity; lower explosion limit; and upper explosion limit.

- **Effect of Flash Point:**

Generally, a liquid with a flashpoint below the ambient temperature of the surroundings will give off sufficient vapour to mix with the air and be ignited. The lower the flashpoint of a liquid, the higher the risk of fire.

7.8.4. Mitigation Measures:

1. **Maintenance and modifications:** Many incidents involving flammable liquids occur during maintenance and repairs. The likelihood is increased if the work is done by staff or outside contractors who have little knowledge of the hazards associated with flammable liquids. You should only employ experienced contractors. A guide which gives sound practical advice for selecting and managing contractors should be used while employing a contractor.

2. **Hot work Permit:** It is absolutely essential to establish hot work permit system for any hot work to be carried out in the factory, especially in the areas which store flammable solvents of Class A. And this should be strictly followed for any hot work carried out.

3. It is essential that no maintenance work is done until: the potential hazards of the work have been clearly identified and assessed; the precautions needed have been specified in

detail; the necessary safety equipment has been provided; and adequate and clear instruction has been given to all those concerned.

4. In most cases, a permit-to-work (PTW) system should be used to control maintenance operations20 in areas where flammable liquids are stored or used. PTWs are formal management documents .They should only be issued by those with clearly assigned authority to do so, and the requirements stated in them must be complied with before the permit is issued and the work covered by it is undertaken. Individual PTWs need to relate to clearly defined individual pieces of work. PTWs should normally include: the location and nature of the work intended; identification of the hazards, including the residual hazards and those introduced by the work itself; the precautions necessary, for example, isolations; the personal protective equipment required; the proposed time and duration of the work; the limits of time for which the permit is valid; and the person in direct control of the work.

5. **Information and training:** Adequate training and knowledge of the properties of flammable liquids are essential for their safe storage.

6. **The VICES principles-** There are five general principles for ensuring that the risks of fire and explosion, from the storage of flammable liquids in containers, are controlled and minimized. An aid to remembering these five principles is the acronym 'VICES'. There is no order of priority of the principles implied by the use of the acronym.

i. **Ventilation-** Good ventilation means vapours given off from a spill, leak, or release, will be rapidly dispersed. A good standard of ventilation is required in buildings or rooms used for storing flammable liquids, to disperse the vapours from any small releases. The ventilation arrangements need to take into account the heavy nature of the vapours and to ensure adequate air movement at high and low levels. Five air changes per hour are normally sufficient to ensure vapour levels in the store are kept to a low level. For small buildings, the simplest method of ensuring adequate ventilation is to provide fixed, permanent openings
ii. **Ignition-** Ignition sources will be removed from the storage area, by flame proof electrical fittings, no sparking by ensuring permit system during maintenance work, Declaration of ***No Smoking*** and ***No Naked Flame*** area will be followed.
iii. **Containment -** Use of proper containers, providing spill kit, proper drainage of spillage to safe place, collection and recycle ,Containers will be stored in at ground level (singly or in stacks). This enables leaks or releases to be quickly seen, and allows for any vapours to be dispersed effectively by natural ventilation.
iv. **Exchange -** Substituting with less flammable liquid.
v. **Separation:** Flammable liquids will be stored well away from other processes and general storage areas. If necessary the storage will be separated by a physical barrier, wall or partition.

7.8.5. Storage of Toxic Chemicals

Table 7.3 List of Toxic Chemicals (In drums and Warehouse)

Sr. No	Name of the Chemical	NH Value	TLV Value	Max Qty stored	Size of Container	Number of Containers
1	Sodium Nitrite	3	--	6875 Kg	25 Kg/ Bag	275 Bags
2	Resorcinol	3	TWA: 10 ppm	1100 Kg	50Kg/ Bag	22 Bags

Sr. No	Name of the Chemical	NH Value	TLV Value	Max Qty stored	Size of Container	Number of Containers
3	Formaldehyde	3	TWA: 0.75 mg/m3	2600 L	200 L/ Drum	13 Drums

7.8.6. Mitigation measures for storage of chemicals in warehouse

- **Warehouse Design**

Warehouse for the storage of chemicals in drums of the area will be constructed. This will be constructed as per the **IS code 3594** and other relevant standards
Major points are from the code are given below:

1. Roadways around warehouse should be min 5 meters wide and compound gates min 4.5 m wide
2. Floor areas: WH should be divided to have max 750 sq m area by separating walls. Dimensions LXW not exceeding 40 meter
3. Floors should have 2 hrs fire resistance
4. Buildings used for storage of hazardous and extra-hazardous goods should be preferably of single storied structure and in no case should exceed 2 stories in height
5. In no case should a storage building exceed 1S m in height
6. Floor Drainage The floors should be of watertight construction and Scuppers of not less than 20 cm sq cross sectional area should be provided at no more than 6·0 m intervals or as required to take care of maximum water discharge from hydrant/sprinkler system.
7. External Drainage External drains of not less than 25 CM width and 30 Cm depth should be provided along the side of each building and so constructed that any flow of water from the building be directed to a suitable ground tank or reservoir or public drainage system in the vicinity not leading to a natural water source. No external drainage of warehouses storing hazardous goods should be connected to public drainage system which leads directly to a natural water source.
8. Every storage/warehouse building should have a minimum of two exit doorways, and at the rate of one exit doorway per every 30 m length of the external walls of the building
9. The means of exit as well as the exit ways, travel distances, etc, should be as per the guidelines given in IS 1641 : 1988 If used for storage of hazardous goods, it should conform to Type I of IS 1642 : 1989.

- **Additional measures for improving Warehouse Safety**

Measures for improvement in the design of warehouse:

1) Dividing warehouse into fire compartments, by suitably designed firewalls, to limit the spread of fire.
2) Limiting the quantity of hazardous chemicals stored.
3) It is safe practice to store explosive, self igniting, oxidizing and organic peroxides separately, preferably in different compartments.
4) Storage of chemicals should be planned by categorizing these based on their hazardous properties, like toxicity, flammability, explosibility, for which MSDS needs to be critically studied.
5) Based on the above, proper segregation of materials should be achieved.
6) Installation of smoke, fire and toxic gas leak detectors.

7) It should be easily possible to reach and attend toxic chemical leakage.
8) There should be enough space, and pathways for easy approach and escape.
9) Having all flameproof fittings inside the warehouse.

7.8.6.1. Storage and handling of Bromine:

Bromine will be stored in 2500 liter tank and maximum quantity stored will be 2450 liters

- **Special precautions recommended for handling highly toxic chemicals:**

1. Storage tank with proper MOC, lead lined will have to be used.
2. It must be stored in open with ample ventilation.
3. Transfer system to the user reactor or intermediate vessel should be properly designed. If by pump, then pump with pump with recommended MOC, mechanical seal, to reduce the leakage to zero, should be used.
4. Or properly designed system to transfer under Nitrogen pressure or Bromine vapour pressure, similar to Ammonia tanker unloading and transfer system should be used.
5. Vent of the tank should be connected to the properly designed scrubber with suitable alkali circulation system.
6. Bromine leak detectors should be installed at places where ever it is used, near the storage, reactor.
7. All recommended PPEs should be used and SCBA should be used and readily available all the time.

- **Special precautions recommended for handling highly toxic chemicals:**

- **BROMINE**

1. **DANGER: HIGHLY TOXIC LIQUID.**
2. It produces Vapors which is very toxic if breathed in. The liquid cause severe burns to the eyes and skin. It has TLV = 0.1 ppm for 8 hour exposure and STL (Short Term Exposure Limit) 0.3 ppm for 15 minutes exposure.
3. **Routes of Entry:** Absorbed through skin. Dermal contact. Inhalation. Ingestion.
4. **Chronic exposure has serious effects on digestive and cardiovascular system.**
5. **Health monitoring: Pre appointment and regular Medical check-up of workers should be carried out in consultation with the qualified IH qualified Medical doctor.**
6. **HANDLING INSTRUCTION:** Wear goggles, face shield, chemical resistant gloves and online breathing apparatus, Air pressure suit and Gum Boot etc whenever handling Bromine. Keep Sodium thiosulphate 20% solution ready in 200 liter drum for spillage control (Neutralization).
7. **FIRST AID:**

- **Eyes** - Flush immediately with water for 15 minutes lifting eyelids occasionally.
- **Split Skin or clothing** - Remove contaminated clothing and shoes immediately. Wash affected area with sodium thiosulphate solution (20% or 0.1 M). If irritation is present, get medical attention from Health Services immediately.
- **Inhalation** - Remove from exposure area to fresh air immediately. If breathing has stopped administer artificial respiration. If breathing is difficult, administer oxygen. Keep affected person warm and at rest.
- **Ingestion** – Do not more than wash out the mouth with water do not induce vomiting. Sips of water may help cool the throat and help keep the airways open. See a doctor.

- **SPILLS/LEAKS** -Report all spills/leaks. Extinguish any possible ignition sources. Stop leak if you can do so without risk. Evacuate the area.
- **EMERGENCY RESPONSE-**Wear S.C.B.A., and full turnout gear. Do not touch spilled material. Use sodium thiosulphate solution (20% 01 1 M) to reduce vapors. Keep upwind of spill. For small spills, take up with sand or other absorbent material and place into sealed containers for later disposal. For large spills, dike far ahead of spill. Keep unnecessary people away. Isolate area and deny entry.

7.8.6.2. Hazards and Mitigation Measures in handling of Oleum and Sulphuric Acid

- **Hazards:**

Oleum is dangerous to human health. Oleum is rapidly destructive to all body tissues, causing severe burns which may result in scarring.

- **Workplace exposure**: Oleum is toxic by ingestion, inhalation or contact with skin and eyes. Potential exposures may occur at work place as well as it may also occur in the event of a transportation incident. Persons involved in maintenance, sampling and testing activities, or in the loading and unloading of Oleum containers are at greater risk of exposure.
- **Hazard On spillage** :Oleum releases sulfur trioxide gas (SO3) gas when spilled. The SO3 quickly reacts with moisture in the air to form tiny droplets of sulfuric acid mist. These H2SO4 mist particles appear as a white cloud. Spills of oleum should be contained and isolated from waterways, sewers and drains. Oleum will react violently with water and a considerable amount of heat is generated during dilution.

- **Mitigation Measures**

Following good safe handling practices will minimize the likelihood of exposure to oleum.-
1. Persons involved in exposure risk activities should always wear proper personal protective equipment such as rubber gloves and boots, a chemical resistant full acid suit, goggles, face shield, an approved respirator and a hard hat.
2. Oleum should be carefully diluted and then soaked up with an approved absorbent material which can be swept or shoveled up and placed in a suitable container for disposal. The contaminated area should be washed down with water. Lime or soda ash (sodium carbonate) may be used to neutralize contaminated water.
Larger spills of oleum should be contained and carefully diluted with water before neutralizing with a suitable neutralizing agent. Disposal should be in accordance with applicable local, state or federal regulations. Persons attempting to clean up oleum spills should wear proper personal protective equipment (see guidelines in the Safety Data Sheet). If required, report spills to the appropriate local, state and federal authorities.

7.8.7. Storage of Acids and Alkalis

Following acids and Alkalis will be stored in the premise in the storage tanks:

Table 7.4 List of Acids stored in Tanks/drums

Sr. No	Name of the Chemical	NH Value	TLV Value	Max Qty stored	Size of Container	Number of Containers
1	HCL **(37%)**	3	TWA: 1 ppm	13488 L	Tank	1
2	Oleum **(60%)**	3	TWA:1(mg/m3)	9600 L	Tank	1

Sr. No	Name of the Chemical	NH Value	TLV Value	Max Qty stored	Size of Container	Number of Containers
3	Sulphuric Acid **(98%)**	3	TWA: 1 mg/m3	10800 Kg	25 Kg/ Drum	432 Drums
4	**NaOH Flakes**	3	TWA: 2 mg/m3	4500 Kg	50 Kg/ Bag	90 Bags
5	**KOH Flakes**	3	CEIL: 2 (mg/m3)	5000 Kg	50 Kg/ Bag	100 Bags
6	**Acetic Acid**	--	--	20000 L	200 L/ Drum	100 Drums

7.8.7.1. Hazard Identification and Mitigation Measures for storage of Acids in tanks

- **Hazard Identification**

Leakage HCL storage tank particularly will cause serious environment pollution problem and may harm the workers in the factory, as TLV for HCL gas is = 3-5 ppm only.

- **Mitigation Measures**

Following mitigation measures are suggested to minimize possibility of major leak from HCL tank and air pollution in particular. But these are applicable and relevant for all acid storage tanks.

HCL storage tank leakage can create serious risks, not only to people on-site, but also to the emergency services, to the general public off-site and to the environment. The greatest risk of significant harm is a large spill or leak from tanks or pipe work or associated plant. The main causes of such incidents include:

- failure to detect corrosion and replace corroded components;
- damage caused by the impact of vehicles or other objects;
- overfilling

Small spills and leaks can produce serious injuries if people come into contact with the liquid or inhale the fumes. Minor incidents can develop into major incidents if prompt emergency action is not taken.

The basic aim to suggest mitigation measures is to minimize the likelihood of a spillage; reduce the consequences of such an incident, particularly with regard to people and the environment.

- **Location of the tank**

When selecting the location of acid storage tanks, the consideration should be given to the distance of the proposed tank farm from:

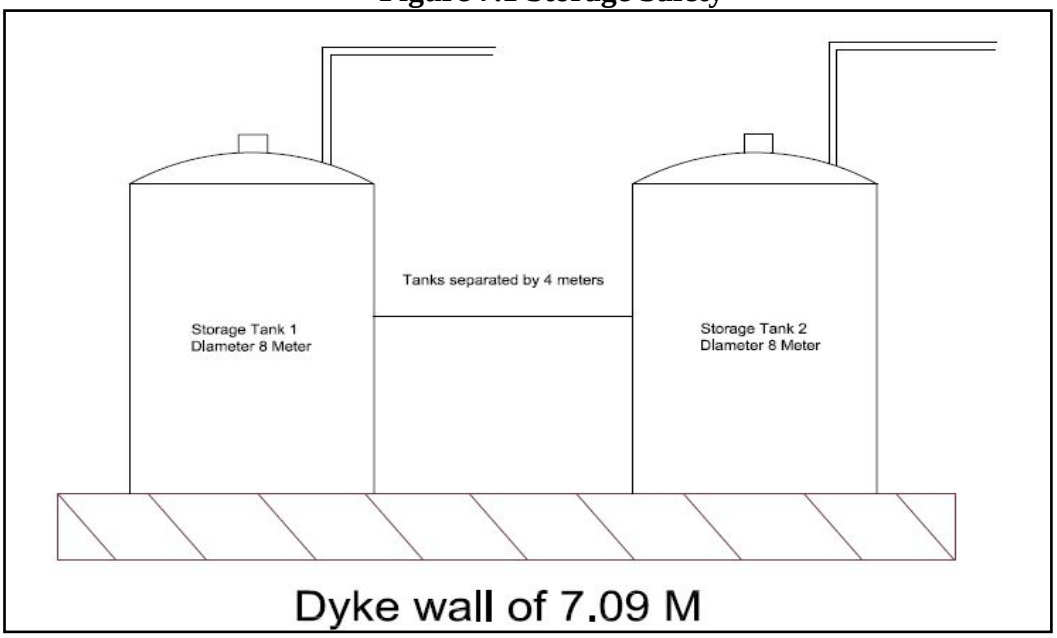
- the site boundary
- roadways and site thoroughfares
- occupied buildings
- Storage or processing of other dangerous substances particularly incompatible substances such as strong alkalis and oxidising agents; water courses and boreholes.

The tanks are aboveground and must be installed on the foundation (and the supports for horizontal tanks). These should normally be of concrete with the required load bearing strength and thickness.

Storage tanks of HCL and Oleum and must be stored seperately and must be covered with the dyke walls.

- **The purpose of the dyke wall is to:**
  - ❖ prevent the liquid entering drainage or other water systems.
  - ❖ prevent the spread of the liquid which could present a hazard to other plant or personnel both on and off site;
  - ❖ Prevent contamination of land.
  - ❖ allow the controlled recovery or treatment of the spilled material.
- The dyke walls and floor should be constructed of materials resistant to the acid being stored. Acid resistant tiles are available and bricks and cement can be faced with acid resistant coatings. Coatings will require maintenance and regular renewal. The choice of materials will depend on the acid itself, its concentration and temperature.
- The bund should have sufficient capacity to contain the largest predictable spillage. A bund capacity of 110% of the capacity of the largest storage vessel within the bund will normally be sufficient. Consideration should be given to the provision of individual dyke walls for each acid tank to prevent damage to other tanks if a leak occurs. Chemicals which react with the acid should not share the same bund.
- The dyke walls should have sufficient strength to contain an acid spill.
- Rainwater should not be allowed to accumulate in the bund.
- Provision must be made for the removal of bund contents (e.g. acid spills or rainwater). These can be, providing a sump. And a manually controlled sump pump, should be provided. Bund liquids should be analyzed as necessary before removal or disposal to prevent contamination of drainage systems.
- If a drain valve is used it should be kept locked in the closed position and only used by authorised personnel. The drain valve and any associated piping should be made of materials compatible with the acid stored.

Figure 7.1 Storage Safety



- **Vents and Overflow lines of the storage tank:**

Atmospheric tanks should have separate vent and overflow lines. The overflow should be sized to prevent any pressure build up within the tank in the event of an overfill. The overflow diameter should be equal to or greater than the inlet diameter. Normally, the overflow is at least 100 mm (4 inches) in diameter and at least 350 mm below the vent base. It should terminate as close to the ground as possible within the bund or other contained area. To prevent fuming, a dip leg and small water lute can be used.

To prevent release of fumes into the atmosphere, vent lines of bulk acid tanks should feed into a scrubber unit. The scrubber should be designed to cope with the fumes given off and the pressures generated during the filling of the tank. The scrubber should be so designed that HCL fumes escaping should be within the norms set by the statutory authorities.

Water, sodium hydroxide solution or dilute acid solution can be used as the scrubbing medium. Provision should be made to monitor the pH of the scrubbing solutions.

Piping: While designing the piping and piping routing it is advisable to have minimum flange joints. The line should be so routed to avoid walkways and joints over the walk ways.

All pipe lines of acid, being of HDPE MOC, should be protected against foreseeable impact from vehicles or mobile plant.

7.9. Storage of Coal

It is proposed to install and operate 4 TPH boiler using Imported coal as fuel.

7.9.1. Mitigation Measures for Coal Storage

1) Fire hydrant lines (self auto-mode fire fighting) will be laid around these areas.
2) No hot work will be permitted in this area without safety permit.
3) There will be no high voltage (H.T.) transmission lines over & near briquette and coal storage.
4) All useful material will be stored far away from storage of coal area.
5) Proper supervision staff with necessary communication facility will be deployed.
6) Training will be arranged for all the staff in normal & emergency operating system.
7) Proper training will be imparted for creating awareness among workers about sudden coal fire and emergency action plan. This will be part of On-site-emergency plan

B) QUANTITATIVE RISK ANALYSIS (QRA)

7.10. NFPA Rating

NFPA rating for raw materials to be stored on site are summarized in following table

Table 7.5 NFPA Rating of Raw Material

No.	Name of Chemical	NH	NF	NR
1.	Alumina	2	0	0
2.	Acetic Acid	3	2	0
3.	Aniline	3	2	0
4.	Barium Chloride TS	2	0	0
5.	Boric acid	1	0	0
6.	Bromine	3	0	0

No.	Name of Chemical	NH	NF	NR
7.	Toluene	2	3	0
8.	Potassium Carbonate	2	0	0
9.	Soda ash	2	0	1
10.	Methanol	1	3	0
11.	Ethyl Acetate	1	3	0
12.	Ethyl Alcohol	2	3	0
13.	Fluorescein	2	1	0
14.	Hydrochloric Acid	3	0	1
15.	Hyaluronic Acid	1	1	0
16.	Oleum	3	0	2
17.	N,N-Dimethyl-p-toluidine (P- Toluedine)	2	2	0
18.	Piperidine	3	3	0
19.	Pyrene	2	1	0
20.	Rosin (Gum)	2	1	0
21.	Salicylic acid	0	1	0
22.	Sodium Amide	3	3	2
23.	Sodium Bisulfite	2	0	0
24.	Sodium carbonate	2	0	1
25.	Sodium Nitrite	3	0	1
26.	Sodium sulfate anhydrous (Sodium Sulphamate)	2	0	0
27.	Fluorescein	2	1	0
28.	Sulphuric Acid	3	0	2
29.	Cyanoacetamide	2	1	0
30.	Sulphanilic Acid	2	1	0
31.	D & C Green	2	1	0
32.	Sodium Hydroxide	3	0	1
33.	Resorcinol	2	1	0
34.	Formaldehyde	3	2	0
35.	Sodium Bicarbonate	1	0	0
36.	Quinoline Yellow SS	2	1	0
37.	Potassium Hydroxide	3	0	1
38.	Calcium Chloride	2	0	2
39.	D&C Red 27	2	1	0

Refer **Appendix - H** (**MSDS** of most hazardous chemicals)

The QRA results shall be utilized in design of plant layout while locating storage tank farm Vis a vis other plant buildings etc.

7.11. Quantification of hazards due to storage of hazardous materials

Worst case scenarios for leakage/spillage of hazardous raw materials using ALOHA software are done. This is summarized in following table:

Table 7.6 Risk Assessment - Worst Case Scenarios and Mitigation Measures

Sr. No.	Raw Material	Scenario of Spillage/ Leakage	Area of Spread	Mitigation Measures
1.	Bromine	Leak from hole in vertical cylindrical tank Non-flammable chemical is escaping from tank	• Model Run: Heavy Gas • Red : 62 yards --- (8.5 ppm = AEGL-3 [60 min]) • Orange: 395 yards --- (0.24 ppm = AEGL-2 [60 min]) • Yellow: 1117 yards --- (0.033 ppm = AEGL-1 [60 min])	• **Small Spill**: Absorb with an inert material and put the spilled material in an appropriate waste disposal. • **Large Spill:** Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.
2	37 % HCL	Evaporating Puddle	• Red : 66 yards --- (100 ppm = AEGL-3 [60 min]) • Orange: 141 yards --- (22 ppm = AEGL-2 [60 min]) • Yellow: 499 yards --- (1.8 ppm = AEGL-1 [60 min])	• **Small Spill:** Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate. • **Large Spill:** Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material.Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce

Sr. No.	Raw Material	Scenario of Spillage/ Leakage	Area of Spread	Mitigation Measures
				vapors. Prevent entry into sewers, basements confined areas; dike if needed. Call for assistance on disposal Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities
3	Oleum	• Evaporating Puddle	• Red : less than 10 meters(10.9 yards) --- (160 mg/(cu m) = AEGL-3 [60 min]) Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances. • Orange: 32 yards --- (8.7 mg/(cu m) = AEGL-2 [60 min]) Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances. • Yellow: 219 yards --- (0.2 mg/(cu m) = AEGL-1 [60 min])	• **Small Spill:** Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.. • **Large Spill:** Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material.Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Refer **Appendix - I (**for severity mapping carried for hazardous chemicals)

7.11.1. Mitigation Measures based on QRA

- **Hazard**

It is clear that even a small leak in Bromine tank can cause spread of toxic Bromine to spread widely in the factory area, with concentrations in the range which can seriously affect the workers and in worst case situation affect population outside the factory area.
Similar will be true for HCl and Oleum tank leakage.

- **Mitigation measures**

1. The above results will be taken into the consideration while planning for tank layout and factory layout.
2. On-site emergency plan should consider the above results.
3. It is recommended to install Bromine gas leak detector and take early action in case of even minor leakage.
4. Regular preventative maintenance will be carried out on Bromine and other tanks to prevent leakage.
5. Proper Personal Protective Equipments (PPEs) and Self-Contained Breathing Apparatus (SCBA) will be always available near the storage.
6. SOP in case of leakage, action to be taken should be known to all.
7. If necessary, population outside the factory premises should be aware of the hazards and action to be taken.
8. Plan to evacuate workers and outside population should form a part of DMP, to be prepared in consultation with industries around local government authorities
9. And maximum employees should be trained to deal with the leakages.

7.12. FIRE FIGHTING

Since number of flammable solvents are stored in the warehouse, fire-fighting system should be designed as per the applicable IS or international code. For e.g. Section 13 IS code 3594.
Major mitigation measures:

1. Segregation of Class A solvents storage from other drum storage.
2. It is necessary to obtain the approval of CCE for the storage of Class A Solvents, in warehouse.
3. Installation of flame/smoke detectors with alarms.
4. Cooling/ automatic spray arrangements to cool the drums.

7.13. OCCUPATIONAL HEALTH CENTER (OHC)

The company will establish OHC as per the Factory act, Rule 73 clearly states the requirements, rules for pre-employment and regular medical check-up, trained man-power required to be employed in OHC, need for 24X7 Ambulance availability.

Since the workers will be dealing with hazardous and toxic chemicals following is suggested

1. It is clear that the parameters for periodic health check up for workers has to be based on and decided on the hazardous chemicals handled in the process (Raw material, intermediates, solvents, products), their toxic properties and the extent to which shop floor

workers, including contract labours, operators, officers are exposed to these chemicals. Detailed information on the groups of hazardous chemicals, chemicals included in the group, their use, target organs, (organs which are affected by the exposure to these chemicals) and corresponding medical tests to be carried out is available.

2. It is expected that the parameters based on such or similar tables, hazardous properties of chemicals (available in MSDS) have to be finalized by the OHC doctor in consultations with the safety officials of the company.
3. Frequency of periodic examinations will depend upon the exposure, TLV values, extent of these chemicals in air, based upon air monitoring.
4. Periodic medical examination, in comparison with pre medical checkup results will reveal the ill effects on the worker's health. This will help early detection of the disease and the effect on organs tec. This will be used for suitable corrective action to prevent further deterioration. Suitable medical treatment will be initiated for the worker.
5. If air monitoring shows presence of hazardous chemicals more than TLV values, suitable action needs to be initiated immediately to improve process conditions/ pollution measures.

For less hazardous industries, same health parameters as per pre employment check up will be included in periodic medical checkup.

7.13.1. EHS policy:

Company will be clearly defined EHS policy and it will be known to all employees and will be properly displayed.

7.14. ONSITE EMERGENCY PLAN

AFCMPL will prepare **On-site Emergency Plan based on the following guidelines, before the plant start-up.**

This can be made as per the following guidelines suggested below:
On-site and Offsite emergency plan will be prepared as per the factory act and will be prepared as per Rule no. 12 of factory act (control of Industrial Major Accident Hazard Rules, 2003) as per the guidelines given in Schedule 6.

Objectives of Onsite Emergency Plan will be:

a) To control emergency situation arising out of possible hazards identified in the factory fire, explosion, and toxic leakage.
b) To identify all possible hazards, its consequence, areas affected.
c) To estimate areas affected.
d) Define actions to be taken in case of emergency.
e) Identify persons responsible to take necessary actions to deal with situation.
f) To localize emergency and if possible eliminate it.
g) To avoid confusion, panic and handle the emergency in a planed manner.
h) To minimize loss of life and property to the plant as well as to the neighborhood.
i) To carry out rescue operations
j) To treat injured persons and transfer to the nearest hospital for treatment.
k) To restore normalcy.

- It will specify names of key personnel as

1. Chief Controller (Generally he is Factory Chief)
2. Incidence Controller (Generally he is plant in charge where emergency has occurred or shift in charge after General Shift)

3. Under Chief Controller, three teams are formed
    a. RESCUE TEAM
    b. SERVICE TEAM
    c. WELFARE TEAM
4. Liaison Officer

The nature of responsibilities of these Key personal & Teams are clearly defined. Reporting chain of command will be clearly defined. Following documents will be required and will form essential part of the Onsite and offsite Emergency Plan

1. Factory layout showing location of all plants, location of hazardous storage, location of Emergency control center.
2. Factory layout showing designated assembly areas
3. Block diagram of manufacturing processes.
4. List of hazardous chemicals stored.
5. MSDS of all hazardous chemicals
6. List of Anti dots
7. List of Key Factory personnel with contact numbers and addresses.
8. List of employees trained in fire fighting with contact numbers
9. List of employees trained in first-aid and rescue operations
10. List of Telephone numbers and addresses of outside government and other agencies mainly
    - Nearest Police station
    - Nearest Fire Brigade Station
    - Ambulance services
    - Nearest Government and other Hospitals
    - Blood Bank
    - MSEB
    - MPCB

1. Emergency Action Plan in case of all possible hazards identified.
2. Procedure for reporting emergency will be clearly defined.
3. Actions to be taken by personnel where emergency has occurred and
4. Actions to be taken by personnel at other location will be clearly defined.
5. Precautions/Actions to be taken after emergency will be clearly defined.

7.14.1. Training and Mock Drill

It is absolutely necessary to train & carryout mock drills for success of emergency plan during actual emergency. Emergency procedures should be laid down clearly and convincingly to everyone on site, particularly the KEY PERSONNEL & ESSENTIAL WORKERS.

7.15. DISASTER MANAGEMENT PLAN

This will be prepared after the preparation of On-site emergency Plan in co-ordination with industries round and local Government authorities.