



EYEWASH & SHOWER FOR PRETREATMENT OF CHEMICAL SPILLAGE AT ETP AND STP

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Abstract—

In every industry, at least for a single purpose chemicals are being used, which may sometimes leads to accident. Exposure to chemicals can be corrosive, toxic, and they may react, often explosively. There is an existing system for the safety of eyes and skin named as eyewash and shower, gives the First Aid treatment to prevent the severity of injury by washing chemicals off a person in the event of chemical spill. In this paper it's a try to make this system much user friendly by making it a portable.

Keywords—Eyewash, safety shower, bladder, pressure tank, Pressure regulator.

I. INTRODUCTION

In today's world chemical accidents in industry are playing a major role. A chemical accident is the unintentional release of one or more hazardous substances which could harm human health or the environment.

Human skin has seven layers of ectodermal tissue which guards the underlying muscles, bones, ligament and internal organs. And also human eye is an organ of vision which plays a very important role in our life, gives us the sense of sight allowing us to observe many things.

Chemical accidents may occur whenever toxic materials are stored, transported or used, the most severe accidents are industrial accidents involving major chemical manufacturing and storage facilities.

I. PROBLEMS ARISING DUE TO CHEMICAL SPILLAGE

A. Hazards due to chemicals

Chemicals can be:

- (1) Corrosive
- (2) Toxic
- (3) Explosively Reaction.

The impacts of chemical accidents can be deadly, for both human beings and the environment.

B. Effectsofchemicalsondirectcontactwithskin

Therearetwotypesofskindamagesduetochemicalspillage.Itcanbeasthefollowing:

- (1) Temporarydamage
 - a. Dryskin
 - b. Redskin
 - c. Crackedskin,etc.
- (2) Permanentdamage
 - a. Changeincolor
 - b. BurnsmayleaveapermanentScar
 - c. Exposuretocertainchemicalsmayresultinliverdamage,etc.

II. METHODOLOGYOFPROJECT

With the concept of water pressure tank, this portableeyewashandshowerisbeingdesigned.Theprincipleofwater pressure tank is that, the water is pressurized with thehelp of normal compressed air. This is performed with thehelpofaBladdertypepressuretank.

A. Bladdertypepressuretank

It is a type of tank containing pressurized air and water separated by a membrane (bladder). They are pre- chargedwith air at the factory. On average, a bladder pressure tanklasts5-7years.

B. Workingandfunctionofbladdertypepressuretank Working:

- ❖ Asincreaseinairpressure,itenforcesthevolume of water in a bladder pressure tank togetcompressed.Andperiodically,theamountofairinthetankshouldbemeasuredandshouldberechargediftheairpressureistoolow.

Function:

- ❖ Maintain a desired range of waterpressureinthe distribution system. And also it minimizespumpcycling,preventingfrequentstartsandstopsprotectingfacilitiesfromdamage.

C. Principleofbladdertypepressuretank

Initially we need fill the tank with water from the top ofthe tank valve then we need to apply air pressure in thebottomofthepressuretank.Thisairpressuremakethebladder (balloon) to bulge upwards and the pressure tends toactonthewaterabovethebladder(balloon)insidethetank.

In this way the water stored in the tank tends to be in apressure and when the valve is opened, it comes out with thepressurewhatwehaveprovidedatthebottomoftankthroughthebladderwithoutanyotherexternalenergy.

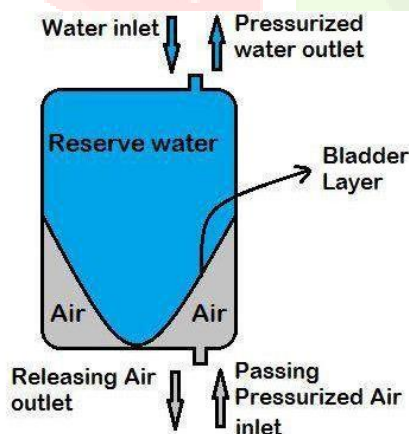


Fig.1Beforeapplyinginputairpressure

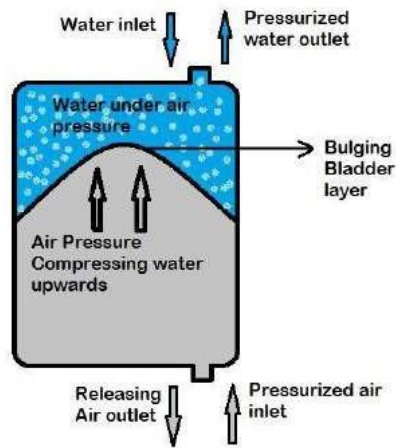


Fig.2 After applying input air pressure

D. Flexible bladder

- Flexible bladder tanks are made with high resistance PVC material and are welded with high frequency (HF) soldering techniques.
- The bladder walls are made up of polyester with PVC induction.
- The materials used in bladder walls are generally UV resistant and are chosen for their chemical stability and resistance to mechanical operation.

E. Function of Pressure Gauge

- **Manometer:** An instrument for measuring the pressure of a fluid, consisting of a tube filled with a liquid, the level of the liquid being determined by the fluid pressure and the height of the liquid being indicated on a scale.

F. Function of Pressure Regulator

- **Pressure regulator:** It is a control valve that reduces the input pressure of a liquid to a desired value at its output.
- Regulators are used for gases, liquids and can be an integral device with an output pressure setting, a restrictor and a sensor all in the one body, or consist of a separate pressure sensor, controller and flow valve.

III. DESIGN OF PROJECT

With the reference of ANSI standards the design is worked out as the following:

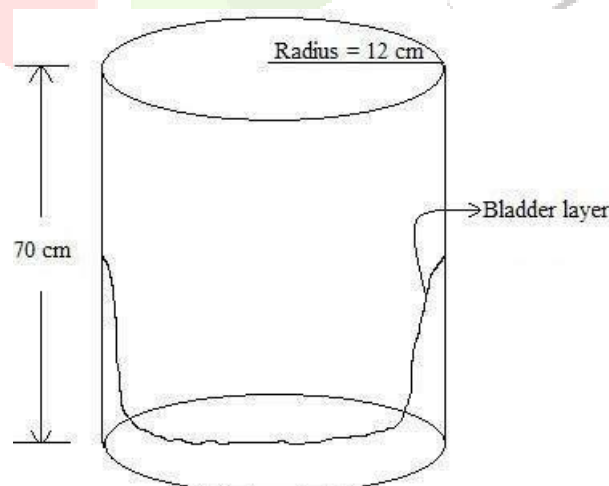
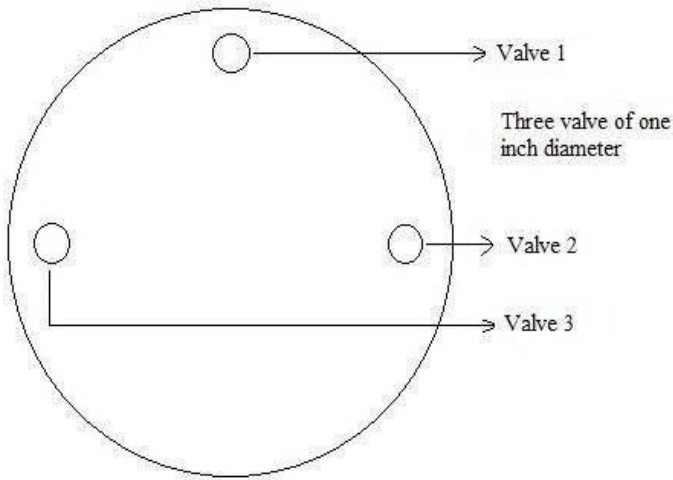


Fig.3 View of cylindrical tank



Valve 1 - Pressure gauge
Valve 2 - Eyewash and Shower
Valve 3 - Inlet of water

Fig.4 Top view of cylindrical tank

Diameter of pipe = 1 Inch

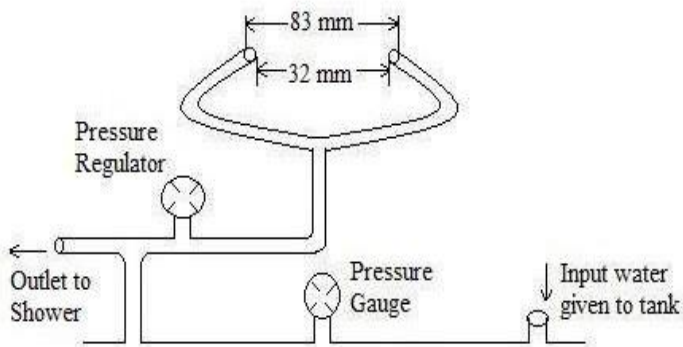


Fig.5 Side view of upper part of cylinder

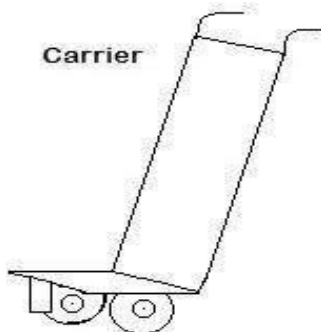


Fig.6 Carrier

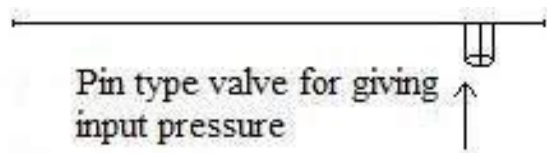


Fig.7 Side view of bottom part of cylinder

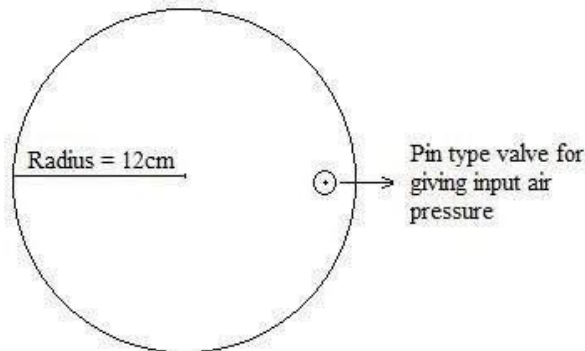


Fig.8 Bottom view of the cylinder

IV. CALCULATIONS AND PROOF

As per ANSI standard, Diameter of pipe used is **1 inch**, and include the following parameters:

1. **0.4 gallon/min** (means **1.5 liters/min**)
2. This flow rate provides **30 PSI** (Means **2 bar**) pressure of water in the pipe.
3. Allowed for **15 mins** (standard time for first aid treatment).

Therefore, if the flow rate is 1.5 liters per minute, then for 15 minutes total outlet water would be:

$$\begin{aligned} \text{Total outlet water} &= 15 \text{ mins} * 1.5 \\ &= 22.5 \text{ liters.} \end{aligned}$$

Which means **22.5 liters** of water is enough to continuously operate for 15 mins as per the ANSI standard.

So we can consider the following dimensions for the project: Height of the cylinder = 70 cms

Radius of the base circle = 12 cms

Then, the volume of the cylinder can be calculated as, $\text{Volume} = \pi r^2 h$

$$\begin{aligned} &= \pi * (12)^2 * 70 \\ &= 31667.25 \text{ cubic centimeter} \end{aligned} \quad \text{Then, in liters, volume} = 31.667 \text{ liters.}$$

Approximately we can fill 30 liters of storage water.

V. CONCLUSION

Hence it is proved that all the parameters discussed above will give the required output,

- ❖ Flow of water at a pressure 2 bar.
- ❖ Time for continuous flow of water is achieved more than 15 minutes.
- ❖ Easy to move the equipment.
- ❖ User friendly
- ❖ Life of the equipment is minimum 5 years.

- ❖ Purpose of the equipment is successfully achieved.
Therefore, the severity of chemical spills on skin and eyes can be minimized.

REFERENCES

- ANSI-Z358.1
(American National Standards Institute).
- OSHA
(Occupational Safety and Health Administration).
- EN-15154
(European Committee for Standardization).
- ISEA SELECTION, INSTALLATION AND USE GUIDE EMERGENCY EYE WASH AND SHOWER EQUIPMENT.
- SWAT (Sanitizing Wash And Treatment).
- SLAC (SLAC Environment, Safety, and Health Manual).

