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THE THREAT AREA ANALYSIS USING DISPERSION MODEL DEVELOPING ERP

G.Kamalakannan, A.V.Balan

Industrial Safety Engineering

Department of Mechanical Engineering, K.S.R college of Engineering, Tiruchengode.

Pg.kamal@gmail.com

Abstract— In general some chemical are very hazardous if miss dealing is done it will lead to severe losses like life, property, environment etc…in this case furferal alcohol and sulphonic acid storage dispersion in analyzed using the dispersion model. The situation such as wind, the capacity of storage, the wind direction, the volume present are observed visually using relevant equipments and the software criteria is full filled and the dispersion is observed and emergency associated to it is planned in this research, health concerns and environmental issues are discussed in this paper.

Keywords— *Dispersion model, heavy gas dispersion, furfural alcohol, sulphonic acid, reactivity profile, emergency response and preparedness.*

I. INTRODUCTION

The primary function of furfural alcohol and sulphonic acid acts as resin and catalyst respectively.

1.1 FURFURAL ALCOHOL

Furfural alcohol, also called 2-furylmethanol or 2-furancarbinol, is an organic compound containing a furan substituted with a hydroxymethyl group. It is a clear colorless liquid when pure, but becomes amber colored upon prolonged standing. It possesses a faint burning odor and a bitter taste. It is miscible with but unstable in water. It is soluble in common organic solvents. Upon treatment with acids, heat and/or catalysts, furfural alcohol can be made to polymerize into a resin, poly (furfural alcohol).

Furfural alcohol is manufactured industrially by the catalytic reduction of furfural which is Obtained from corncob and sugar cane bagasse. It finds use as a solvent, but is primarily used as an ingredient in the manufacture of various chemical products such as foundry resins, adhesives, and wetting agents.

Furfural alcohol has been used in rocketry as a fuel which ignites hypergolically (immediately and Energetically in contact) with acid or red fuming nitric acid oxidizer. The use of hypergolic avoids the need for an igniter. In fall of 2012, Spectra, a concept liquid rocket engine using White fuming nitric acid as the oxidizer to Furfural alcohol fuel was static tested by Copenhagen Suborbital.

Furfural alcohol is probably a BK channel agonist. Because of its low molecular weight, furfural alcohol can impregnate the cells of wood, where it can be polymerized and bonded with the wood by heat, radiation, and/or catalysts or additional reactants. The treated wood has improved moisture-dimensional stability, hardness, and decay and insect resistance; catalysts can include zinc chloride, citric or formic acid, or borates

1.1.1 USES OF FURFURAL ALCOHOL

The major use of furfural alcohol is in the production of resins for bonding foundry sands for production of cores and moulds. The binder system contains furfural alcohol in monomer or polymer form.

1.2 SULPHONIC ACID

A sulfonic acid (or sulphonic acid) refers to a member of the class of organosulfur compounds with the general formula $RS(=O)_2–OH$, where R is an organic alkylor aryl group and the $S(=O)_2–OH$ group a sulfonyl hydroxide. A sulfonic acid can be thought of as sulphuric acid with one hydroxyl group replaced by an organic substituent. The parent compound (with the organic substituent replaced by hydrogen) is the hypothetical compound sulphurous acid. Salts or esters of sulfonic acids are called sulphonates.

1.2.1 APPLICATIONS OF SULPHONIC ACID

Although both alkyl and aryl sulfonic acids are known, most of the applications are associated with the aromatic derivatives.

A) Detergents and surfactants

Detergents and surfactants are molecules that combine highly nonpolar and highly polar groups. Traditionally, soaps are the popular surfactants, being derived from fatty acids. Since the mid-20th century, the usage of sulfonic acids has surpassed soap in advanced societies. For example, an estimated 2 billion kilograms of alkylbenzenesulfonates are produced annually for diverse purposes. Lignin sulfonates,

produced by sulfonation of lignin are components of drilling fluids and additives in certain kinds of concrete.

B) Dyes

Many if not most of the anthroquinone dyes are produced or processed via sulfonation. Sulfonic acids tend to bind tightly to proteins and carbohydrates. Most "washable" dyes are sulfonic acids (or have the functional sulfonyl group in them) for this reason. p-Cresidinesulfonic acid is used to make food dyes.

C) Acid catalysts

Being strong acids, sulfonic acids are also used as catalysts. The simplest examples are methane sulfonic acid, CH_3SO_2OH and *p*-toluene sulfonic acid, which are regularly used in organic chemistry as acids that are lipophilic (soluble in organic solvents). Polymeric sulfonic acids are also useful. Dowex resin are sulfonic acid derivatives of polystyrene and is used as catalysts and for ion exchange (water softening).Nafion, a fluorinated polymeric sulfonic acid is a component of proton exchange membranes in fuel cells.

D)Drugs

Antibacterial drugs sulfa drugs are produced from sulfonic acids.

II.METHODOLOGY

The software ALOHA version 2.53 is used to estimate the threat area for the two chemicals firstly the reactivity is studied accordingly and emergency response and preparedness is recommended in this paper.

2.1 PRODUCT DATA 1

ARYL SULFONIC ACIDS, LIQUID, WITH NOT MORE THAN 5% FREE SULFURIC ACID

- UN/NA Number : 2586
- DOT Hazard : Corrosive
- Reactivity - Strong Oxidizing Agent
- Air & Water Reactions- Freely soluble in water, may generate heat upon dilution.

2.1.1 REACTIVITY PROFILE (SULFONIC ACID)

- Belongs to the Following Reactive Group(s) Acids, Inorganic Oxidizing

ARYL SULFONIC ACIDS, LIQUID, WITH NOT MORE THAN 5% FREE SULFURIC ACID react exothermically with chemical bases (examples: amines, amides, inorganic hydroxides).

The reactions can generate dangerously large amounts of heat in small spaces. Dissolution in water or dilution of concentrated solutions with water may generate heat. Can react with active metals, including iron and aluminum, and also many less active metals, to dissolve the metal and liberate hydrogen and/or toxic gases. Can initiate polymerization in certain alkenes. React with cyanide salts and compounds to release gaseous hydrogen cyanide.

Flammable and/or toxic gases are also often generated by reactions with dithiocarbamates, isocyanates, mercaptans, nitrides, nitriles, sulfides, and weak or strong reducing agents. Additional gas-generating reactions may occur with sulfites, nitrites, thiosulfates (to give H2S and SO3), dithionites (SO2), and carbonates: the carbon dioxide gas from the last is nontoxic but the heat and spattering from the reaction can be troublesome.

Can catalyze (increase the rate of) chemical reactions. May burn but not ignited readily. Produces highly toxic fumes of oxides of sulfur when heated to decomposition.

2.1.2 PROVIDED INPUT DATA'S FOR SULFONIC ACID (PRODUCT 1)

A) ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

- Wind: 106.57 miles/hour from
- ESE at 3 meters
- Cloud Cover: 5 tenths
- Air Temperature: 28° C
- Stability Class: D
- Relative Humidity: 50%

B) SOURCE STRENGTH:

- Direct Source: 900 kilograms
- Height: 1 meters
- Release Duration: 1 minute
- Release Rate: 33.1 pounds/sec
- Total Amount Released: 1,984 pounds

2.2 PRODUCT DATA 2

FURFURYL ALCOHOL

- UN/NA Number 2874
- DOT Hazard Label Poison
- A clear colorless liquid. Flash point 167°F. Boiling point 171°F. Denser than water. Contact may irritate skin, eyes and mucous membranes. May be toxic by ingestion and skin contact and moderately toxic by inhalation.
- Reactivity Alerts- Polymerizable
- Air & Water Reactions- Slightly soluble in water.

2.2.1 REACTIVITY PROFILE (FURFURAL ALCHOL)

Acetyl bromide reacts violently with alcohols or water, Mixtures of alcohols with concentrated sulfuric acid and strong hydrogen peroxide can cause explosions. Example: An explosion will occur if dimethylbenzylcarbinol is added to 90% hydrogen peroxide then acidified with concentrated sulfuric acid.

FURFURYL ALCOHOL will polymerize rapidly and at times with explosive force in the presence of strong mineral acids, Alkyl hypochlorites are violently explosive. They are readily obtained by reacting hypochlorous acid and alcohols either in aqueous solution or mixed aqueous-carbon tetrachloride solutions.

Chlorine plus alcohols would similarly yield alkyl hypochlorites. They decompose in the cold and explode on exposure to sunlight or heat. Tertiary hypochlorites are less unstable than secondary or primary hypochlorites, .

Base-catalysed reactions of isocyanates with alcohols should be carried out in inert solvents. Such reactions in the absence of solvents often occur with explosive violence

2.2.2 PROVIDED INPUT DATA'S FOR FURFURAL ALCOHL (PRODUCT 1)

A) ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

- Wind: 100.56 miles/hour
- Direction- ESE at 3 meters
- Ground Roughness: 9 centimeters
- Cloud Cover: 5 tenths
- Air Temperature: 30° C
- Stability Class: D
- Relative Humidity: 50%

B) SOURCE STRENGTH:

- BLEVE of flammable liquid in vertical cylindrical tank
- Tank Diameter: 0.58 meters
- Tank Length: 0.88 meters
- Tank Volume: 233 liters
- Tank contains liquid
- Internal Storage Temperature: 30° C
- Chemical Mass in Tank: 262 kilograms
- Tank is 99% full
- Internal Temperature at Failure: 234.8 C
- Percentage of Tank Mass in Fireball: 99.9%
- Fireball Diameter: 41 yards
- Burn Duration: 4 seconds
- Pool Fire Diameter: 0 yards
- Burn Duration: 2 minutes
- Flame Length: 0 yards

III RESULT AND DISCUSSION

3.1 OUTPUT FOR SULPHONIC ACID

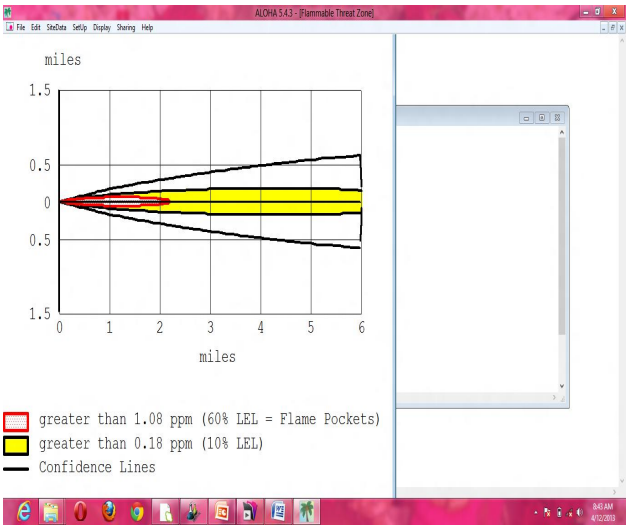

Figure 1: Output for sulphonic acid

Form the figure it is observed that from the source point in association with the provided input wind direction data there will be a trouble about to 6 miles and in sideways it gradually surrounds form 0.2 miles to 0.5 miles.

If this happens the emergency plan is discussed below.

3.1.1 HEALTH

- TOXIC; inhalation, ingestion or skin contact with material may cause severe injury or death.
- Contact with molten substance may cause severe burns to skin and eyes.
- Avoid any skin contact.
- Effects of contact or inhalation may be delayed.
- Fire may produce irritating, corrosive and/or toxic gases.
- Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution.

3.1.2 **FIRE**

- Small Fire - Dry chemical, CO^2 or water spray.

- Large Fire - Dry chemical, CO^2, alcohol-resistant foam or water spray.
    - Move containers from fire area if you can do it without risk.
    - Dike fire-control water for later disposal; do not scatter the material.
- Fire involving Tanks or Car/Trailer Loads
    - Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
    - Do not get water inside containers.
    - Cool containers with flooding quantities of water until well after fire is out.
    - Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
    - ALWAYS stay away from tanks engulfed in fire.

3.1.3 SPILL OR LEAK

- Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area).
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Do not get water inside containers.

3.1.4 FIRST AID

- Move victim to fresh air.
- Call emergency medical service.
- Give artificial respiration if victim is not breathing.
- Does not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- For minor skin contact, avoid spreading material on unaffected skin.
- Keep victim warm and quiet.
- Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

3.2 OUTPUT FOR FURFURAL ALCOHOL

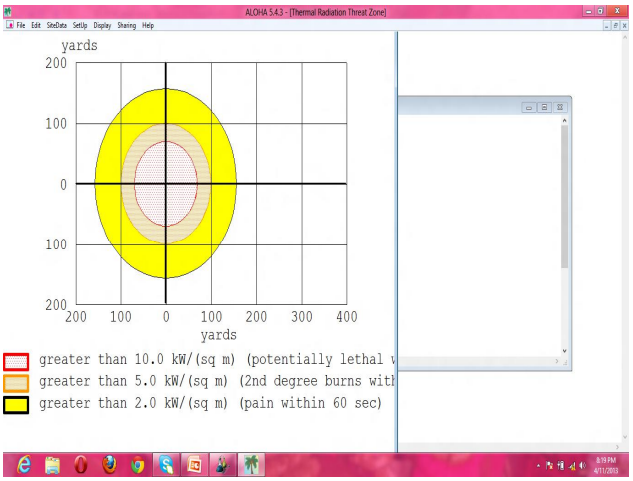

Figure 2: Output for furfural alcohol

In association with the given input data's the danger extends about 150 yards from the point of storage. So the emergency is constructed here are as follows.

3.2.1 FIRE OR EXPLOSION

- Combustible material: may burn but does not ignite readily.
- When heated, vapors may form explosive mixtures with air: indoors, outdoors and sewers explosion hazards.
- Those substances designated with a **(P)** may polymerize explosively when heated or involved in a fire.
- Contact with metals may evolve flammable hydrogen gas.
- Containers may explode when heated.
- Runoff may pollute waterways.
- Substance may be transported in a molten form.

3.2.2 EVACUATION

Spill

- Initial Isolation and Protective Action Distances for highlighted materials. For non-highlighted materials, increase, in the

downwind direction, as necessary, the isolation distance shown under "PUBLIC SAFETY".

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

V. CONCLUSION

Thus the threat zone is identified, it is determined that the sulphonic acid reaches to 6 miles from the point and the furfural alcohol seems to reach 150 yards from the point of opening of 1.5cm and 0.3 meter from the bottom. In association with this the emergency should be followed as explained in this paper.

REFERENCES

1. Alessio Zaccone, Ansor Gäbler, Sebastian Maa, Daniele Marchisio & Matthias Kraume, (2007), Drop breakage in liquid-liquid stirred dispersions - Modelling of single drop breakage, An article published in chemical engineering science, Vol. 62, pp. 6297-6307

2. Alexander Lavrov , Andrei B. Utkin , Rui Vilar , Armando Fernandes , (2006), Evaluation of smoke dispersion from forest fire plumes using lidar experiments and modeling, International Journal of Thermal Sciences, Vol. 45, pp. 848–859

3. Andrew Riddlea, David Carruthers, Alan Sharpe, Christine McHugh, Jennifer Stocker, (2003), Comparisons between FLUENT and ADMS for atmospheric dispersion modeling

4. Evica Stojiljkovic, Miroljub Grozdanovic, Srdjan Glisovic, (2011), Methodological framework for assessment of overall hazard of an accident, Journal Of Scientific & Industrial Research, Vol.70, pp. 204-209

5. J.C. Edwards, R.A. Franks, G.F. Friel & L.Yuan, (2005), CO dispersion from a coal fire in a mine entry

6. Gab-Bock LEE, Ho-Sik EUM, Doo-Ho LEE, Yang- Hee YANG, Sang-Hun LEE, (2011),Three-Dimentional Dispersion Modeling Of Liquid Radioactive Effluents around the Wolsong Nuclear Power Plant Site in Korea, Progress in Nuclear Science and Technoliogy, Vol.1, pp. 360-363

7. C. Gorle, J. van Beeck , P. Rambaud, G. Van Tendeloo, (2009), CFD modelling of small particle dispersion: The influence of the turbulence kinetic energy in the atmospheric boundary layer, Atmospheric Environment, Vol. 43, pp. 673–681

8. E. Gallego, C. Soriano, F.X. Roca , J.F. Perales, M. Alarco, X. Guardino, (2008), Identification of the origin of odour episodes through social participation, chemical control and numerical modelling, Atmospheric Environment, Vol. 42, pp. 8150–8160

9. Nishant Pandya, Eric Marsden, Pascal Floquet, Nadine Gabas, (2008), Sensitivity analysis of a model for atmospheric dispersion of toxic gases, 18th European Symposium on Computer Aided Process Engineering – ESCAPE 18

10. Prankul Middha, Olav R. Hansen, Idar E. Storvik, (2009), Validation of CFD-model for hydrogen dispersion, Journal of Loss Prevention in the Process Industries, Vol. 22, pp. 1034–1038