



SAFETY IN HAZARDOUS MATERIAL TRANSPORTATION

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ABSTRACT Transportation is major part of Logistics. Special care to be taken for Transportation of Hazardous materials as they can cause catastrophic consequences and Care should be taken while manufacturing, storage, loading and Transportation of chemicals which are dangerous in nature. Once the vehicle is in the plant premises there are various control measure for either prevention or mitigating the consequences, but once vehicle leaves plant premises, Safety entirely depends on the driver and the condition of the vehicle. There is necessity for Risk based evaluation of routing for Decision making authorities for regulating hazardous materials transportation vehicles through road. Adequate research has been done on Routing of Hazmat Trucks, Emergency response models and network design problems for hazardous material transportation have been studied by many researchers. As no adequate data available for India, the importance of safety in Hazmat transportation was explained by considering data of last 10 years that is (2007 to 2017) taken from United States Hazmat Transportation.

KEYWORDS :

INTRODUCTION:

According to OSHA Hazardous materials is defined as "Any substance or chemical which is a Health Hazard or Physical hazard including: Chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers, agents which act on hematopoietic system; agents which damage the lungs, Skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophoric, unstable reactive or water – reactive and chemicals which in course of normal handling, use or storage may produce or release of gases, fumes, Vapors, mists, or smoke which may have any previously mentioned characteristics." OSHA 29 CFR 1910.1200. United Nations described hazardous materials in to 9 categories. They are:

1. Explosive Substances and articles
2. Gases
3. Flammable Liquids
- 4.1 Flammable Solids, Self-Reactive Substances and solid desensitized explosives.
- 4.2 Substances Liable to spontaneous ignition
- 4.3 Substances which in contact with water emits Flammable gases.
- 5.1 Oxidizing Substances
- 5.2 Organic Peroxides
- 6.1 Toxic Substances
- 6.2 Infectious substance
7. Radioactive Material
8. Corrosive Substances.

ACCIDENT ANALYSIS

It is important to keep the information of hazardous materials and only some countries maintain special departments for transporting Hazardous materials. These departments maintain a database for hazmat incidents and the results with respect to number of fatalities and Damage in terms of money incurred. (Yilmaz, Erol et al. 2016)

Figure – 1 shows that the incidents data with air ways as medium of Transport from (2007 to 2017) during Hazmat transportation according to information taken from US – PHMSA, Department of Transportation, Pipeline and Hazardous materials (Transportation, Administration et al. 2018, JULY 14).

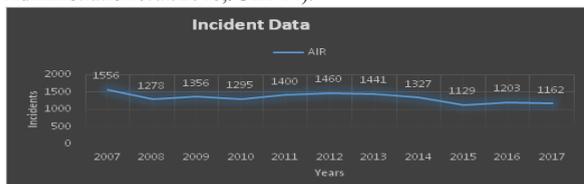


Figure – 2 shows that the incidents data with water ways as medium of Transport from (2007 to 2017) during Hazmat transportation according to information taken from US – PHMSA, Department of Transportation, Pipeline and Hazardous materials.

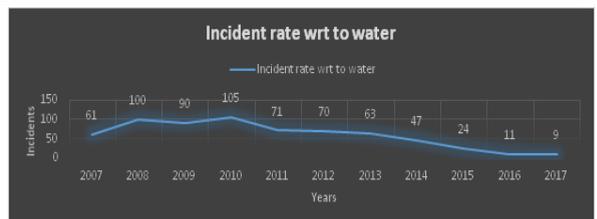


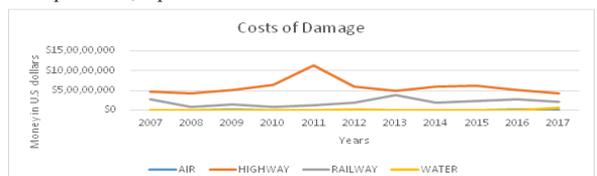
Figure – 3 shows that the incidents data with Highways ways as medium of Transport from (2007 to 2017) during Hazmat transportation according to information taken from US – PHMSA, Department of Transportation, Pipeline and Hazardous materials.



Figure – 4 shows that the incidents data with Railways ways as medium of Transport from (2007 to 2017) during Hazmat transportation according to information taken from US – PHMSA, Department of Transportation, Pipeline and Hazardous materials.



Figure – 5 shows the data of cost of damage incurred considering all modes of Transport from (2007 to 2017) during Hazmat transportation according to information taken from US – PHMSA, Department of Transportation, Pipeline and Hazardous materials



If we analysed the above data, it was found that total of 330541

incidents occurred from 2007 to 2017, and majority of incidents occurred in transportation of Hazardous materials through Highways i.e. (159552) and total costs of damage incurred were \$866050128.00 out of which only Highways incurred damage costs of \$641031075.00

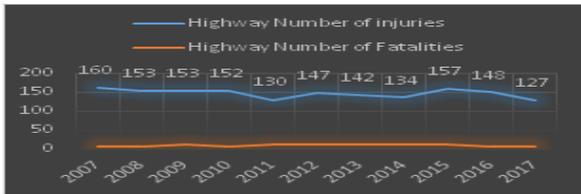


Fig: 6 (No of Injuries and Fatality data while Transporting Hazardous material on Highways)



Fig: 7 (No of Injuries and Fatality data while Transporting Hazardous material on Highways)

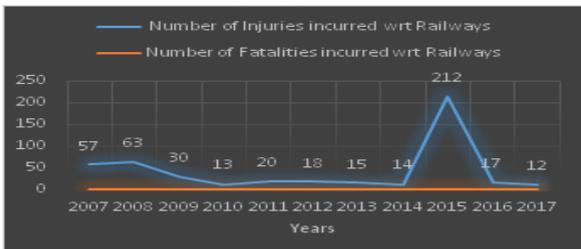


Fig: 8 (No of Injuries and Fatality data while Transporting Hazardous material on Railways)

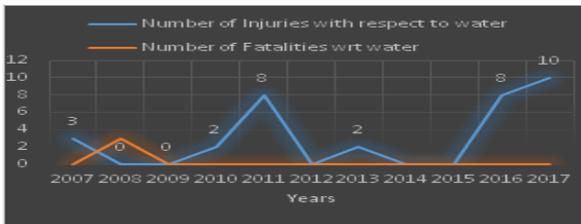


Fig: 9 (No of Injuries and Fatality data while Transporting Hazardous material on Water.)

From the above data, total injuries incurred over the last 10 years (2007 to 2017) were 2220 where injuries occurred while transporting HAZMAT in Highways were 1603. Fatalities due to HAZMAT transportation were 114 (2007 to 2017) out of which 110 fatalities occurred on Roads.

From the above data it is clear that special attention and proper safety measures are required when transporting dangerous goods.

SAFETY IN HAZARDOUS MATERIAL TRANSPORTATION:

Risk is different when hazardous materials is transported from one place to another. There is necessity for Risk based evaluation of routing for Decision making authorities for regulating hazardous materials transportation vehicles through road(Yilmaz, Erol et al. 2016).

Risk is generally defined as “The measure of Probability and Severity of harm to an Exposed receptor due to potential undesired events involving a hazmat”. (ALP, 1995). $Rab = Pab * Cab$ (where Rab is the transportation link between a and b) (Pab is the probability of accident occurrence on link a,b) (Cab is the consequence of accidents on link a,b) (Erkut and Verter 1998) (Glickman and Erkut 2007) Used Quantitative Risk assessment approach to identify events that are most likely to occur and with highest consequence. Quantitative Risk assessment involves three steps:

- 1.) Identification of Hazard and Exposed Receptor
- 2.) Frequency analysis
 - Involves determining the probability of undesired event.
 - Determining the level of exposure to potential receptor, Provided the nature of Event.
 - Estimating the Level of Severity over a given level of Exposure.
- 3.) Consequence Modelling using ALOHA (Areal locations of Hazardous Atmosphere) and Risk Calculation.

ROUTING AND SCHEDULING:

The government and carriers must enact some strategies in order to decrease risks of transportation of Hazardous materials. Consideration should be to time of transportation.(Ronza, Vilchez et al. 2007, Yilmaz, Erol et al. 2016) According Government, Local Authorities serve as Supervisor to hazmat Transportation Carriers and they allocate the road segments with in time Period. All the carriers should follow the specified route and within Specified Time periods which are authorized by Government or Local Authorities.

SAFETY RULES FOR THE TRANSPORTATION OF HAZARDOUS MATERIALS:

(Vilchez, Sevilla et al. 1995) On September 30, 1957 a European agreement concerning the “International carriage of Dangerous Goods (ADR)” was done at Geneva under the initiation of United Nations Economic Commission for Europe, and it came in to force on 29 January 1968. Various countries have developed their HAZMAT transportation according to this ADR.

(Abkowitz and Cheng 1988) Discussed in their article that various safety measures that are adapted for Transportation of Liquid Petroleum in Singapore Highways.

In America the USDOT issues the “Transportation Regulations” in TITLE – 49”(Transportation code of Federal regulations(49CFR) and govern the transportation of Hazardous materials in all modes of Transportation.

In India, Specific guidelines were given in Motor Vehicles Act, 1988 and is a central act applicable throughout the country. On August 10, 2013 motor Vehicles Department of India enacted Central Motor Vehicle rules (CMV rules) for the transportation of HAZMAT throughout India.

SAFETY RULES ACCORDING TO CENTRAL MOTOR VEHICLE RULES:

- 1.)Rule No 129 states that:
 - “Every goods carriage carrying dangerous or hazardous goods shall display a distinct mark of the class label appropriate to the type of dangerous or hazardous goods”.
 - “Every package containing dangerous or hazardous goods shall display the distinct class labels appropriate to the type of dangerous or hazardous goods”.
 - “In the case of packages containing goods which represent more than one hazard, such packages shall display distinct labels to indicate the hazards”.
 - “Every goods carriage carrying goods of dangerous or hazardous nature shall be fitted with a tachograph, an instrument to record the lapse of running time of the motor vehicle; time speed maintained, acceleration and deceleration etc., and a spark arrester”.
- 2.) Rule 130 states manner of Display of Class labels:
 - “The class label shall be so positioned that the size of the label is at angle of 45 degrees to the vertical and the size of such label shall not be of less than 25 mm square which may be divided into two portions, the upper half portion being reserved for the pictorial symbol and the lower half for the text”.
- 3.) Rule 131 states “Responsibility of the consignor for safe transport of dangerous or hazardous goods” in which duties of the consignor is defined.
- 4.) Rule 132 states the “Responsibility of the Transporter or the owner of Goods carriage”.It is the responsibility of the transporter to ensure that
 - “The goods carriage has valid registration and permit and is safe for the transportation of the said goods”.
 - “The Vehicle is equipped with necessary First-Aid, Safety equipment, tool box and antidotes as may be necessary to contain any accident”.
- 5.) Rule 133 states the “Responsibility of Driver”.

- "It is the responsibility of the driver to keep all information provided to him in writing i.e., in the form TREM CARD (Transport Emergency Card). This is to be kept in the driver's cabin and is available at all times while hazardous material related to it is being transported".
- 6.) Rule 137 contains the class labels with respect to Hazardous materials and also further describes the criteria for the toxic, inflammable and explosive chemicals.

CONCLUSION:

It is clear from the above data that Hazardous materials transportation accidents are higher in Road ways. (Samuel, Keren et al. 2009) mentioned in their paper that there should be fast response in the accident area. He mentioned that there should be telephone facility for every 3 to 5 kms in National High ways. The major problem is that there is no sufficient data available in India for doing Risk assessment. Data should be collected by Department of Transportation, India and it should be made public so that awareness will be created in Public. (Sivaprakash, Joseph et al. 2015) The drivers should be well trained and required to check their vehicles thoroughly. They should issue "Certificate of Fitness" for all the vehicles once in a month (Yılmaz, Erol et al. 2016).

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