

# Review Of Occupational Health And Safety Management System (OHSMS) Of Process Industries With A Case Based Study Of A Fiber Industry

Samir R. Kale, Dr. Ashish M.Gujrathi, Laxmi S. Kale

*Lecturer, Chemical Engineering Department, BITS,Pilani  
Asst. Professor, Petroleum & Chemical Engineering Department Sultan Qaboos Universit, Muscat  
Faculty at Agoshdeep Institute of Professional studies, Nagda*

## Abstract

*The paper presents a state of art review of OHSMS in process industries. Major industrial accidents/incidents are described along with its root cause in the recent past. OHSMS application with a systematic approach can eliminate such incidents and accidents, such approach is also being considered for a fiber industry whose case based review has been discussed in this article. The initial approach is to identify gaps between the standard requirements of OHSMS and existing practices of the industry and implementation steps are suggested based on observations and data collected. Also, root cause analysis model for the particular industry is also suggested.*

## 1. Introduction

Majority of the process industries now operates at relatively higher operating conditions of process variables (such as temperature, pressure, use of hazardous chemicals, etc.), there is an increased risk of accidents, or occupational exposure to hazardous chemicals in process plants. Considering a number of such hazardous process industries (such as petrochemical, polymeric materials, chlor-alkali, nitration, fiber, etc.), these days the process industries are one of the most vulnerable to major disasters. Vivid reminders of few disastrous events related to process industries are Union Carbide, Bhopal India; Icmesa Chemical Company, Seveso, Italy; Three-Mile Island Nuclear Station, Piper Alpha [1,2,3,4]. Even, after these disasters and subsequent timely updated legislations in safety management changes thereof, there are reports of continuous accidents and incidents reoccurring in the chemical process industries. Some of the reported accidents of last decade are given in **Table 1**. Such incidents reiterate the concern of safety for process workers (technical and management employee and

workmen). With this concern of the industries emergence of OHSMS took place in 2001 whose guidelines were issued by International Labor Organization. The brief summary of OHSMS evolution is also discussed in the next section

## 2. Definition of OHSMS

According to Gallagher [5] OHSMS is defined as “A combination of planning and review, the management organizational arrangement, the consultative arrangement, and specific program elements that work together in an integrated way to improve health and safety at work.” According to International Labor Organization [6], OHSMS is a “A set of interrelated or interacting elements to establish OSH policy and objectives, and to achieve those objectives.” Nevertheless, another researcher Nielsen [7] argued that the management systems should not only include the management components but technical components as well. According to Nielsen (2000), OHSMS is defined as “OHSMS systems are not, of course, a well-defined set of management systems. Indeed, there are not clear boundaries between OHS activities, OHS management, and OHSMS systems.” It is therefore presumed from the above definition that there are divergent views on OHSMS. It can hence be hypothesized that OHSMS depends on the characteristic of an individual organization, and one cannot justify one single definition of OHSMS.

### 2.1 Evolution of OHSMS

After the Bhopal disaster in 1984 and Piper Alpha disaster in 1987, Lord Cullen identified the requirement for systematic safety management [8].and also lead the goal-setting approach first laid out in the report of Robbins Committee that resulted in the UK

Health and Safety Work Act, 1974 [9]. The International Organization for Standardization (ISO) considered developing an international management standard for OHS, similar to those already established for quality (ISO 9001) and the environment (ISO 14001). Support for this development among member organizations was insufficient. However, the project was disbanded in 2001 [10]. Companies have, nevertheless, sought certification to an ISO-compatible OHS standard. Indeed, the British Standards Institute developed Occupational Health and Safety Assessment Series (OHSAS) 18001 in response to this demand [11]. This standard was internationally recognized and then adopted by industries as a proxy for an ISO standard. In some industries, more management pressure was observed from trading partners to adopt OHSAS 18001 standards, as there have been previously for ISO 9001 and ISO 14001 [12,13]. In addition, some companies see potential efficiencies by adopting an OHSMS that can be integrated with their existing ISO-based management systems for quality and the environment

The international OHS standard project was referred by ISO to the International Labor Organization (ILO), which was thought to be a more appropriate forum for it. Following this referral, ILO developed guidelines on OHSMS in 2001 [6] through a consensus process that included equal representation from government, labor and employers. The ILO guidelines were envisioned as models for national standards. Dalrymple et al. [14] found that national voluntary standards for OHSMS in the draft or final form existed in Australia, New Zealand, Ireland, Jamaica, Netherlands, Norway, Spain, and the United Kingdom. The forerunner of the British Standards Institute's OHSMSs (BS 8800, OHSAS 18001) was developed by the public sector Health and Safety Executive [15]. The American National Standards Association (ANSI) and the Canadian Standards Association (CSA) both adopted the process of developing a national standard. The Canadian organization had included the ILO Guidelines, OHSAS 18001, and the draft ANSI standard as reference documents. As a result Indian organizations too started attaching the same importance to achieve high OHS performance as they do to other key aspects of their business activities. Therefore, Bureau of Indian Standards (BIS) decided to formulate an Indian Standard on OHS management systems considering this fact and a great demand from the industry for a comprehensive framework of OHS. As many organizations have reported improvements in workplace health and safety, along with significant savings from the implementation of OHSMSs [16]

there was a need to test the effectiveness of all the standards with respect to different elements.

According to Dabanbneh [17] OHSMS would be effective only by integration of the certain elements of each standard (OHSAS 18001, ILO-OSH 2001 and OR-OSHA) as each one has some merits and demerits. With this key elementary knowledge and perspective in it was decided to critically review an important research problem i.e. to redesign the existing OHSMS applied at a well-known fiber industry in India. Therefore, a case based study is presented in section 3.

### 3. Case Based Study of Fiber Industry and gap analysis of OHSMS from standard requirements

It is observed that although there is a formal OHSMS at the Fiber industry, incidents and accidents are reoccurring (see **Table 2**) and therefore, there is a demand for redesigning a robust and effective OHSMS system. The dominant pillars (important elements) of OHSMS need to be identified and analyzed carefully for implementation. Emphasis should be given on understanding and implementation of successful OHSMS to the organization, which will benefit the process owners and the process workers. Therefore, the research on OHSMS design must address the below specified research questions. Few of the research questions and its possible respective comments are identified and are also given below

**Broad research question:** Is the present OHSMS at the Fiber industry effective?

**Comment:** This question arises due to the recurrence of accidents as discussed above.

- a. Research question 1: are the present safety training and development methods adequate to prevent accidents?
- b. Comment 1: Many recent incidents were due to insufficient training and knowledge and were due to lack of awareness and unsafe behaviour among workers.
- c. Research question 2: whether the present OHSMS formats designed for each level of management easily understood? Are there any major constraints with respect to flow of information?
- d. Comment 2: the numbers of formats are not categorized level wise, which may hamper the decision-making.
- e. Research question 3: Are the hazards and consequent risks being meticulously monitored and mitigated across all departments of the fiber Industry? Are

- sufficient qualitative and quantitative tools used and analyzed for removal of these hazards?
- f. Comment 3: Presently traditional tools are only used without sufficient supervisory training for the new hazard identification techniques. New tools and detailed analysis to be done for mitigation and removal of hazards
  - g. Research question 4: Are the health monitoring systems and workplace ergonomically designed? Is any survey and data collected to verify the available results?
  - h. Comment 4: The health checkup is carried out routinely without understanding the critical areas and hazardous exposure conditions.
  - i. Research question: 5: Is the present emergency handling and disaster management team ready to tackle future disaster? Can it be verified by instances?
  - j. Comment 5: Though the past emergency incidents were handled properly, the question may arise for preparatory measures for future possible relatively larger disasters. The resources and the equipment used to tackle the worst-case scenario may not be sufficient.
  - k. Research question 6: Is the auditing process of key elements sufficient to cover the gaps in the implementation of OHSMS?
  - l. Comment 6: The external audit comments are taken into consideration only with respect to economic feasibility. This approach may be rectified in the OHSMS.

Thus, to deal with above-mentioned research problems and problems associated with existing OHSMS design methodology, there is a need to review the existing practices that are followed by the industry and identify the dominant pillars of OHSMS. To improve the effectiveness of the present OHSMS at there is a need to redesign it focusing on the dominant pillars. Therefore, to design the following objectives of the present study research the following implementation steps should be considered.

### 3.1 Implementation steps

The following objectives of the present research- based study are formulated based on the background of this subject:

- a. To study previous process plant disasters and identify the dominant pillars of OHSMS. To review the existing OHSMS general requirement from various standards and guidelines.

- b. To study the specific requirement for the identified dominant pillars with respect to the OHS of the VSF process at Staple Fiber Division.
- c. To identify the existing gaps in pillars of OHSMS at the fiber industry through survey, observation and data statistics of incidents and accidents. To redesign the OHSMS by using various tools and techniques for hazard identification and risk assessment. Also, conduct a consequence assessment study at the fiber industry for unsafe scenarios.
- d. To redesign safety training and development module.
- e. To improve the health management systems by designing ergonomically safe workplace. Verify it with any statistical tool.

To highlight the implementation, the initial gap analysis is done based on observations and data collected. The same is discussed in section 4. The details of remaining research have been addressed in the [18]

## 4. Gap Analysis and suggested model

Systematic gap identification for the fiber industry is a key for further critical analysis in OHSMS. Initially, the gaps are identified through safety manual, log-book records, training data records and audit record book of the fiber industry. Literature review also revealed that only a thorough scientific and management review will reveal the loopholes of OHSMS in a particular organization, since the organization dynamics changes from one sector to another it should be modified to suit the industry in which OHSMS is implemented.. Fiber manufacturing process involves more manual operations in the spinning area (for example. changing the jets from which viscose solution is pumped). Similarly, many steps in this process require manual operations which warrant the control of human error, proper administrative controls and safe work-practices with adequate training. This can be achieved through identifying the gaps and plugging it to build a strong and effective OHSMS. The gaps are identified from standard requirements as shown in **Table 3**

## 5. Conclusions and Recommendations

The following conclusions can be drawn from the review:

- a) Safety Training and Development module should be increased and more coverage to all workers should be given respective on the job training as 90% of accidents and incidents in Fiber industry is due to unsafe act.
- b) Most measures taken are reactive in nature, i.e. taken after the incident, therefore OHS work should include proactive measures to tackle the workplace incidents and monitor it for OHS performance.
- c) Quantification of Hazard and Risk Assessment procedure
- d) Periodic Health check systems.

A model has also suggested for assessing the root cause of the accident which is self explanatory as shown in Figure 1.

- e) Near Miss accident reporting of all events.

**Table 1: Incidents and consequences of reported industrial accidents**

Reported Incidents	Observed Consequences	Month, Year and Place	Reference
Gasoline pipeline from the refinery ruptured	3 Killed and \$ 3.05 million fined	June, 1999 Washington, USA	[19]
Explosion in an oil storage tank during repair work	2 killed and one seriously injured	June, 1999 Tennessee, USA	[20]
Leak of Liquefied Petroleum Gas from Ahmadi Refinery	4 Killed and 49 Injured	June, 2000 Ahmadi, Kuwait	[21]
Explosion at the AZF Fertilizer factory due to vapor cloud explosion	29 Killed and 500 injured	September, 2001 Toulouse, France	[22]
Vasudev Chemicals	Four Employees were killed	June, 2004 Vadodara, India	[23]
Fire at Indian Oil Depot	Economic Loss	June, 2004 Rajbandh, India	[24]
Fire at Gulf Oil R&D Center	Economic Loss	August, 2004 Hyderabad, India	[25]
Fire at Reliance Industries Limited, IPCL, Nagothane Complex	Three Employees killed	June, 2008 Nagothane, India	[26]
Acid Leak at Shasun Chemicals	Production Halt for many days	March, 2011 Vadodara, India	[27]
Fire at Vizag HPCL refinery Unit	Economic Loss	April, 2011 Vizag, India	[28]

**Table 2: Selected accidents at Fiber industry in recent years**

Year	Name of Equipment	Accident			Reference (propriety rights of the company)
		Description	Cause	Nature	
2007	spinning machine-2	While the worker was cutting tow, he got injury by a hook	Lack of precaution	Minor cut on the left ankle	logbook of spinning machine 2
2008	spinning machine-4	The worker slipped and fell into the tow waste pit during shifting machine Fiber reinforced plastic (FRP) cover	Lack of precaution	Internal back	logbook of spinning machine-4
2008	spinning machine-7	The worker slipped and fell into the tow waste pit during shifting the machine's FRP cover	Lack of precaution	Minor cut on thumb	logbook of spinning machine-7
2008	spinning machine-1	The worker got trapped between the tow and the roller	Unsafe behaviour	Elbow fractured	logbook of spinning machine-1
2008	spinning machine-4	The worker got a cut by a knife during tow cutting	Lack of precaution	Minor cut on right ankle	logbook of spinning machine-4
2009	dryer-5	The worker got struck to the beam at the dryer's wet end	Lack of precaution	Cut on ankle	log book of after-treatment section-5

Table 3 OHSMS gap Identification for Fiber Industry

S.No	OHSMS Standard requirements		Existing OHSMS at Fiber Industry	Gaps in the existing systems
1	OHS Policy		The policy has been drafted to cover safety and health aspects of all the employees and workers of the fiber industry with a thrust on continuous review for hazard and risk reduction.	None
2	Planning	Hazard Identification	To establish a system for identification, assessment and control of OHS hazard and risks, for the operational activities or services, intended changes thereon and new projects. Risk assessment is done through matrix.	The planning is based on simple checklists and administrative controls and therefore does not cover the major engineering controls which should be included in the planning process. Risk assessment should be comprehensively covered.
		Legal requirements	The fiber industry complies to the statutory requirements of OHSMS under the schedule XXVI of M.P Factories rule-107	The planning focuses on legal documentation preparation rather than monitoring tools. Monitoring should be done by formation of compliance committee's to check the compliance of individual department and cross-audit it for effectiveness.
		Objectives	Objectives include awareness of safety, understanding of safety requirements at job; enhance awareness of hazard identification and risk assessment	None
		Management Programme	The organization shall keep the record of the compliance to which law it complies, it should focus on periodical evaluation.	Periodical evaluation is missing and varies.
3	Implementation	Implementation of Structure and responsibility	The top management takes the responsibility to allocate resources essential to establish an effective OHSMS, appoint a top executive who will delegate the duties to the other subordinates.	None
		Training, awareness and competence	The training awareness about the hazards and risks for the workers is done through a training calendar, and make them understand the risks of departure from the standard procedures.	Training module needs to be redesigned by studying the previous incidents and accidents. It should identify the training needs and establish a correlation between training and incidents.
		Consultation and communication	All levels of management to worker collaboratively to identify the hazards and communicate them to the supervisors and top-management.	Level-wise information requirements to be identified and developed so that each and every hazard is reported and taken for action plan.
		Documentation and data control	Documentation is done to include all the elements of OHSMS to meet all the requirements.	None
		Emergency preparedness and response	The organization responds to the emergency situation and prepares the team to tackle the emergency situation. The fiber industry has a quick response emergency team to handle any emergency.	The responses are measured by Mock-Drills. Therefore, emergency scenario identification should be done and mock drill effectiveness to be measured.
4	Checking and	Performance	The fiber industry's OHSMS performance is	Most measures taken are reactive in nature, i.e. taken

<b>corrective action</b>	measurement and monitoring	measured by carrying out an External audit. They rate the audit and quantify in their terms. Also, action plan is generated to monitor the Non-Compliance	after the incident, therefore OHS work should include proactive measures to tackle the workplace incidents and monitor it for OHS performance.
	Accidents, incidents, non-conformances & corrective actions	Record incidents, accidents and non-conformance to rectify OHS deficiency	Near-miss incidents also need to be recorded as it has significant impact on overall OH&S
	Record and records managements	Records are maintained to conform to OHSMS and to achieve result. Old records to be discarded and new one be retained.	Records are well maintained as per the standard requirement.
	Audit	Audit is performed to check whether there is conformance to the OHSMS requirements or not. At the fiber industry, the audit is carried out externally as well as internally.	All the loopholes on OHSMS should be discussed with the auditor and action plan should be generated to have a effective and efficient OHSMS

IJERT

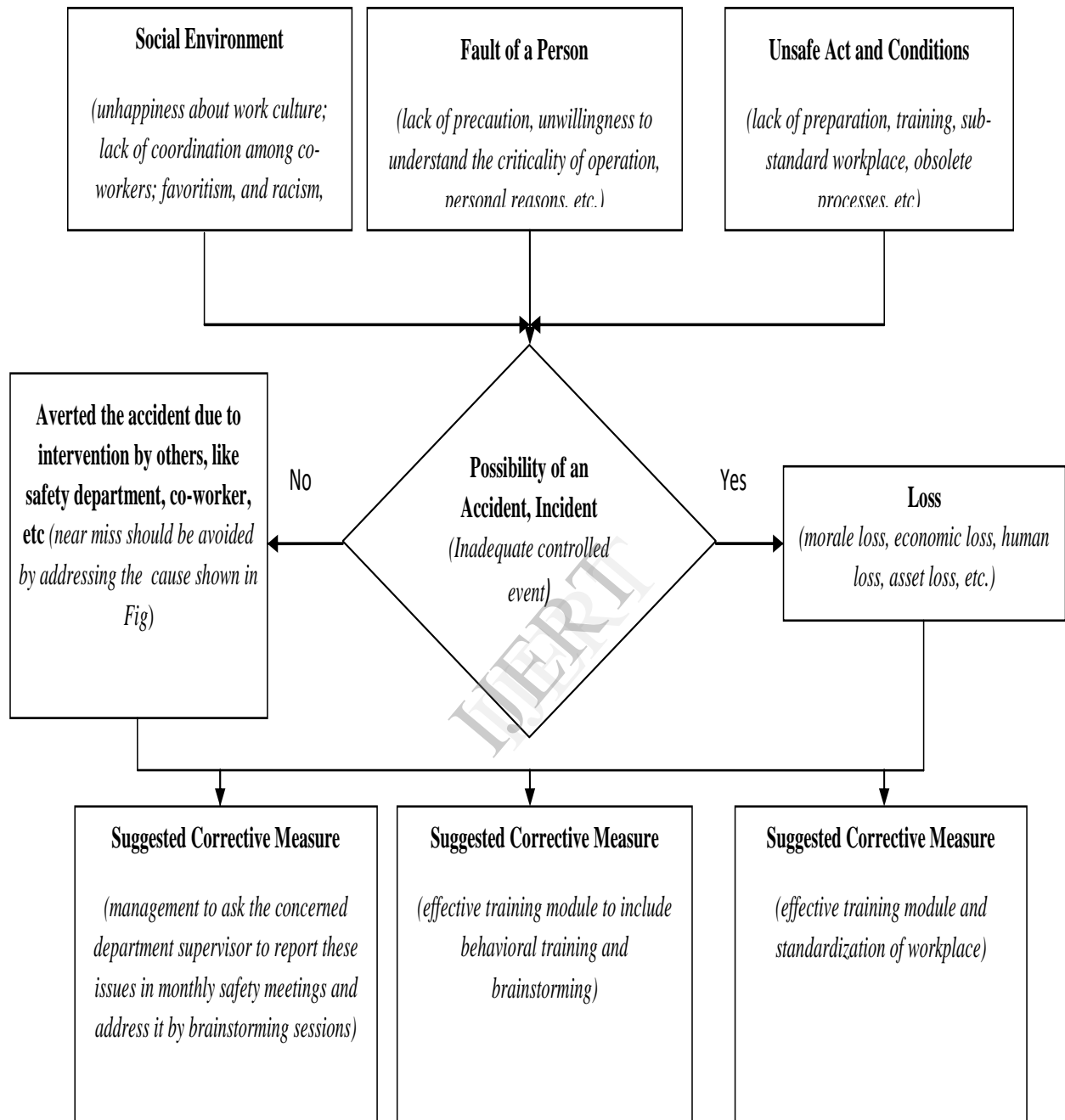


Figure 1 Accident causation model and associated mitigation steps



## References

- [1] Knegtering, B. (2002), Safety Lifecycle Management in the Process Industries- The development of a qualitative safety-related information analysis technique. Ph.D. Thesis, Eindhoven University of Technology, Netherlands
- [2] Willey, R.J., Hendershot, D. C., Berger, S., The Accident in Bhopal: Observations 20 Years Later, AIChE, Orlando, Florida, 2006
- [3] BHS(British Health & Safety Executive), Icmesa chemical company, Seveso, Italy. COMAH information page on the Seveso Disaster, July 9, 1976
- [4] Hopkins, A. (2001), Was Three Mile Island a 'normal accident'? *Journal of Contingencies and Crisis Management*, 9, pp 65 -72
- [5] Gallagher,(2000), Occupational Health and Safety Management Systems: System Types and Effectiveness, Unpublished Ph.D., Deakin University, Melbourne.
- [6] ILO (International Labor Organization, Guidelines), Occupational Safety and Health Management Systems (MEOSH/2001/2(Rev)). International Labour Office, Geneva, 2001
- [7] Nielsen, K. Organization theories implicit in various approaches to OHS management. In: Frick, K.,Jensen, P.L., Quinlan, M., Wilthagen, T. (Eds.), *Systematic Occupational Health and Safety Management: perspectives on an International Development*. Pergamon, Amsterdam, 2000
- [8] Cullen, The Lord D. (1990). *The Public Enquiry into the Piper Alpha Disaster*. Her Majesty's Stationary Office, London.
- [9] Robens Report (1972) *Safety and Health at Work* (Cmnd 5034). HMSO, London.
- [10] Bennett, D. (2002). Health and safety management systems: Liability or asset? *Journal of Public Health Policy*, 23,pp 99-124.
- [11] Abad, J., Mondelo, P.R., and Llimona, J. (2002). Towards an International Standard on Occupational Health and Safety management. *International Journal of Occupational Safety & Ergonomics*, 8, pp 309-319.
- [12] Winder, C. (1997). Integrating quality, safety, and environment management systems. *Quality assurance Journal*,5,pp. 27-48.
- [13] Wright,T.(2000). IMS - Three into one will go!: The advantages of a single integrated quality, health and safety, and environmental management system. *Quality Assurance Journal*,4, pp.137-142.
- [14] Dalrymple, H., Redinger, C., Dyjack, D., Levine, S.,and Mansdorf, Z. (1998), *Occupational Health and Safety Management Systems : review and analysis of international, national, and regional systems and proposals for a new international document*. International Labour Organization, Geneva.
- [15] HSE (Health and Safety Executive), *Successful health and safety management: HSG65*.Sudbury, ON: Health and Safety Executive, 1997.
- [16] Dalrymple, H., Redinger, C., Dyjack, D., Levine, S.,and Mansdorf, Z.(1998), *Occupational Health and Safety Management Systems : review and analysis of international, national, and regional systems and proposals for a new international document*. International Labour Organization, Geneva
- [17] Dabaneh, J (2007) *Effective Occupational Health and Safety Management Systems: Integrateion of OHSAS 18001, ILO –OSH 2001 and OR-OSHA*, 10<sup>th</sup> Annual Applied Ergonomics Conference, March 12-15, Dallas, Texas
- [18] Kale, S. , (2013) , *Design of OHSMS at Staple Fiber Division, THE FIBER INDUSTRY*, Unsubmitted Ph.D Thesis, BITS, Pilani
- [19] CNN (Cable News Network), (1999a), *Largest fine ever sought for fatal pipeline explosion in Washington State*. [www.cnn.com/2000/law/06/02/pipeline.safety.fine/index.html](http://www.cnn.com/2000/law/06/02/pipeline.safety.fine/index.html), (last assessed 10.06.2011).
- [20] CNN (Cable News Network), (1999b), *2 killed in Tennessee oil tank blast*. [www.cnn.com/us/9906/30/tank.explodes](http://www.cnn.com/us/9906/30/tank.explodes) (last assessed 10.06.2011)
- [21] CNN (Cable News Network), (2000b), *4 dead, 49 hurt in blast at Kuwait's largest oil refinery*. [www.cnn.com](http://www.cnn.com), (last assessed 10.06.2011).
- [22] Barthelemy, F.,Henri, H., Jacques, R., Jean-Paul, H., and Jean-Francois, R. (2001), *Report of the General Inspectorate [sic] for the Environment: Accident on the 21<sup>st</sup> of September 2001 at a factory belonging to the Grande Paroisse Company in Toulouse]*
- [23] Business Line, (2004a), *Explosion in Vadodara factory claims four* [www.thehindubusinessline.in/2004/06/08/stories/2004060801921900.htm](http://www.thehindubusinessline.in/2004/06/08/stories/2004060801921900.htm) (last assessed 29.05.2011).

- [24] Business Line, (2004b), Rajbandh fire: Panel to scrutinize safety norms.  
<http://www.thehindubusinessline.in/2004/06/08/stories/2004060801160500.htm>, (last assessed 29.05.2011).
- [25] Business Line, (2004c, Fire at Gulf Oil R&D centre.  
[www.thehindubusinessline.in/2004/08/12/stories/2004081202610200.htm](http://www.thehindubusinessline.in/2004/08/12/stories/2004081202610200.htm), (last assessed 29.05.2011).
- [26] Business Line, (2008),. Fire at Reliance petrochem unit kills 3; production not disrupted.  
[www.thehindubusinessline.com/todays-paper/article1626219.ece](http://www.thehindubusinessline.com/todays-paper/article1626219.ece), (last assessed 29.05.2011).
- [27] Business Line, (2011a), Acid Leak in factory sears Shasun Pharma.  
[www.thehindubusinessline.com/markets/stock-markets/article1523177.ece](http://www.thehindubusinessline.com/markets/stock-markets/article1523177.ece), (last assessed 29.05.2011).
- [28] Business Line, (2011b), Fire in Vizag HPCL refinery vicinity.  
[www.thehindubusinessline.com/industry-and-economy/economy/article1688795.ece](http://www.thehindubusinessline.com/industry-and-economy/economy/article1688795.ece), (last assessed 29.05.2011).

IJERT