Statistical Analysis of Chemical Accidents

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Introduction

A numerous amount of chemical accidents have killed thousands of innocent people. Many of the accidents that occurred at Oil & Gas companies, gas stations, or even universities could have been prevented one way or another. The type of accidents can be identified as flammable vapor explosions, dust explosions, reactive chemical explosions, and toxic chemical releases. These types of chemical accidents are great aspects that can determine how these detrimental chemical accidents can be prevented

On February 16, 2007, there was a vapor explosion at the Valero Mckee refinery which caused $50 million of damage and the entire refinery to be evacuated.

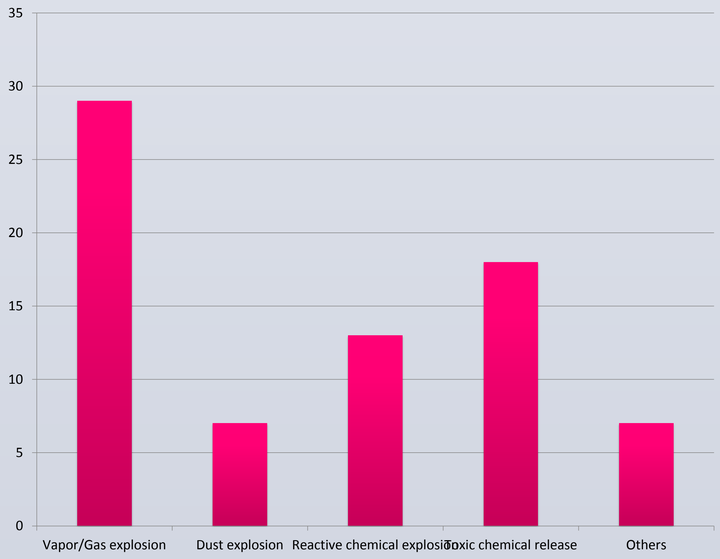


Fig. 1 shows the different types of accidents that occurred. The flammable vapor explosion and toxic release were the two most common types of accidents. The main type of accidents was flammable vapor explosions that resulted in 39% of all the types of chemical accidents

Results & Discussion

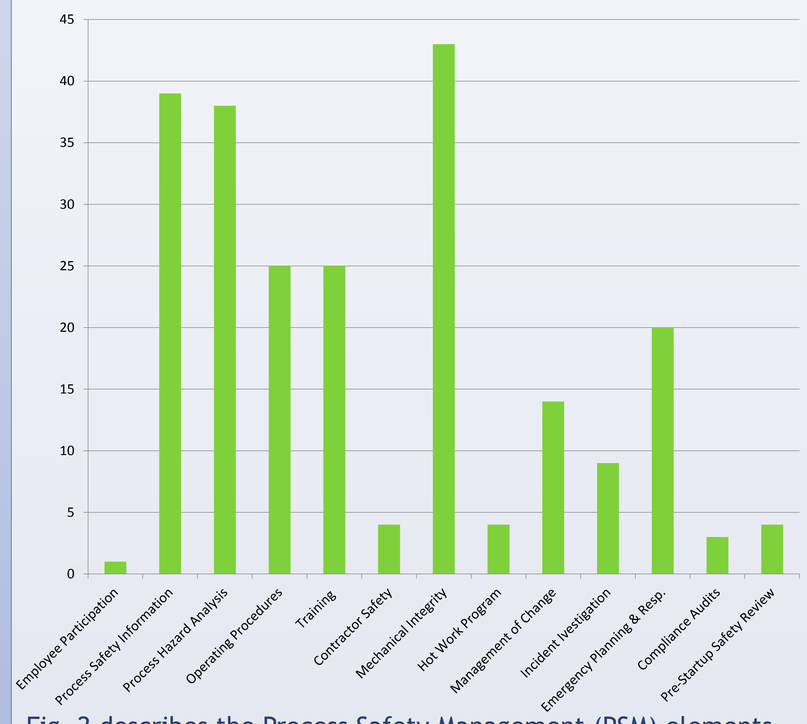


Fig. 2 describes the Process Safety Management (PSM) elements that each accident had violated within each company. Throughout the analysis of PSM violations, the results show that mechanical integrity, process safety information, and process hazard analysis were the top three types of violations while 19% of the PSM violations were due to mechanical integrity.

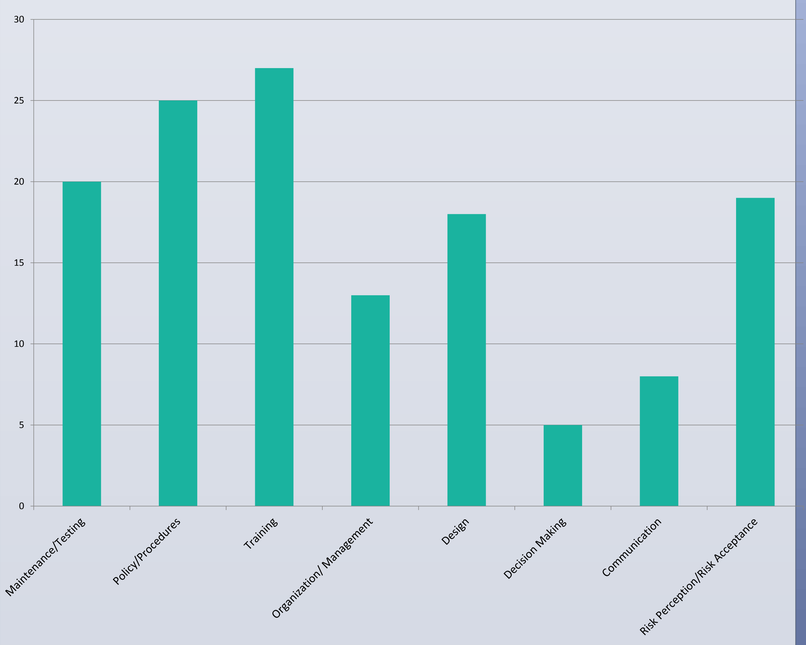
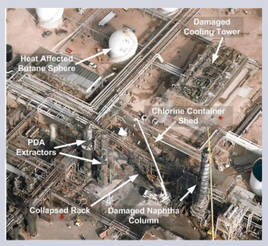


Fig. 3 describes eight different types of factors that are under the category of human error within each incident. The results show that lack of training was the main contribution to the outcome of chemical accidents. The results also show that 79% of these chemical accidents were due to human error.



Recommendations

Although the cause of most accidents were due to unsafe precautions throughout these facilities, recommendations were given to each type of incident that occurred. Flammable Vapor/Gas, Dust, Reactive Chemical, Toxic, and other explosions are all types of incidents that recommendations were given to.

Flammable Vapor/Gas Explosion Recommendation:

Make changes to the power piping, ASME B31.1, to require the use of inherently safer fuel gas piping cleaning methods rather than natural gas blows by using air blows.

Dust Explosion Recommendation:

Require member companies to develop and implement combustible dust hazard awareness training for all facility audit personnel, and incorporate combustible dust hazard identification in the audit protocols.

Chemical Explosion Recommendation:

Implement comprehensive mechanical integrity programs with an emphasis on thorough inspections of critical equipment, use indicators to monitor safety performance, and investigate as well as report near misses as well as loss of containment incidents.

Toxic Release Recommendation:

Develop guidance on the effective design and maintenance of HVAC systems and other necessary control room components designed to protect employees and equipment in the event of a release of hazardous materials.

Confined Space Recommendation:

Amend the OSHA permit-Required confined spaces rule for general industry to establish a maximum permissible percentage substantially below the LEL for safe entry and occupancy in confined spaces

Conclusion

The research has shown that 79% of the chemical accidents were due to human error, the most common amount of process safety management violations was the mechanical integrity program, and that flammable vapor explosions are one of the most common types of accidents. Implementing the fourteen elements of process safety management, effective maintenance and well trained workers will help prevent these dangerous accidents to continue to occur.

References

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3) P. Smith, H. Kincannon, R. Lehnert, Q. Wang, M. Larranaga, Human Error Analysis of the Macondo Well Blowout, *Process Saf. Prog.* **2013,** 32, 217-221

Acknowledgements

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