

Occupational health and safety management system in fireworks industries – an effective way to improve safety performance.

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Abstract : The Fireworks manufacturing processes involve use of hazardous chemicals and extreme care has to be taken by people who are involved in the process. A good safety culture in the factory can eliminate the unwanted events. A good safety culture can be inculcated by following the best practices adopted in industries throughout the world. The objective of this paper is to suggest good safety management practices for fireworks units in order to improve safety performance. Existing Safety practices and safety systems were reviewed with discussion with supervisors and foreman of fireworks units. Management system standards like OHSAS 18001, ISO 14001 and the guidelines of these standards were used and requirements were customized for the fireworks units. By Implementing the suggested management practices in the industries safety performance can be improved during fireworks manufacturing.

IndexTerms – Safety management system, Fireworks, safety performance

I. INTRODUCTION

Fireworks were first developed in India or china for display at religious festivals and spread to other parts of the world (Michael S. Russell 2009). The manufacturing of pyrotechnics is an inherently hazardous process. Failure to properly recognize unsafe conditions and to take steps to mitigate the hazards can result in unexpected circumstances resulting in injury or death (OSHA 3912-03 2017). Various recommendations to enhance safety were reported in the fireworks literature (Ghosh,K.N, 1987) (Sivapirakasam S.P et.al) (Rajathilagam.N. and Azhagurajan..A 2012). The material used in fireworks manufacturing are basically categorized into Fuels , Oxidizing chemicals , chemicals which produce colour and smoke , Binders and substances which accelerate or retard combustion (Ghosh,K.N., 1987). Thus the use of hazardous chemicals identifies the need for fire prevention system and effective safety management system in the fireworks units. The objective of this work is to suggest occupational safety management practices for fireworks units from various guidelines and standards. Existing Safety practices and safety systems (OSHA 3912-03, 2017) were reviewed with discussion with supervisors and foreman of fireworks units.

II. METHODOLOGY

Safety practices and safety management systems prevailing in the fireworks units were studied and compared with occupational health and management system standard and process safety management guidelines. Based on the study features of effective safety management system were suggested for a typical fireworks unit. This can provide framework for establishing good safety system in the fireworks industries

III. FRAMEWORK FOR ESTABLISHING GOOD SAFETY MANAGEMENT SYSTEM

Following are the key features of safety management systems suggested in order to improve and enhance the safety system in the fireworks manufacturing units.

3.1 Delegation Of Safety Supervisor

A person can be assigned to look after safety functions in the unit. Many titles exist for management personnel who are responsible for plant safety. The following is the list of some of these titles.

1. HSE specialist
2. Safety Engineer
3. Safety Officer
4. Loss- Prevention Co-coordinator
5. Work protection supervisor
6. Accident Prevention Superintendent

Roles and responsibilities should also be defined like conducting safety meetings, promoting safety and conducting accident investigation. A qualified person can be assigned the role of safety specialist in the fireworks units to look after the safety function. If qualified person is not available adequate training can be imparted to the foreman to meet the expected knowledge and skills. The knowledge on handling of hazardous chemicals, hazard identification tools ,safety promotional methods and safety supervision can be the focus areas on which the people have to trained.

3.2 Personnel Orientation On Safety

This orientation consists of introducing all employees to the company and the plant safety policies, rules and regulations. Carefully and concisely the safety supervisor should explain all standard company fire safety rules, safety programme and any special regulations peculiar to that fireworks activity. For example while entering the rooms the worker should discharge static electricity using ESD (electro static discharge) plate. This orientation can be done in a speech to a few employees along with demonstration of handling of explosive mixture with a video, if available, for a large group of employees.

3.3 Conducting regular toolbox meetings and pep talks

Safety Toolbox meetings can be held weekly at a convenient time, that is, at a time that is least disruptive to the job. Initially the foreman or supervisor can give the talk. The safety spokesperson for each craft should address a gathering of all the members of that particular craft; however, if the size of the crew is prohibitively large, smaller groups can be assembled. Pep talks of fifteen to twenty minute duration on safety topics can be done daily. The experienced foreman/supervisor in the units can prepare the speech on various topics and deliver in a small gathering on day to day basis.

3.4 Good reporting system and documentation

All safety activities should be recorded and files and documents should be easily accessible. These records and reports form the foundation of accident prevention. Accident report, Accident investigation report and inspection reports are some of the few. For comprehensive list of safety records legal requirements such as Explosive act & rules, Factories act, standards on safety management systems like OHSAS 18001: 2007, ISO 45001 – Occupational Health and safety management system and IS 14489 : 1998 Code of practice on occupational safety and health audit can be referred.

3.5 Evolving safe work method and safe operating procedure

Safe work method can be obtained by job safety analysis and past accident history for the particular job. Workers should be informed and trained on these procedures.

3.6 Daily Job-Site Surveys

Plant surveys and inspections should be carried out daily by supervisor, independent of each other but confined to the respective areas of that supervisor's activities. The craft representatives should also be responsible in their area, and should notice anything outside their responsibility to the appropriate supervisor for correction. Craft representatives should recognize unsafe conditions and unsafe acts and rectify them, normally using their own work force. Their representative should regularly survey the area for hazardous debris and other potential hazards. Similarly, other trade representatives should do the same thing in their respective areas. Any unsafe conditions noticed during these surveys should be rectified immediately using the trade representative's own work group. The problem stays and is resolved by people working within their normal expertise. Daily surveys also encourage communication among workers. For daily inspection and surveys appropriate checklist can be developed and used. Based on the changes checklists have to be periodically reviewed and modified.

3.7 Daily plant inspection by management personnel Orientation.

A very efficient and effective way of keeping on top of hazard recognition is by making it the company policy that all management personnel are responsible for safety irrespective of whether or not they serve on the safety committee. These responsible management delegates should be inspecting the plant concurrently with the trade surveys, paying particular attention to the high risk areas.

3.8 Daily inspection by the safety coordinator

The daily inspection routine should be carried out by the safety coordinator. This person can conduct inspection at least once in a day, or more often if time permits and inspect the whole unit, paying attention to all various activities but particularly to potential hazards and high risk zones.

3.9 Safety committee meeting

Regular Safety committee meetings have to be conducted at least once in a fortnight. Agenda can be circulated well in advance to all the members and also to the invitees. Safety engineer will chair the safety meeting. Date, time of the meeting can be specified in the circular. Finishing time should also be mentioned. The meeting should not be too long. All members are needed to participate in the meeting and contribute by giving suggestions to enhance safety performance.

3.10 Safety promotion

Safety can be promoted by safety celebrations, conducting seminars publishing newsletter and bulletins of company management preference. Various safety competitions like Safety Slogan, Safety drawing, Essay, safety suggestions and best safety award can be arranged for workers to create interest on occupational health and safety.

3.11 Management Review of Safety system

The management can review on regular basis the occupational health and safety system existing in the industry and can identify the means to improve them as per the suggestions given in OHSAS 18001: 2007.

3.12 Setting Occupational Health and safety objectives and action plans to achieve them.

Safety objectives can be set at various function levels. For each safety objectives action plan to reach the objective by fixing the responsibility and target date.

3.13 Conducting Safety training programmes for the workers

The assigned safety coordinator can organize safety training programmes covering all the workers. For new workers a comprehensive safety induction training programme can be given.

Training can be provided in the following topics.

1. Housekeeping
2. Safety in the manufacturing of fancy items
3. Safety in the preparation of Tip Composition.
4. Safety in handling explosive mixture
5. Safety in fuse making
6. Safety in Product testing
7. Safety in the storage and transportation of finished products.
8. Fire prevention and Protection
9. Static Electricity
10. Lightning protection (Target audience : for electricians in the fireworks units)
11. Safety in handling of following chemicals
 - Aluminium Powder and flakes
 - Magnesium
 - Sulfur
 - Potassium Nitrate
 - Barium nitrate
 - Gunpowder
 - Strontium Nitrate
 - Red Phosphorous
 - Calcium Carbonate

3.14 Development of emergency plans and carrying out mock drills.

Emergency plans for fire and explosions can be developed considering the different stakeholders. The role of external agencies should also be considered in designing the plans. The emergency plans can be tested on regular basis as mentioned in OHSAS 18001: 2007.

3.15 Quality testing of purchased raw material

The incoming raw materials can be verified for quality. A separate laboratory can be used to perform the tests. For each incoming lot samples have to be taken and tested before sending the raw material for actual production.

3.16 Chemical analysis of explosives and pyrotechnics formulations;

New formulations can be tested for safety and legal approval should be obtained.

3.17 Safe plant layout with adequate safety distance

The safety distance and isolation have to be maintained as per the explosive rules and codes.

3.18 Maintaining the lowest inventory of chemicals

A record for inventory can be maintained and monitored. Inventory levels can be specified for each room and can be maintained.

3.19 Showing the top management commitment by publishing the policy and communicating to workers.

The importance of safety has to be communicated to the employees. This can be initiated with drafting a set of Health , Safety and Environment policies. The policies can be explained to the worker and top management commitment on HSE can be elaborated. [OHSAS 18001: 2007]

3.20 Establishing Permit to work system.

Work permit systems can be introduced in the fireworks units for hazardous works, maintenance work , height works for any maintenance , manufacturing of tip compositions and other hazardous works. Suitable formats can be designed for each work specifying the precautions to be taken.

3.21 Compiling safety information about explosive chemicals and safe operating procedure for process equipment

Safety Information related to fireworks chemical compositions, work procedures , Material safety data sheets and emergency information can be compiled and available to the workers.

IV. RESULTS AND DISCUSSION

4.1 Framework for establishing safety management systems for fireworks units have been documented .Management system standards , accidental statistics and literature mentioned in the references have been referred and management system practices have been suggested. Supervisors and foreman of fireworks units were trained for implementation of above safety practices in their units. By implementing the above suggestions in fireworks units safety can be enhanced in industries.

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