# Investigation of Thermal Analysis on Fire Work Chemical Composition

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*Abstract*- In all types of industrial sector, the accidents are happening and increasing day by day. Particularly in sivakasi, huge number of accidents take place in fireworks alone when compared other industries. Crackers produced from fireworks made of Al, S and KNO3. These chemical powders are hazardous in nature, very sensitive and when exposed to heat and humidity it leads to decompose. In this paper sensitiveness of the chemical powders using friction and impact sensitivity test is presented. Climatic condition is one of the key factor influencing the accident rate. The various hazardous processes are involving like mixing the chemical powder, filling the mixed powder tube, drying the chemical mixture for making the crackers. During these processes, mishandling of powders leads to fire due to mechanical sensitivity. So, the main aspire of this study is to evaluate the causes of fire and explosion. The statistics of the accidents and its root causes are presented in this work. Further, safety measures for preventing the accidents and safeguarding the environment is detailed So here I am collected all accidents statistics and founded its root causes. Finally I will give safety remedial measures for preventing the accident and make safe environment in fireworks.

*Keywords*:-Fireworks, accident analysis, safety measures

## I. INTRODUCTION

Sivakasi is a large manufacturing centre of crackers gratitude to its innovative and work cognizant people. It is an rid and warm region. It is well recognized all over India for its industries like Fireworks, Match Industries, Printing Industries. In fact the whole country depends on Sivakasi for its supply of fireworks and matches. India is the second largest producer of fireworks after China. In sivakasi more than 90% of India's overall fireworks production taking place.

Fireworks in Sivakasi

The fireworks industry in Sivakasi is worth between Rs 800-1000 crores. .There are nearly 983 fireworks factories giving a job for more than 70,000 employees and about 1 lakh indirect such as paper tube making, wire cutting, box making industries in the country side. About 20-

25 workers pass away each year in fire accidents in this industry[1.] create antastic displays of light, noise and smoke.

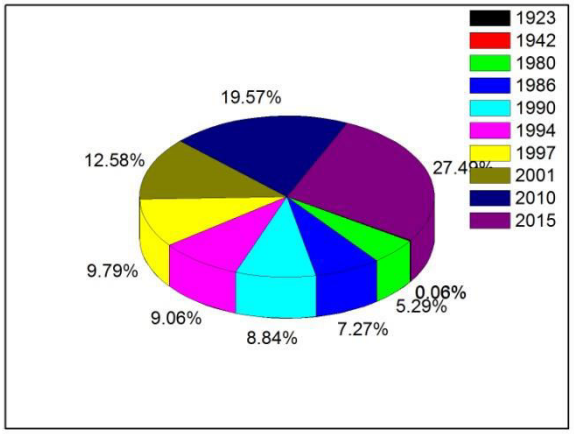



Figure .1Fireworks in sivakasi (Ref.19 & % is % of fireworks )

Fireworks are sources of using hazardous material and as in any manufacturing industry, Fireworks units also prone to produce accidents. To decrease the risk of accidents, safety procedures are to be maintained and followed strictly inside the manufacturing areas. The Pyrotechnic compositions used for fireworks are a mixture of fuel, an oxidizer, binder, colorants and other material with special effects.

The different chemicals using are sulfur, aluminum powder of different grades, barium nitrate, potassium nitrate, sodium nitrate, strontium nitrate, dextrin, charcoal, aluminium powder, PVC, magnesium powder. All of these chemicals are hazardous in nature and very sensitive. So we should handle the powder carefully.

The manufacturing processes in the fireworks industry can broadly be classified into seven stages.

- Mixing of chemicals.
- Filling the chemicals
- Fuse making
- Fixing the fuse
- Drying the chemicals
- Wrapping/Labelling the product
- Packing
- Storage

216 fatalities and 63 are severely injured from 1994 to 2008. It shows that most accidents were caused by in excess of gunpowder put in at one time and accidents resulting from carelessness while making fireworks. Unsafe acts and unsafe conditions are the main reasons for these accidents. 127 persons were died and 69 persons were injured in fireworks industries accidents during the period from 2010 to 2012. It shows that the workers are unaware of the dangers in the chemicals they are handling. Unsafe acts and unsafe conditions are the main reasons for the accidents.

## II. ACCIDENT IN FIREWORKS

Each and every year accident rate was increased abruptly. In 2001 -2002 only 7 accidents are occurred, 7 peoples were died. but 2010-12, 127 peoples were died. this is for needs of crackers for everyone and lacking of safety measures.

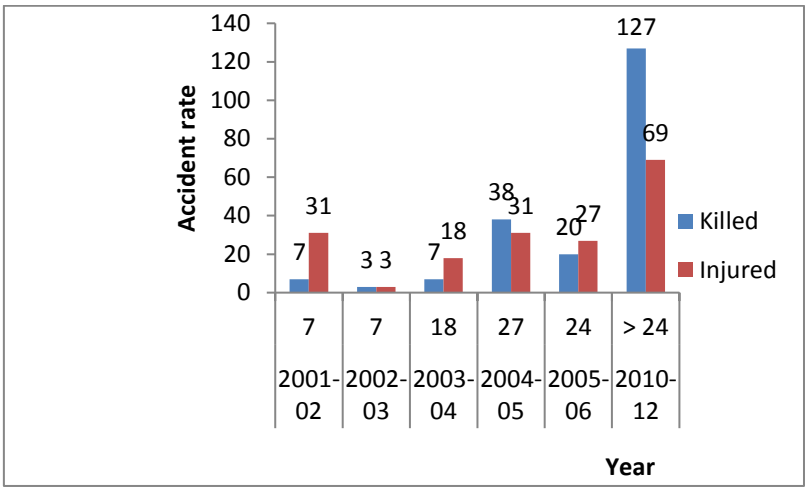



Figure 2 Accident strategy in fireworks

The accident data are collected from the Chief Inspector of Factories, Chennai for the period 2010 to 2012. The number of fatalities during the period was 127 which involve 30 factories.

One hundred and twenty seven persons were died and sixty nine persons were injured in fireworks industries accidents during the period from 2010 to 2012.

Petroleum and Explosive safety organization (PESO) annually released the report for all explosive industry include fireworks accident. Here I prepared graph using PESO data's.

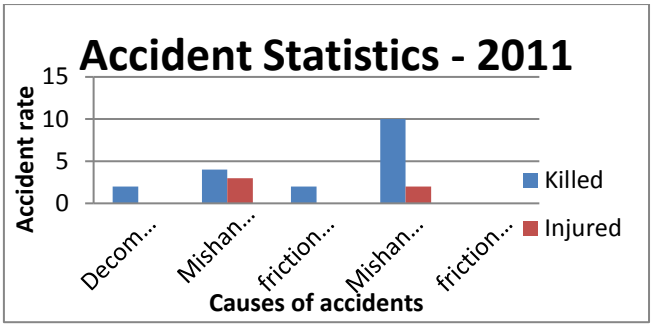
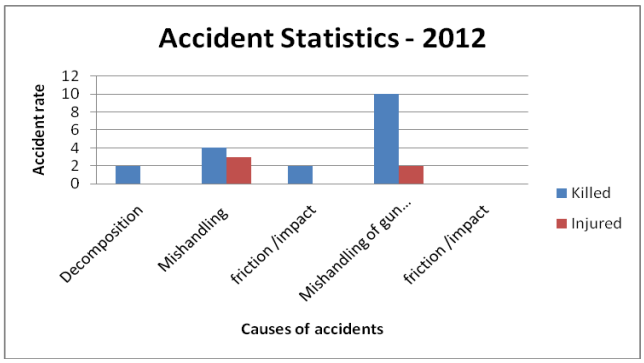



Figure 3.1

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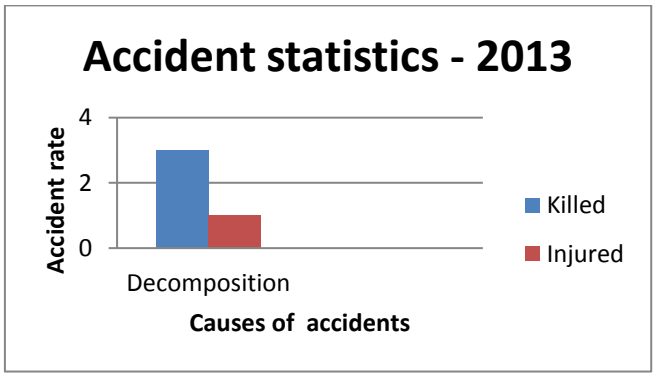


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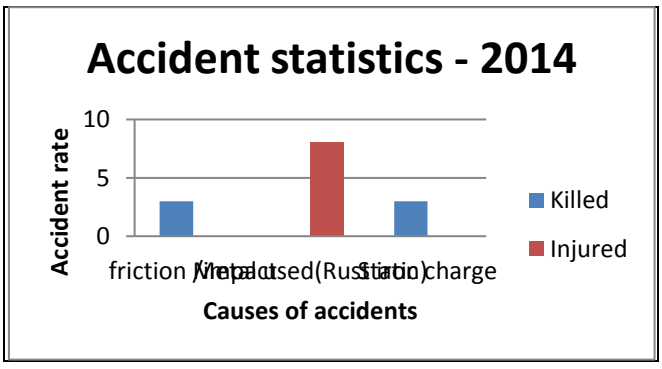


Figure 3 PESO Accident report – 2011-2014
Causes of accident

From the PESO report, In fireworks many accidents are occurred due to

- Mishandling of chemical powder
- Mixing the chemical powder
- Filling
- Friction
- Impact
- Static electricity.

Due to the carelessness of the workers chemical powders are fall into the floor and exposed to frictional contact into the floor fire may occur. By conforming that here I tested impact and friction sensitivity test for different chemicals alone and mixed chemical powders like gun power and fancy stars. The result shows that when the chemical power are in separate fire hazardous is less than mixed chemical powder.

## III. Experimental Test

There due to these accidents there we change the chemical compositions of the present fire works industry. After this making the changes we will do the following tests for the safety issues.

### Friction Sesitivity Test

The response of material to a varity of stimuli (friction, impact) which can cause danger during transport is critical to determining safe handing procedure. The friction test detremines whether or not a solid , a liquid or a pasty substance presents a danger of explosing or rection when submitted to the effect of friction.

To set the friction tester into starting position, turn the hand wheel on thr top of the motor in such a way that the two marks at the side of thr table and base are lined up. When pressing the start button , the table has to move on time backwards and than one time forward. After setting the machine in the start position, a porcelain plate is placed into the holding assembly with the “sponge marks” in the opposite direction of motion

### Impact Sensitivity Test

The production of solid propellant grains high exposive devices and pyrotechenique devices is a big challenge due for the hazardoes nature of the material. The production involves handling processing. Transportation and storage of rawmaterial in process. End and finished products. The hazaradous due to impact , friction heat and shock exist all while during mixing . finishing etc ..., thus it is very much essential to study the hazardous nature high energy material.

Top anvil is placed above the mixture sample. Movable cast steel block is set to a required height and tightened . The straighteness of block is checked using hydraulic level indicator. Weight is connected to release device. Spark sensor is held around the avile . The solenoid control is actuated using a remote and weight is allowed to fall on the top anvil vertically.

## Thermogravimetric Analysis

Thermogravimetric analysis (TGA), or simply thermogravimetry (TG), is a technique for measuring changes in the sample mass that occur while the sample temperature is varied in accord with a controlled temperature program. The measuring device is called a thermobalance, which is a combination of a sensitive analytical balance with an electronically programmed furnace. The runs are conducted in controlled gaseous atmosphere that can be either static or dynamic. The samples studied by TGA are either solids or low volatility liquids. The sample size is normally within the range 1–100mg, although the instruments for handling gram size samples are also available. The sensitivity of TGA is limited by the sensitivity of the balance, which can be as high as 0.1mg.

The shape and position of the TG curve is determined by the mechanism and kinetics of the process associated with the mass change. All modern TGA instruments are a combination of a balance and a furnace, both of which are controlled electronically. The furnace can be positioned either vertically (a and b) or horizontally (c and d). In either position of the furnace.

## Noise Level Test

Noise level test was carried out as per the rules of notification of Petroleum and Explosives Safety Organisation, Govt. of India. It was measured by four noise level Monitors using Model no. 824L (Make: Larson and Davis, USA) and the average value of the readings was taken as noise level data. The noise level was measured at 1.2 m elevation from the ground level of bursting at 4 m distance. The metres were placed in four places and angle between each of them is 908. A hard concrete surface of 5 m diameter was the site for the explosion with no obstacle (like tree or any other structure) to carry out the noise level test. For repeatability of the results, five samples of each composition have been checked. Reproducibility of the results was carried out by the results of all experiments and was evaluated with different equipment of same specification.

There we finally concluded that after the all tests we want to get the value between the above given ranges. If it above the range means it will not at all safe composition.

# IV. SAFETY MEASURES

The following safety measures should be followed by the workers and its supervised by the occupier and safety officer in inside the fireworks unit for mitigate the accidents.

- Storing the pyrotechnic chemicals in separate room.
- Name boards for each process to be displayed.

- Utensils used for one type of mixture should not be used for other type of mixture.
- Wear rubber shoes while at work.
- Do not carry matches.
- Doors are made of woods fitted with non ferrous hinges.
- Doors shall be open outwards.
- Least quantity of chemical composition in working places (not more than the prescribed limit).
- Room shall be well ventilated to reduce the probability of dust explosion.
- Firework products are never to be dragged roughly.
- Fire buckets shall be filled with dry sand and never being used for other purpose.
- Display safety posture ( for uneducated workers).
- All rooms have minimum of two fire exits.
- Floor should be covered with electrically conducted rubber mat.
- Space between the buildings shall be minimum 10 meters.
- Space between the drying platforms and other rooms shall be 18 meters.
- Distance between mixing and filling sheds shall be 18 meters.

## V.CONCULSION

- There finally we conclude that we changing the chemical compotion and the reducing size of the particle the powder will be very safe.
- Our goal is to prepare the safest compotion to the fire industry.
- By changing the size of the chemicals we can we can reduce the sound pollution.
- There we find the solution that for this dangerous chemicals like aluminum we are replacing the chemical with global waste like tamarind seed powder.

- There we using the nano size chemical powder for reducing the sound pollution.
- We use to change the chemical mixture composition of the present fireworks industry for the safety check.
- We have done the tests for the above mixture like impact, friction, noise level & TGA.
- We taken care of the people who work in the fire work industry like the heat resistance and the roughness in the powder for shifting.
- We have taken care about the crackers that in what nature how it will give the reaction for the people.
- We taken care about the people for not effecting the human body.

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