

AIR OVEN ACCIDENT INVOLVING PYROTECHNIC COMPOSITION

BY

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INTRODUCTION:

Premier Explosives Ltd., is a well established organization; engaged in the manufacture of industrial explosives; explosive accessories; propellants and special devices for civil and defense use since 1980.

Premier Explosives Ltd., in house R&D facility is recognized by Department of Scientific and Industrial Research (DSIR); India and University of Gulbarga; India.

INCIDENT:

The research team was working on development of a new delay composition consisting of lead iodate and lead dinitrobenzoate which are co precipitated.

One experiment has been carried out with batch size of 150 grams.

The material was filtered, washed thoroughly with water and final wash was given with denatured spirit. (Denatured spirit is ethanol with 1 to 2% methanol)

Ethanol is very volatile with flash point of about 23°C and auto ignition temperature of about 363°C.

The flammable limit of ethanol vapor in air is 6% minimum which is highly flammable.

The washed material was taken in a tray and kept for drying in an air oven. The oven was non flame proof type with coils directly heating the oven.

The material was kept in the oven at 5 PM and laboratory was closed for the day at 5.30 PM.

The next day morning at 6.00 am when the lab drying room was opened it was found that the oven containing the pyrotechnic composition had completely collapsed and another oven by the side on another table fell down.

OVEN:

There are two partitions in the oven cabinet; dividing the cabinet into 3 parts.

The heating coils are placed at the bottom of the oven covered by a perforated plate.

The Oven is provided with a covered vent which can be closed if required.

The temperature sensor is located in the top compartment of the oven with thermostat to control the oven temperature.

The oven is also being used for other materials.

ANALYSIS METHODOLOGY USED:

For the investigation of this incident Fault Tree Analysis (FTA) method was used.

Fault tree analysis was developed in 1962 for the U.S. Air force by Bell Telephone Laboratories.

Later adopted and extensively applied by the Boeing Company.

In this methodology; to know the reasons for any unusual occurrence various causes for the event are identified by brain storming or open discussion with all connected with the event.

The identified causes are laid out as a tree with the branches.

They are connected by gates comprising either of the two following logical functions.

OR



AND



A fault tree is a graphical model of all parallel and sequential combinations of events that lead to the top event.

Description of Symbols used in fault tree



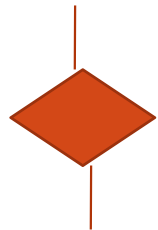
Top event

(The primary undesired event of interest)



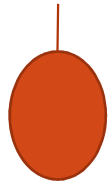
Intermediate event

(Caused by more primary level events described below)

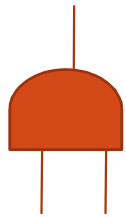


Un developed event

not developed any further because either it is not useful
or data unavailable



Basic initiating event does not need to be developed further.



AND Gate

Logic gate where output occurs only if all inputs occur



OR Gate

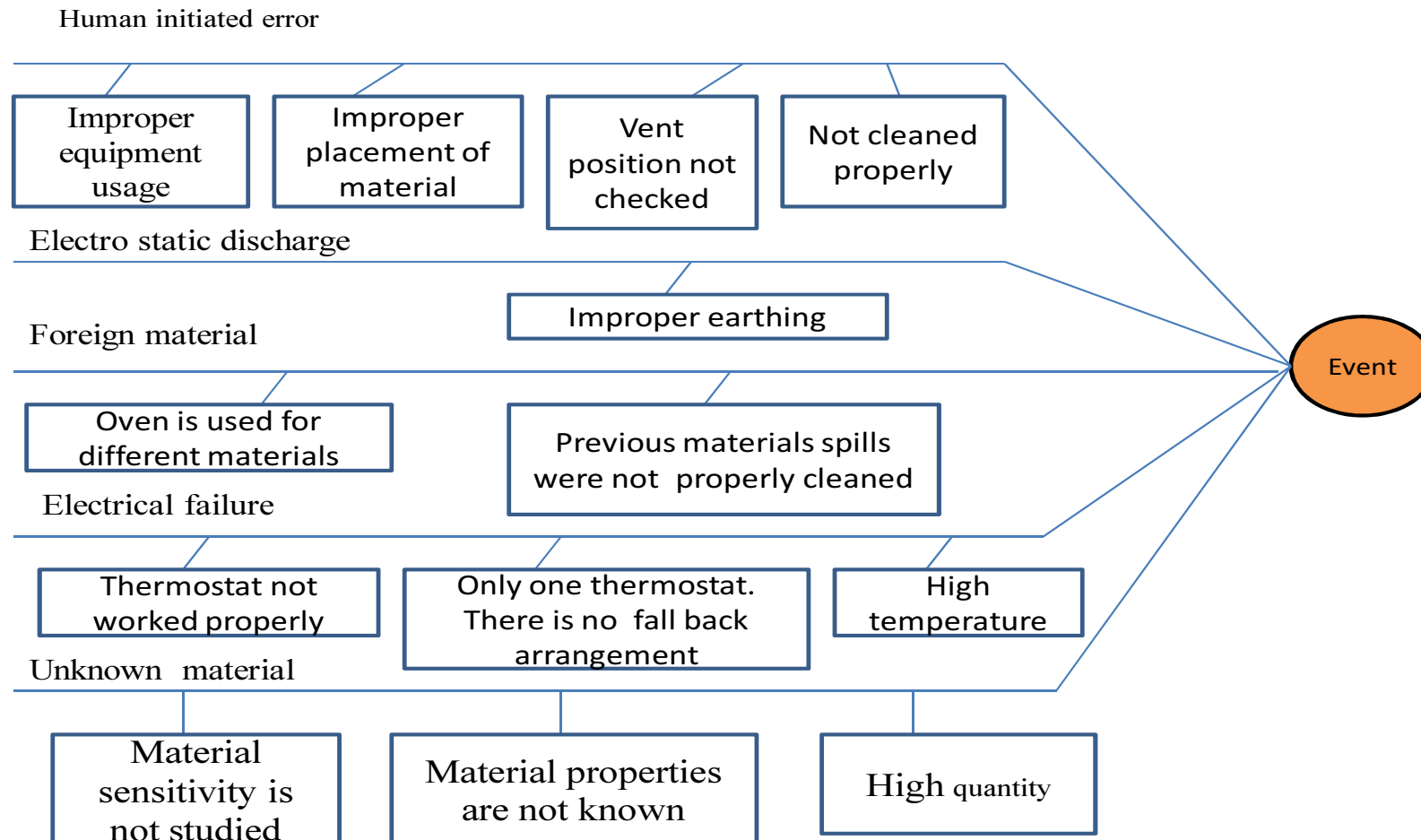
logic gate where output occurs if any of the inputs occurs

INVESTIGATION:

All the team members inspected the incident site and remnants were observed.

A brainstorming for identifying all probable causes has was conducted.

The participants after examining the remnants and discussing the incident made certain observations which are made into a fault tree as shown below.



DISCUSSION:

1.0 Human initiated error:

- a) Improper equipment was used. Only flame proof ovens to be used for hazardous materials drying.
- b) Air vent position is not checked

2.0 Electro static discharge:

- a) The oven is earthed at only one place with a crocodile clip
- b) No rigid earthing is provided

3.0 **Electrical failure:**

- a) Only one thermostat
- b) No fall back arrangement

4.0 **New Material:**

- a) This is the first time the material is made in the lab
- b) Material data sheets are not developed.

REMEDIAL ACTIONS TAKEN:

1. Standard operating instructions for all the equipment is made
2. Pre use check list is also developed for all the equipment
3. Only FLP ovens will be used for high energy materials.
4. Before making higher quantities the characteristics of the compound should be made at 2 g or 3 g level for establishing safety parameters.
5. Training of all persons in HAZOP of all operations.

All these are now implemented.

CONCLUSION:

From the above case study it can be established that FTA is a very handy tool for unusual occurrence investigation.

It will lead the investigation to root cause and give a concrete reason for the occurrence,

It will also drive the analyst to find out the remedial methods to avoid reoccurrence of the faults.

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Thank you