DUST EXPLOSION IN A SPRAY DRIER:

A Perspective on the Probable Causes

People are shocked by the devastating accident at Sigachi near Hyderabad.

So far only sketchy details through media are available.

What we know for sure is that this incident involves **microcrystalline cellulose powder,** and that it allegedly happened while **spray drying**.

A Four-member high level committee has been appointed to investigate the root cause of the incident. We will have to wait for their report.

We have been flooded with question as to how this happened. The Scenario can be assessed as follows…

For dust explosion to happen it has to fulfil the **explosion pentagon** criteria. The five parameters for any explosion to take place are –

1. **Fuel**
2. **Air (oxygen)**
3. **Ignition source**
4. **Dispersion**
5. **Enclosure (Confinement)**

During spray drying, except for ignition source **all other four parameters are present**. So, we need to look for ignition source in the set up.

The requirement of ignition strength and enormity of explosion will depend upon the powder(fuel) involved. In this case, it is microcrystalline cellulose powder. The properties of this microcrystalline powder are required to investigate the incident.

The MIE (Minimum Ignition Energy,) Pmax and Kst (Rate of Pressure rise during explosion) depend upon the specific substance. Even in case of microcrystalline cellulose, the properties will depend upon its method of preparation and particle size.

So, the properties of the microcrystalline cellulose will vary a bit depending upon how it is prepared. In the absence of actual data let us try to decipher with the properties reported in literature.

MIE ranges from 30mJ to 600 to 1000mJ
MIT (Min Ignition Temp.) = ~400C
Burning class = 5
Dust layer (5mm) ignition temp = 330◦C
Explosion category: St -1
Pmax = 6-9 Kg/cm2 and **Kst** < 200 bar.m/sec

Looking at these properties, ***explosion due to static is highly unlikely*** if no flammable solvents are present.

Now we have to find **possibilities of ignition source** in the system during the operation.

Possibilities are as below:

1. If air heating is by direct fired heater, then in case of ***filter failure***, burning /incidence particle enter into spray dryer leading to incident.

2. If the spraying is not proper, then there can be ***encrustation at the top of the dryer***. This material will be continuously in touch with hot air. This material can decompose and then burning material can fall in the dryer leading to fire/explosion.

3. In case of disk atomizer or any ***rotating parts*** in the system, if bearing fails, the temperature can go high leading to ignition.

4. ***Exhaust blower*** is used letting out the air. An air filter or scrubber is used in air outlet line prior to blower. This will ensure that no fine particles get into blower which can lead to fire and explosion at exhaust blower. If the filter bag ruptures then fine particles will enter into blower leading to explosion. The pressure wave due to this explosion can back track into spray dryer along with burning material which can then lead to ***secondary explosion*** in spray dryer.

If explosion takes place the pressure generated will be around 6-8 bars. If explosion vents are not provided or if they are undersized, then a big blast will take place. ***The microcrystalline cellulose is highly combustible*** (BZ class 5) and **fire will spread very fast** in the surrounding. If flammable solvents are present in the premises, it will lead to further devastating impact.

These are the possibilities and we will get a true picture only after the investigation is complete. What is crucial is that we must take all the necessary precautions to avoid above situations. Most importantly, we should have with us, the properties like dust explosion and burning behaviour of products prior to carrying out the operation.

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