Overview of Fire Situation for 2008

AND

Case Studies of Recent Fires

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SCOPE

- Fire Statistics
- Case Study 1 - Dropped Light
- Case Study 2 - Electrical Origin
- Case Study 3 - Pure Oxygen Hazards
- Case Study 4 - Dust Cloud Explosion
- Conclusion
Fire Incidents from Year 2004 to 2008

Total Number of fires responded by SCDF

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Fires</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>4916</td>
</tr>
<tr>
<td>2005</td>
<td>5039</td>
</tr>
<tr>
<td>2006</td>
<td>4702</td>
</tr>
<tr>
<td>2007</td>
<td>4796</td>
</tr>
<tr>
<td>2008</td>
<td>4973</td>
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Breakdown of Fire Incidents from 2004 to 2008

Commercial & Industrial Fires

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Fires</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>340</td>
</tr>
<tr>
<td>2005</td>
<td>314</td>
</tr>
<tr>
<td>2006</td>
<td>311</td>
</tr>
<tr>
<td>2007</td>
<td>319</td>
</tr>
<tr>
<td>2008</td>
<td>317</td>
</tr>
</tbody>
</table>

- **Commercial**: 197, 159, 152, 152, 158
- **Industrial**: 143, 155, 161, 161, 160
- **Total**

0 50 100 150 200 250 300 350 400 450 500 550

Year
Causes of Fires in Singapore

In 2007 and 2008

Causes of Commercial & Industrial Fires

Breakdown of Fire Causes in 2007 and 2008


No. of Fires

Your cigarette butt could have caused this

Careless smokers cited as common cause of fires here

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S MOKERS, take heed.
You are adding to the latest national half-year fire statistics.
And it does not make you look good.
Because the Prime Minister had just spoken about the need to be more gracious.

Yesterday, the Singapore Civil Defence Force said that fires in the home and in the grass reached the top of the list of fires.

The Singapore Civil Defence Force (SCDF) said that fires in the grass and in the home saw the biggest increase this year as numbers almost tripped.

There were only 18 cases during the first half of last year. This jumped to a whopping 300 cases this year.

SCDF said the dry spell in February and March this year contributed to the huge jump. And numbers are expected to grow this year because of the weather.

The organisation has advised members of the public not to throw lit materials like cigarette butts and matchsticks on grass patches, gardens and fields.

Don't dump rubbish

Unwanted furniture should also not be dumped on fields or gardens as they could act as additional fuel to burning vegetation.

Cigarette butts were mentioned again as a cause for “dropped light” fires, which the SCDF said are the most frequent causes of fires.

Household fires (unattended cooking, gas, electrical appliances) this year fell by 8 per cent to 469 cases from 510 cases last year.

This was a five-year low.
But the SCDF had to respond to 2,545 fires this year, more than the 2,273 fires during the same period last year.

To tackle the threat of rubbish fires, the SCDF alerts its Civil Defence Executive Committee members, who are civil defence volunteers in housing estates, on fire statistics every three months.

SCDF informs them which blocks are more susceptible to rubbish fires and these volunteers visit residents there to educate them on how to prevent such fires.

The SCDF said that in the first six months of this year, there were 173 repeat cases of rubbish chute fires in certain blocks.

PM Lee Hsien Loong, during his National Day Rally speech on Sunday, had called on Singaporeans to be
Residents suspect a cigarette was the cause of this rubbish chute fire in Ang Mo Kio Avenue 4 yesterday. ST PHOTO: SHAHRIYA YAHAYA
OR EVEN THIS.....
SMOULDERING FIRE...

• Under the right conditions, dropped light can result in fires.

• May be smouldering for hours before ignition.
CASE STUDY 1

Basement Cark Park of Commercial Building
9th Jan 2009 (Friday) @ 1141 hrs

- Fire believed to be caused by indiscriminate disposal of cigarette butts.

- Smoking ban imposed on all indoor public places since 1 Jan 09.

- Smoking activities continue in inconspicuous places.
Fire involved items such as building materials, metal components, tiles, etc. stored inside the Air Plenum at basement 3 car park.
LAYOUT PLAN OF BASEMENT 3 CAR PARK

- Entrance into carpark
- Parking Lot
- Exhaust Air Shaft Above
- Area of Origin
- Exhaust Duct Room
- CARPARK Exhaust Fan Room
- F(E) B3-1
- F(E) B3-2
- Air Plenum

Exhaust Fan Room
ORIGIN AND CAUSE OF FIRE

Cigarette butts found on the ground and inside the exhaust ducting at B1 car park

Believed that the cigarette butts were thrown down through B1 car park exhaust ducting vent and landed inside the Air Plenum at B3

The exhaust fan may have fan up the ignition source (lighted cigarette butts).
Fire results in loss of business…
Safety Tips:

• Fully extinguishing cigarettes, joss sticks, incense papers, etc. after use

• Proper disposal into ashtrays, incense bins, etc.

• Identify places where smokers may light up and establish security and safety patrols.
CASE STUDY 2

Workstation in Storeroom of Production Plant
1st Oct 2008 (Wednesday) @ 1250hrs

- Fire extinguished by SCDF before fire spreads to rubber products
- Damage localized to the workstation.
- Fire believed to have originated from an energized multi-extension socket.
Line of Demarcation

Line of Demarcation
Line of Demarcation

Severe Charring
Severely damaged electrical wirings and fittings
Switch found to be in the 'ON' position.

Location of Main Switch where multi-extension socket was plugged in.
Why it may be a hazard?

1. Kept out of sight

2. Likely to be left on

Other combustibles nearby
Safety Tips:

• Do not overload power points.

• Main switch ‘OFF” when not in use
CASE STUDY 3

4-room HDB unit in Woodlands
12th July 2008 (Saturday) @ 1242 hrs

- Fire involved contents of an air-con compressor (fire and explosion).

- 1 person sustained burn injuries to his hands and legs.
LAYOUT PLAN OF UNIT

- CORRIDOR
- SWITCHBOX
- LIVING ROOM
- BEDROOM 1
- SOFA
- BEDROOM 2
- MATTRESS
- MASTER BEDROOM
- KITCHEN
- TOILET
- GAS CYLINDER
- REFRIGERANT
- UNAFFECTED AIRCON
- MATTRESS
- SWITCH
- STUDY TABLE
- THE AFFECTED AIRCON

NOT TO SCALE
DETAILS OF INCIDENT

• Contractor was performing a pressure test on the air-con compressor to test for leakages. The gas used was pure oxygen from a cylinder (verified by HSA)

• Sudden explosion heard and 1 worker sustained burn injuries.

• Secured by personal safety line and did not fall off.
Onboard a Docked Vessel in Tuas 8th June 2008 (Sunday) @ 1151 hrs

- Fire involved contents of pipelines on a ship.

- The pipelines (for delivering hydraulic oil) had to be tested to a specified pressure.

- 6 workers sustained burn injuries.
DAMAGE SUSTAINED:

- Hydraulic controls damaged
- Ruptured hydraulic pipes
- Heat damage to insulation inside big generator room
DAMAGE SUSTAINED:

Battery inside room sustained heat damage

Ruptured pipes and burnt insulation

Place where soap test carried out. Explosion witnessed by workers here
DETAILS OF INCIDENT

- Pressure Test (140 bar) on pipes
- Usage of pure oxygen from manifold system
- Whilst workers were administering a soap test (about 10 mins from initiation of oxygen), a loud explosion occurred. 6 workers sustained burn injuries

COMPRESSED OXYGEN MANIFOLD SYSTEM
MANIFOLD SYSTEM CONNECTED TO THE HYDRAULIC PIPES
• Piping broke off at various joints.
• Pipe ends observed to have ‘opened up’ suggesting the fire occurred from within the pipes.
• Pure Oxygen is an oxidising gas which can vigorously accelerate combustion.

• Presence of lubricating grease and rust were found in the pipes.

• Equipment and material contaminated with oil or grease can ignite easily and burn with explosive violence in oxygen-enriched atmospheres.
Safety Tips:

- Never use pure Oxygen for pressure and leakage tests.
- Common market practice to use inert gases, such as Nitrogen, which eliminates Oxygen from the triangle of fire.
CASE STUDY 4

Creamer Making Plant
24th May 2009 (Sunday) @ 1036hr

- Company acquired machine approx. 8 months back.

- Upped the operating temp (within operating range) to increase output approx. 1 week back.
Current Protection Of Spray Dryer Systems

Baghouse protected By 2 nos explosion Door, size: 49.5” X 37.5”

Spray Dryer protected By 4 nos explosion door Size: 37.5” X 37.5”

Schematic of Creamer making Machine
DAMAGE SUSTAINED:

Partition walls cracked.

Machine panels dislodged.

False ceiling fell.
DAMAGE SUSTAINED:

- Explosion hatches blown out.
- Filters burnt and damaged.
- Ventilation panels fell off.
- Machine sustained heat damage.
Witness Account:

Was topping up freeflow agent when there was an explosion at this location.

Saw flames shooting out sideways.
Closed-Up View of Area of ‘Explosion’

Remains of Silicon Sheet which connects the spray-dryer to the fluid bed.
Dust Cloud Explosions

- Dust clouds of finely powdered substances can become combustible or explosive. When there is a static discharge in a dust or vapor cloud, explosions have occurred. Among the major industrial incidents that have occurred are: a grain silo in southwest France, a paint plant in Thailand, a factory making fiberglass mouldings in Canada, a storage tank explosion in Glenpool, Oklahoma in 2003, and a portable tank filling operation and a tank farm in Des Moines, Iowa and Valley Center, Kansas in 2007. [1] [2] [3]


1. There must be an effective means of static charge generation

2. There must be a means of accumulating and maintaining a charge of sufficient electrical potential

3. There must be a static electrical discharge arc of sufficient energy

4. There must be a fuel source in the approximate mixture with minimum ignition energy less than the energy of the static electric arc.

5. The static arc and fuel source must occur together in the same place and at the same time.
Conditions Necessary for Static Arc Ignition

1. There must be an effective means of static charge generation

- “The flowing movement of finely powdered substances or low conductivity fluids in pipes or through mechanical agitation can build up static electricity.”

- Wagner, John P.; Clavijo, Fernando Rangel [doi:10.1016/S0304-3886(00)00019-X Electrostatic charge generation during impeller mixing of used transformer oil] Department of Nuclear Engineering, Safety Engineering and Industrial Hygiene Program, Texas A&M University, College Station, online 21 August 2000; accessed in Jan 2009
1. There must be an effective means of static charge generation

- Generation of a static charge can happen during handling and processing of dusts and fibers in industry. Dust dislodged from a surface or created by the pouring or agitation of dust-producing material, such as grain or powdered material, can result in the accumulation of a static charge on any insulated conductive body with which it comes into contact.

- NFPA 921
2. There must be a means of accumulating and maintaining a charge of sufficient electrical potential.

- Actual silicone and creamer used in experiment

Silicone Sheet

Electrostatic meter registering a negative charge
Conditions Necessary for Static Arc Ignition

3. There must be a static electrical discharge arc of sufficient energy

- No means of testing at this point in time.
- Local forensic labs unable to support.
- Static discharge is difficult to prove.
Conditions Necessary for Static Arc Ignition

4. There must be a fuel source in the approximate mixture with minimum ignition energy less than the energy of the static electric arc.

3 nozzles sprays a fine mist of liquid creamer mixture.

Mist dries up as it settles in the heated spray dryer.

Creamer powder being channelled into fluid bed.
Conditions Necessary for Static Arc Ignition

4. There must be a fuel source in the approximate mixture with minimum ignition energy less than the energy of the static electric arc.

- Actual creamer used in experiment.
- Cloud of falling creamer is a potential fuel source.
Conditions Necessary for Static Arc Ignition

4. There must be a fuel source in the approximate mixture with minimum ignition energy less than the energy of the static electric arc.

- Witness was introducing freeflow agent at the material time.
- Possibility of freeflow agent igniting as it falls?
Conditions Necessary for Static Arc Ignition

5. The static arc and fuel source must occur together in the same place and at the same time.

Fuel:
Falling dry creamer powder within.

Possible ignition source:
Static discharge from silicone sheet

Machine is earthed

Vibrating fluid bed to move creamer down the processing line
Literature reviews and experiments have shown that:

- Static charge can be generated.
- Silicone sheet can allow charges to accumulate.
- Dry creamer cloud is a possible fuel source.

Creamer sent for forensic analysis:

Higher operating temp. may have resulted in finer creamer particles i.e. more susceptible to ignition.
Safety Tips:

• Conducting a risk assessment on new processes may help to identify potential weaknesses (hazards).

• Guidelines available on MOM website:

## Risk Assessment Guidelines

<table>
<thead>
<tr>
<th>No.</th>
<th>Work Activity</th>
<th>Hazard</th>
<th>Possible Accident / Ill-Health</th>
<th>Possible Risk Control</th>
</tr>
</thead>
</table>
| 3   | Mixing/Blending        | Limbs caught in moving mechanical parts of mixer / blender | Amputations, fractures, sprains          | • Install machine guarding  
• Install sensors  
• Install warning alarms  
• Implement safe work procedures  
• Provide and attend training on machine guarding |
|     |                        | Fire & explosions                      | Injuries / deaths                         | • Install local exhaust ventilation  
• Build covers on mixer/blender  
• Build enclosures around mixer/blender  
• Install dilution ventilation in work area  
• Prohibit ignition, heat sources and open flames  
• Provide well-ventilated, non-air-conditioned work area  
• Implement safe work procedures  
• Provide and attend training on fire and explosion safety  
• Install deluge / fixed water systems  
• Implement emergency plans  
• Conduct regular drills  |
|     |                        | Excessive inhalation of solvent vapours produced by agitation, mixing or blending | Ill-health due to chemical overexposure  | • Install local exhaust ventilation  
• Build covers on mixer/blender  
• Build enclosures around mixer/blender  
• Install dilution ventilation in work area  
• Provide well-ventilated, non-air-conditioned work area  
• Implement safe work procedures  
• Provide and attend training on solvent hazards and control measures  
• Provide, use and maintain respiratory protection  |
CONCLUSION

• Be conscientious about fire safety.
  - Indiscriminate disposal of cigarette butts, etc.
  - ‘OFF’ electrical switches.
  - Check on the use of proper materials in work processes.
  - Conduct risk assessments, where appropriate

• Together, we can prevent fires.
End of Presentation

Thank you for your attention.