Integrated Fire Engineering and Response
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Investigation report on a wooden furniture industry fire.

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Introduction

- This study present the main features of a fire incident report and the experimental work that was performed in order to investigate a 'Serious fire' happened at 27-09-10 in a wooden furniture industry located in an industrial area in Northern Greece in a small distance from the City of Thessaloniki .

- This wooden furniture industry was complied with fire safety measures as predicted by the Greek Government Desicion (no 1589/2006) "Industrial Fire protection". (so, it has been supplied with passive protection measures i.e means of escape, emergency lighting and signs , and active measures i.e. fire detection , permanent fire water supply network but with no sprinkler installation).

- The Timber industry was a 12.500 m2 concrete building. Processed materials was raw wooden materials and final products was furniture and other wooden constructions.

Incident analysis-emergency Response

- The initial call reporting this incident was at 13.06 hours i.e in the middle of working day.
- Timber complex had a trained and equipped Emergency Response Team (ERT) that included 30 members. On the day of the incident; 15 trained emergency responders were immediately available.
- Firefighters from the surrounding fire stations were in 'emergency alert' providing 27 fire vehicles with 80 fire fighters deployed at the scene of fire.
- Fire extinguished after ten (10) hours.

Incident Analysis-cause of fire

Fire investigation was concluded :

1. That the fire has been caused by sparks during maintenance activities(hot works) in the machinery area.
2. No special fire precautions during ‘hot works’ has been taken as predicted by government decision 7/1996
3. Fire was not contained to the room of origin and spread to the whole building
4. Fire almost immediately spread from first to second ignited materials.
5. Fire Compartments were inadequate to stop the fire, and fire was no possible to be suppressed by permanent fire fighting hose reels by industrial fire staff.

Incident Analysis-fire spread

Factors that were leading to the rapid fire growth and flash over conditions:

1. First ignited materials that were ‘unprotected’ stack 2mx3mx2.5m of pine wooden pallets
2. Secondary ignited materials that were raw wooden material.
3. Dust and wooden shavings have contributed to the fire spread in the whole building.

Incident Analysis

- Almost the whole wooden material and electro-mechanical equipment of industry have been destroyed by the fire.
- Estimated property loss 1.600.000 euro.
- On the other hand, the reinforced concrete, columns, beams performed very well in such a severe fire due to high fire resistance of reinforced concrete.
- Nine(9) workers and one(1) fire fighter have been transferred to the local hospital suffering from scrapes and smoke inhalation.

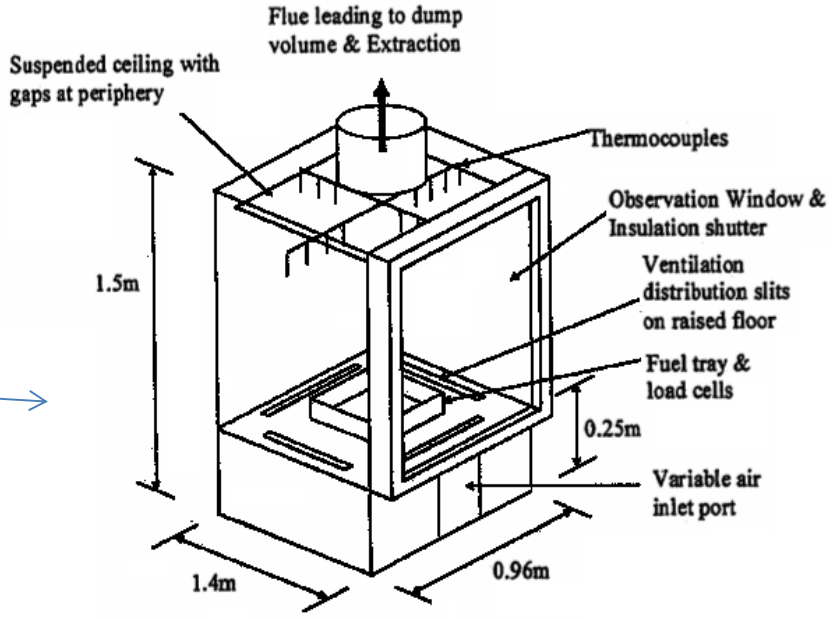
Research work

- A research project was undertaken to investigate this case where the first material ignited was wood; if that ignition and fire spread could have been prevented or minimized by treating the timber surfaces with suitable flame retardants.

Experimental techniques

•The apparatus used was a standard Cone Calorimeter manufactured in accordance to ISO 5660 (1993) and ASTM E1354 (1992).

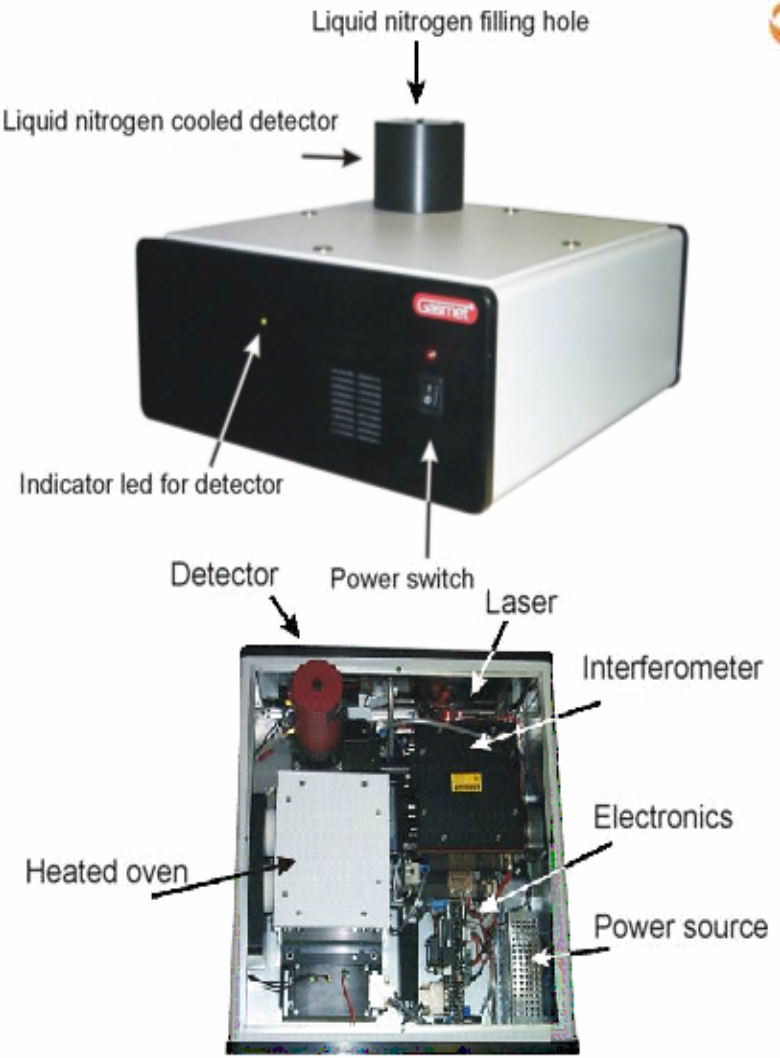
- A 1.56 m3 enclosed fire test facility, 1.4m x 0.92m x 1.22m, was used with separate entrained air inlet at floor level and fire product exit at ceiling level.



University of Leeds Fire Rig Enclosure

Experimental techniques

- A heated sample line was linked to a TEMET GASMET CR-Series portable FTIR.
- This has a multi-pass, gold-coated sample cell with a 2m path length and volume of 0.22l.
- A liquid nitrogen cooled MCT detector was used that scans 10 spectra per second and several scans are used to produce a time-averaged spectrum.



University of Leeds FTIR and its internals.

Thermal behaviour of untreated timber

- All untreated samples clearly burned faster and with the highest HRR.

Pine exposed at Heat flux 35kW/m2

- Seven (7) wooden crib fires were investigated using untreated pine wooden cribs or treated at different percentage (%) of the total surface area with a water – based, intumescent, suitable for internal surfaces.
- One untreated sample was tested using 6g of ethanol as ignition source.

Untreated pine crib into the test.

Thermal behaviour of fully flame retarded timber

No ignition' and lower toxic emissions compared to untreated samples were observed at 35kW/m2 (small scale).

- In all fully-treated (100%) cases, there was no ignition, and increasing amounts of ethanol, i.e., 6, 20, and 30g, were used as ignition sources.
- A "weak" flame initially developed from the burning of ethanol, which "triggered" the in-tumescent flame retardant paint to expand and form "instant firewalls" to contain and finally suppress the developing fire.

100% treated pine crib (used 20g of ethanol as ignition source) in the end of experimental process.

FTIR Toxic Gas Analysis

- In most fully-treated (100%) cases, even in the half-treated (50%) cases, lower or almost equal to unity emissions were measured compared with the bare samples.

- This is due to the fact that, in such cases, due to the in-tumescent action, there was either ‘no ignition’ of the samples (100%-treated cases), or a considerable delay was seen (50%-treated cases).

Toxic Analysis

- The European Community COSHH (COntrol of Substances Hazardous to Health Regulations) workplace 15 minute maximum allowable toxic concentrations are used to evaluate overall toxicity.
- For untreated pine, formaldehyde and acrolein were the dominant gases. Benzene was also significant. CO emissions was significant but not very high.
- Lower toxic concentrations measured for full treatment case where acrolein was the dominant toxic.

Conclusions

- The application of intumescent flame retardants on wooden surfaces located close to ignition sources in the most probable areas for a fire to break out, could be a safe and effective approach in reducing fire losses in the wooden furiture industry

Recommendations

Performing of more small- and medium – scale experiments, treated with the updated technology of the intumescent paints (different parts of wooden cribs or some other form of samples), and using various ventilation rates to achieve both establishing and documentation of the contribution of intumescent technology in fire suppression, are suggested.

Fire safety management of industry need to be improved with:

- Proper use and application of fire safety measures needed
- Check the company's space ; It must be always cleaned from dust and wooden shavings
- Keep out the flammable substances and sparks and take the necessary fire precaution where is required

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Thank you all so much for your attention!