

Fire behaviour of modern cladding materials

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Compartmentation

- To assure safety in a multi-occupancy building, any fire must be contained within the compartment.
- Inside, fire doors and solid walls ensure this.
- Outside, there must be no combustible wall coverings

Grenfell Tower fire spread

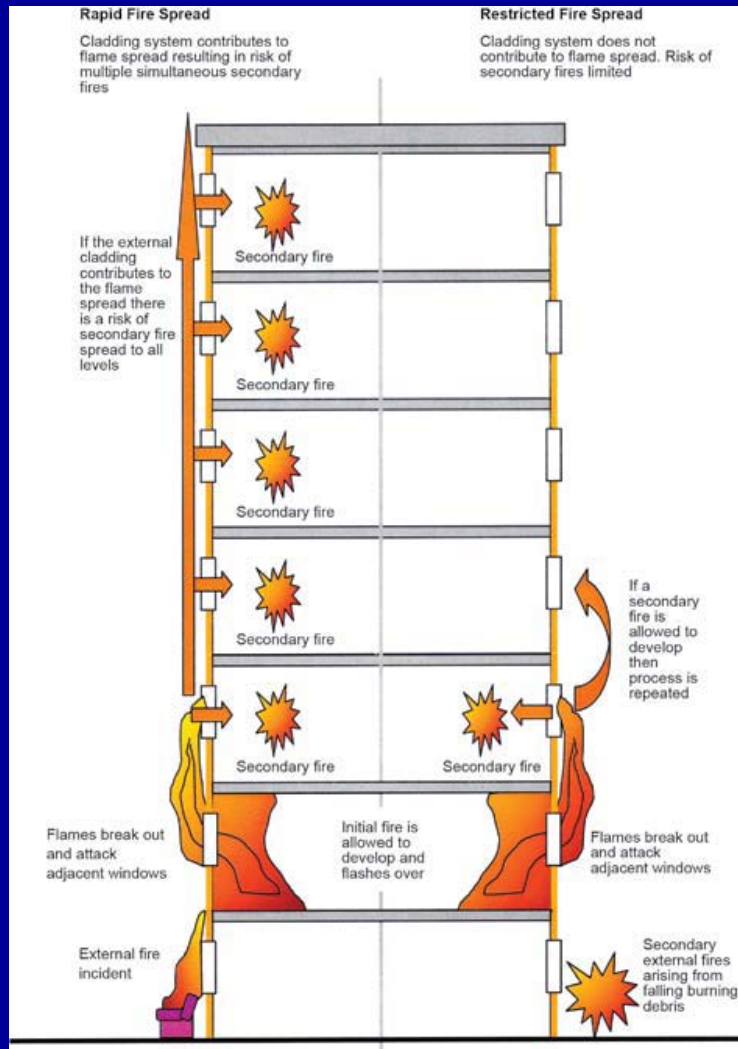


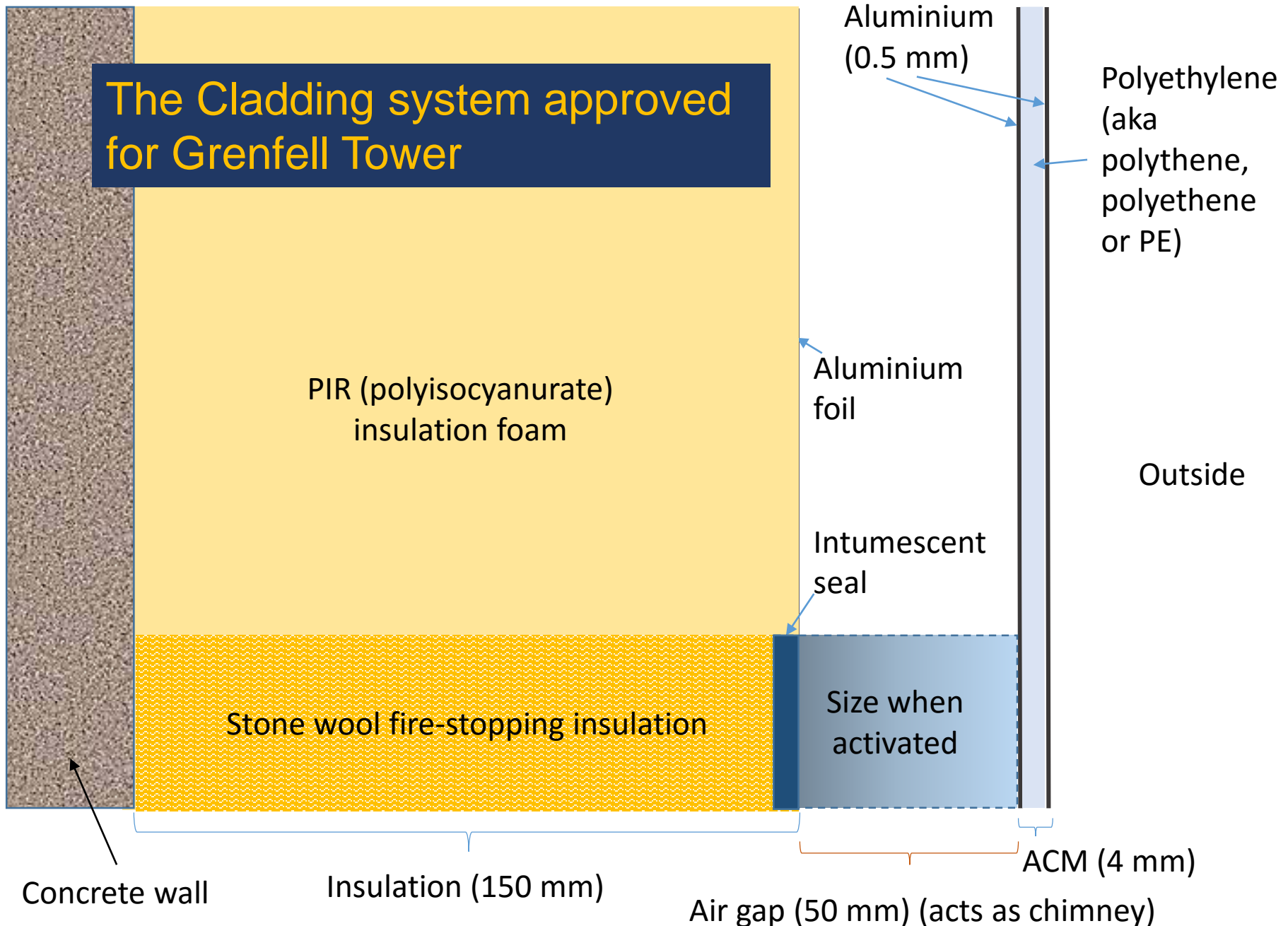
Figure taken from BRE's BR 135 "Fire Performance of external thermal insulation for walls of multistorey buildings"

The worst case should be fire spread to the floor above (RHS), not fire spread through the cladding all the way up the side of the building (LHS), as appeared to occur at Grenfell

How do combustible materials end up on tall buildings?

- UK Building Regulations (Fire Safety) (Approved Document B) refer to BRE document BR 135 and BCA Guidance Note 18
- These provide 4 routes to approval:
 - Use non-combustible materials
 - Test the system in BS 8414 (large scale test)
 - Undertake a “desktop assessment”
 - Use Fire Safety Engineering (holistic approach)

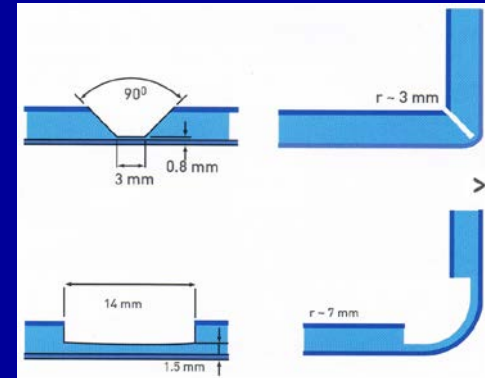
The Cladding system approved for Grenfell Tower



Aluminium Composite Panels



These can be cut and bent to form solid-looking panels



The Composition of the core can be:

1. Polyethene
2. Fire retarded polyethene
3. Mineral filled

How was ACM fire rated?

Passing BS 476-6 and 476-7 gives Class 0 rating

But these only test the aluminium sheet, not PE

BS 476-6

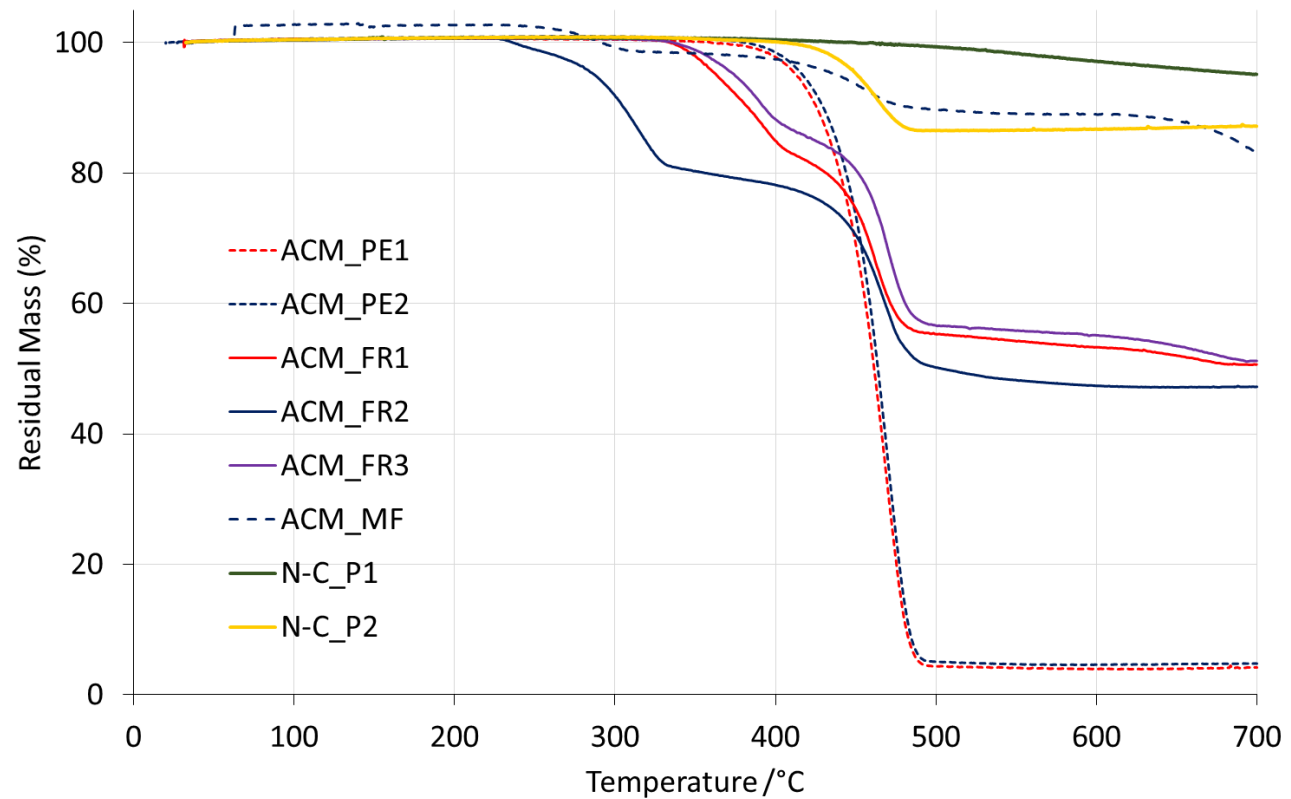
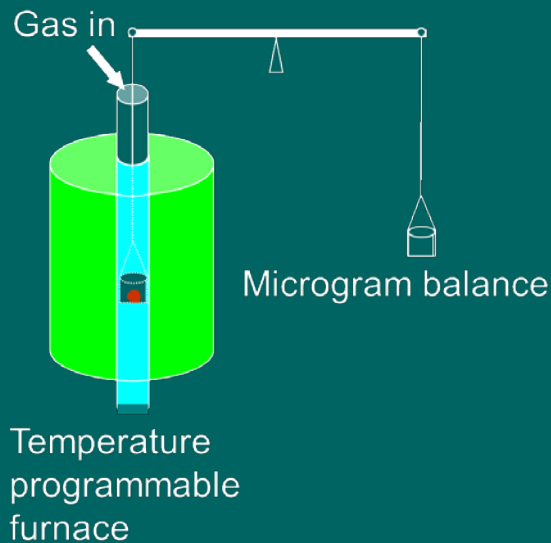


BS 476-7

Panel Materials Tested

Code	Filling
ACM_PE1	PE
ACM_PE2	PE
ACM_FR1	PE with FR
ACM_FR2	PE with FR
ACM_FR3	PE with FR
ACM_MF	Mineral filled
N-C_P1	Stone fibre panel
N-C_P2	Aluminium honeycomb

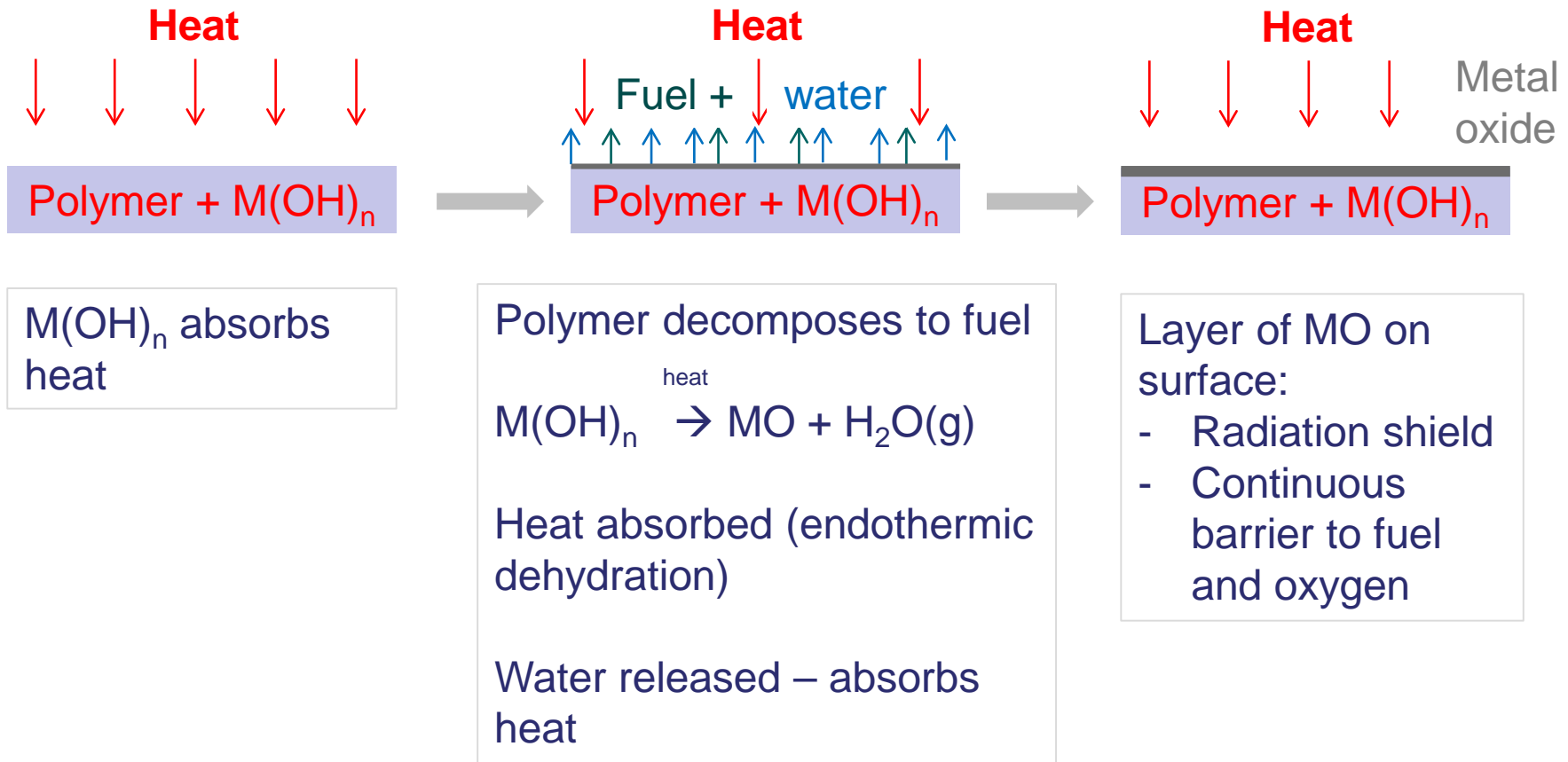
TGA in N₂



There are very clear differences between PE, FR and non-combustible

How do ACM fire retardants work?

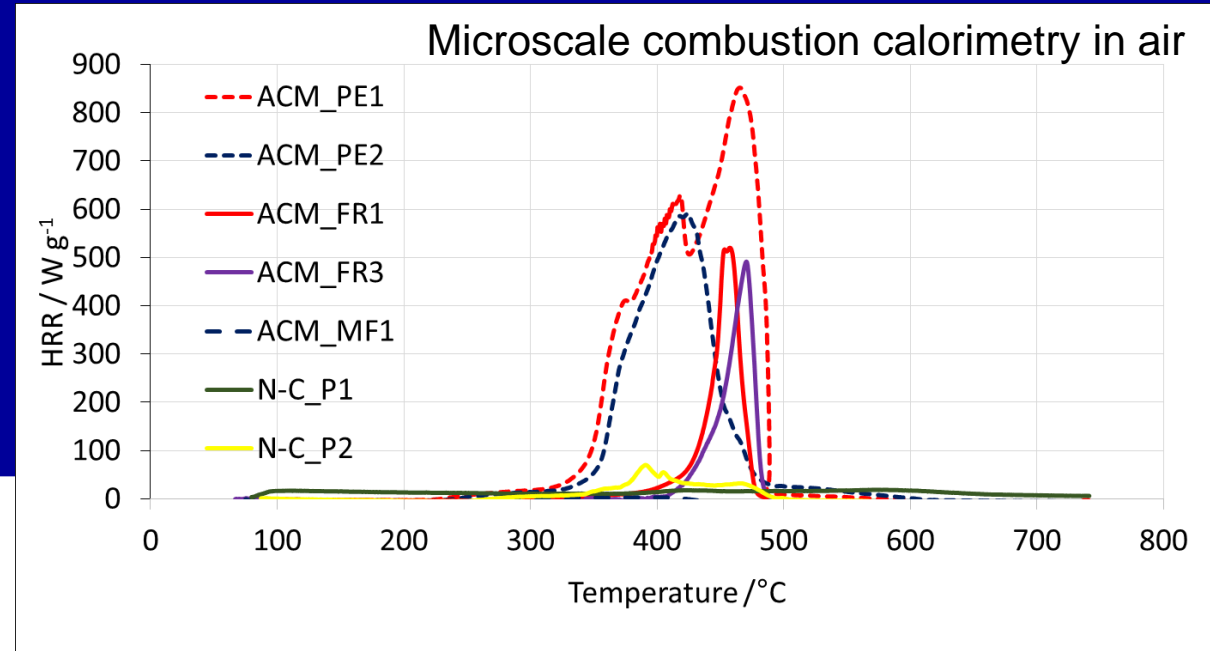
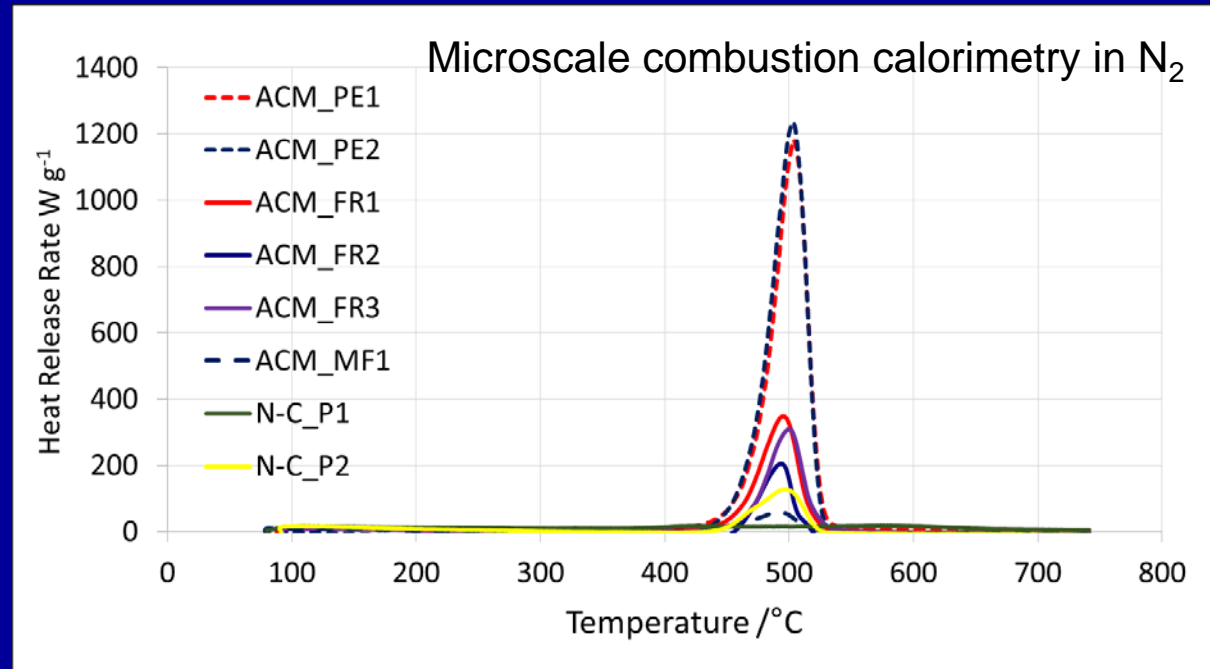
4 modes of action



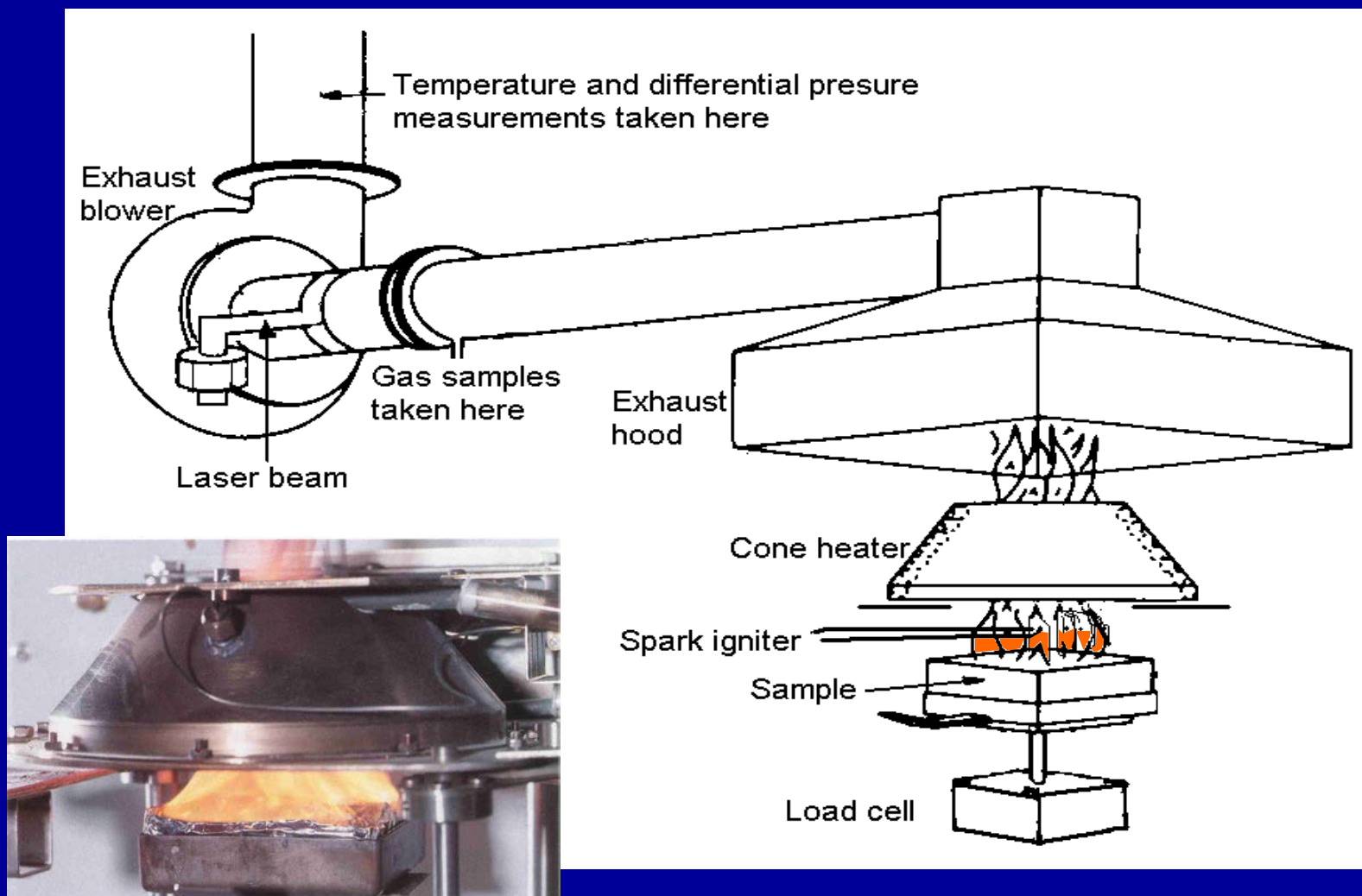
Calorimetry of panel filling

Bomb Calorimetry	Heat of Combustion
Sample	/kJ g ⁻¹
ACM_PE1	46.2
ACM_PE2	46.5
ACM_FR1	13.8
ACM_FR2	14.2
ACM_FR3	13.9
ACM_MF	3.4
N-C_P1	4.2
N-C_P2	-

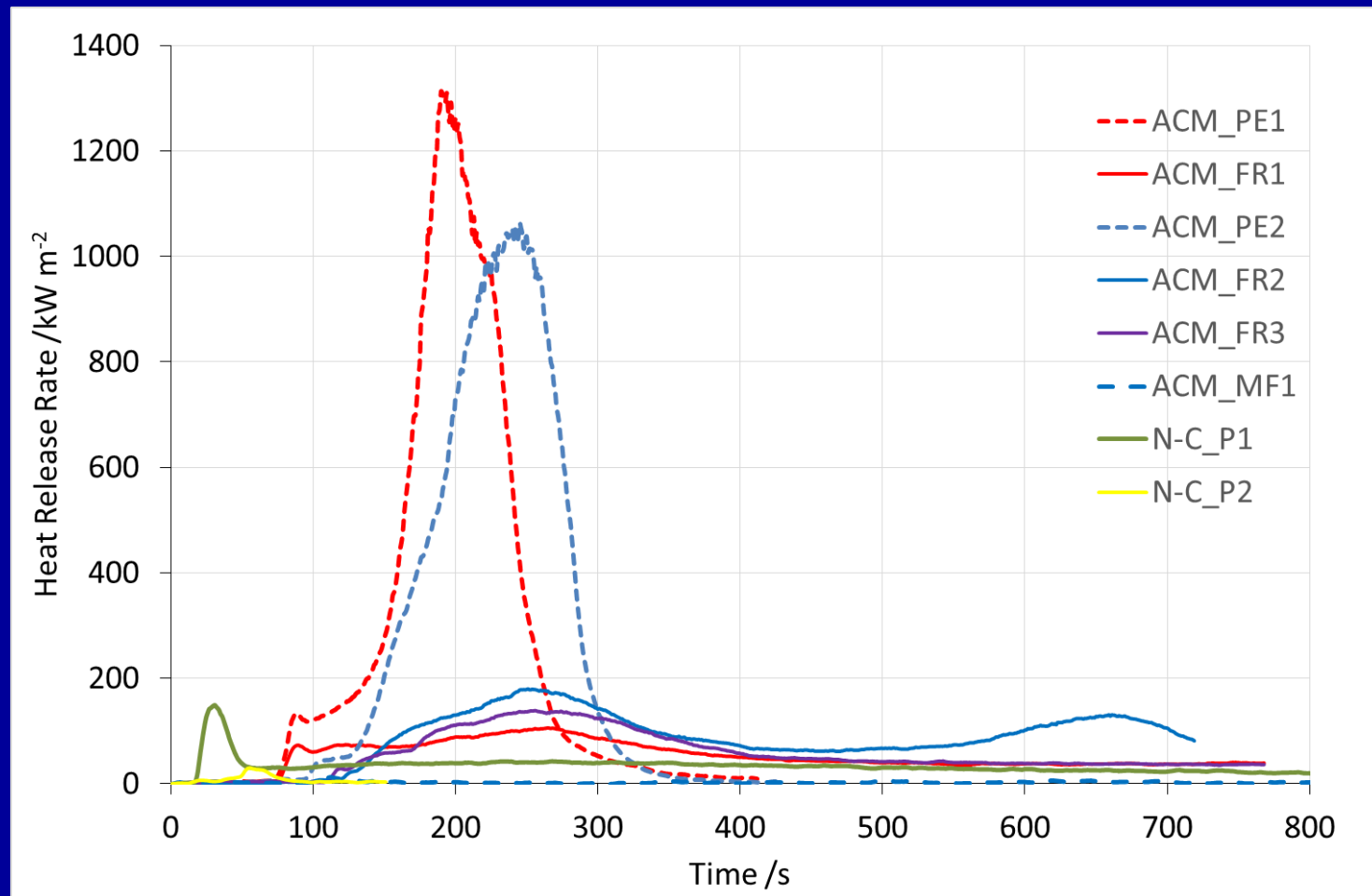
University of
Central Lancashire



Heat release – The cone calorimeter



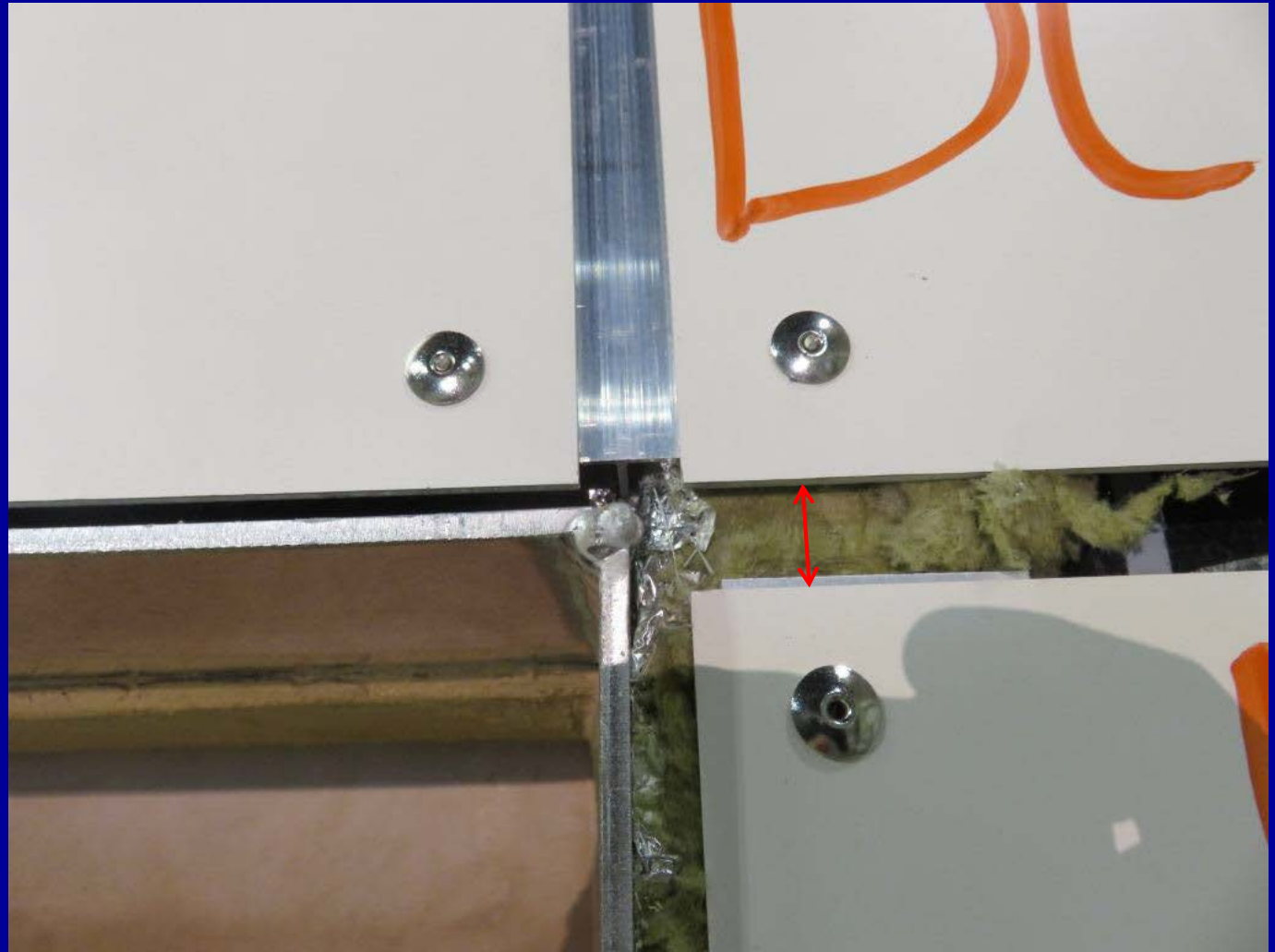
Cone calorimetry of panels (tested using 70 x 70 mm samples)



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Panel Installation in BRE test

The 20 mm gap between the panels makes it easier for the fire to attack the combustible core



ACM Panels or Foam Insulation?



Address Downtown Hotel, Dubai
No deaths, hotel reopened
ACM only

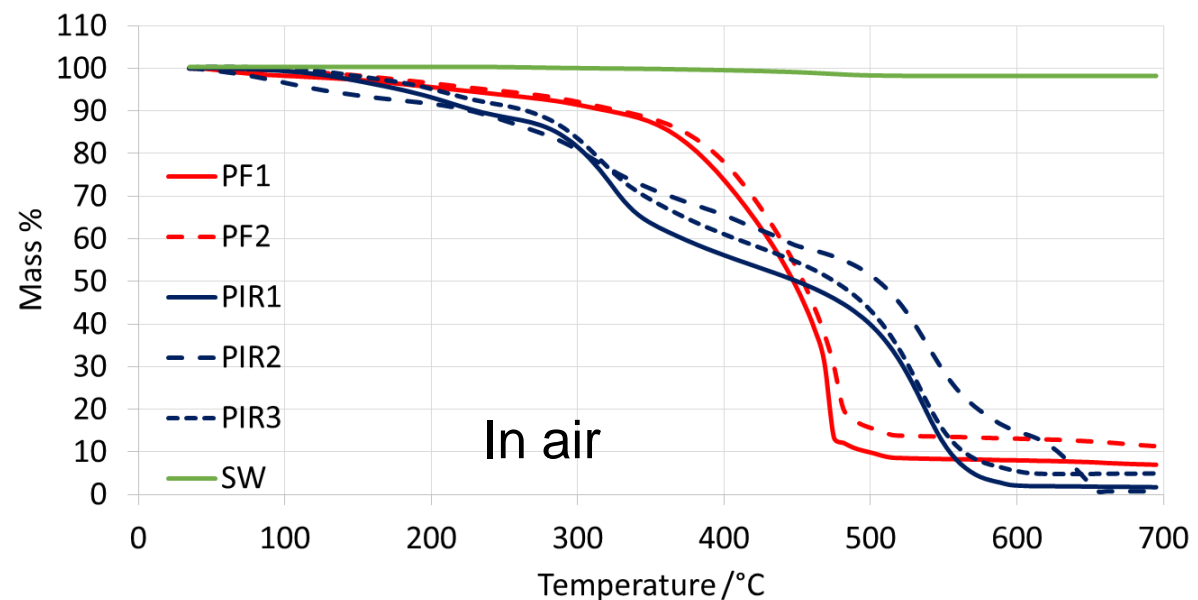
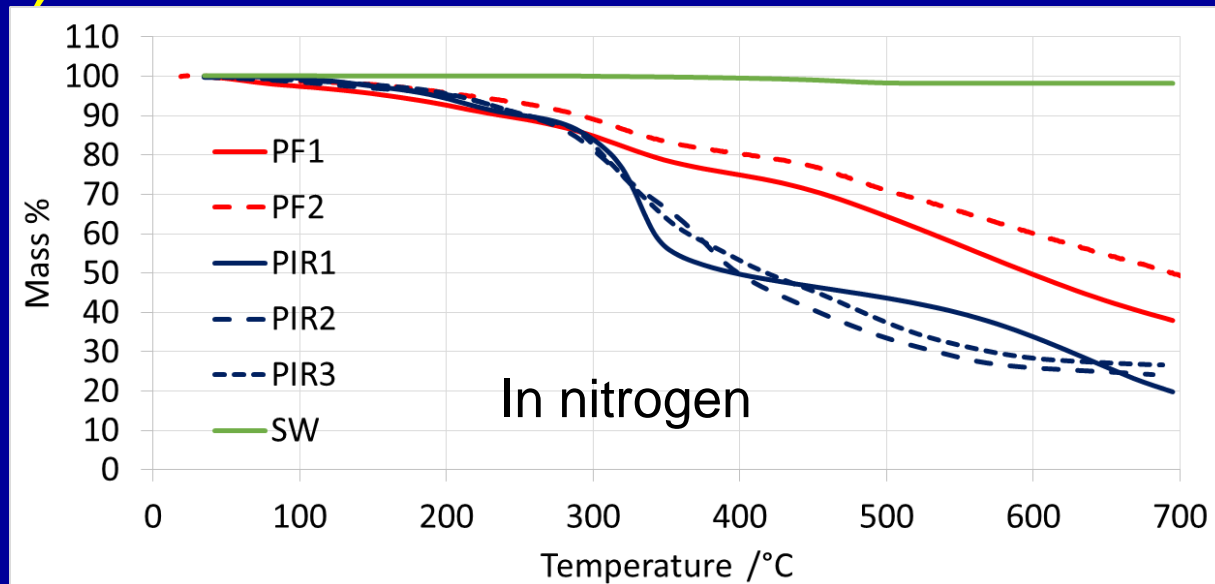
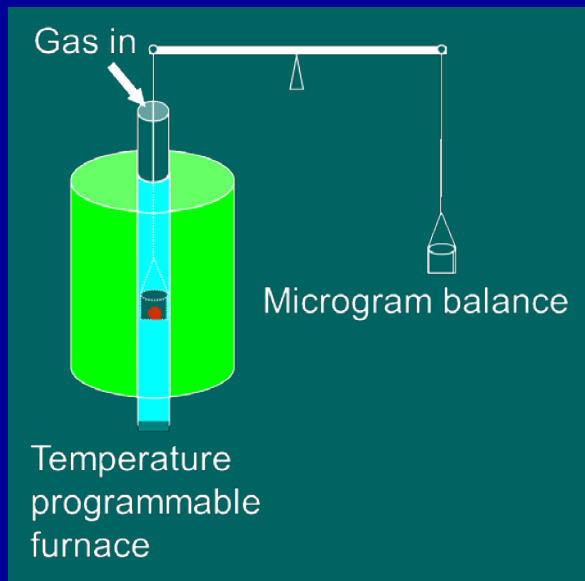


Grenfell Tower
80+ deaths
ACM + PIR Insulation

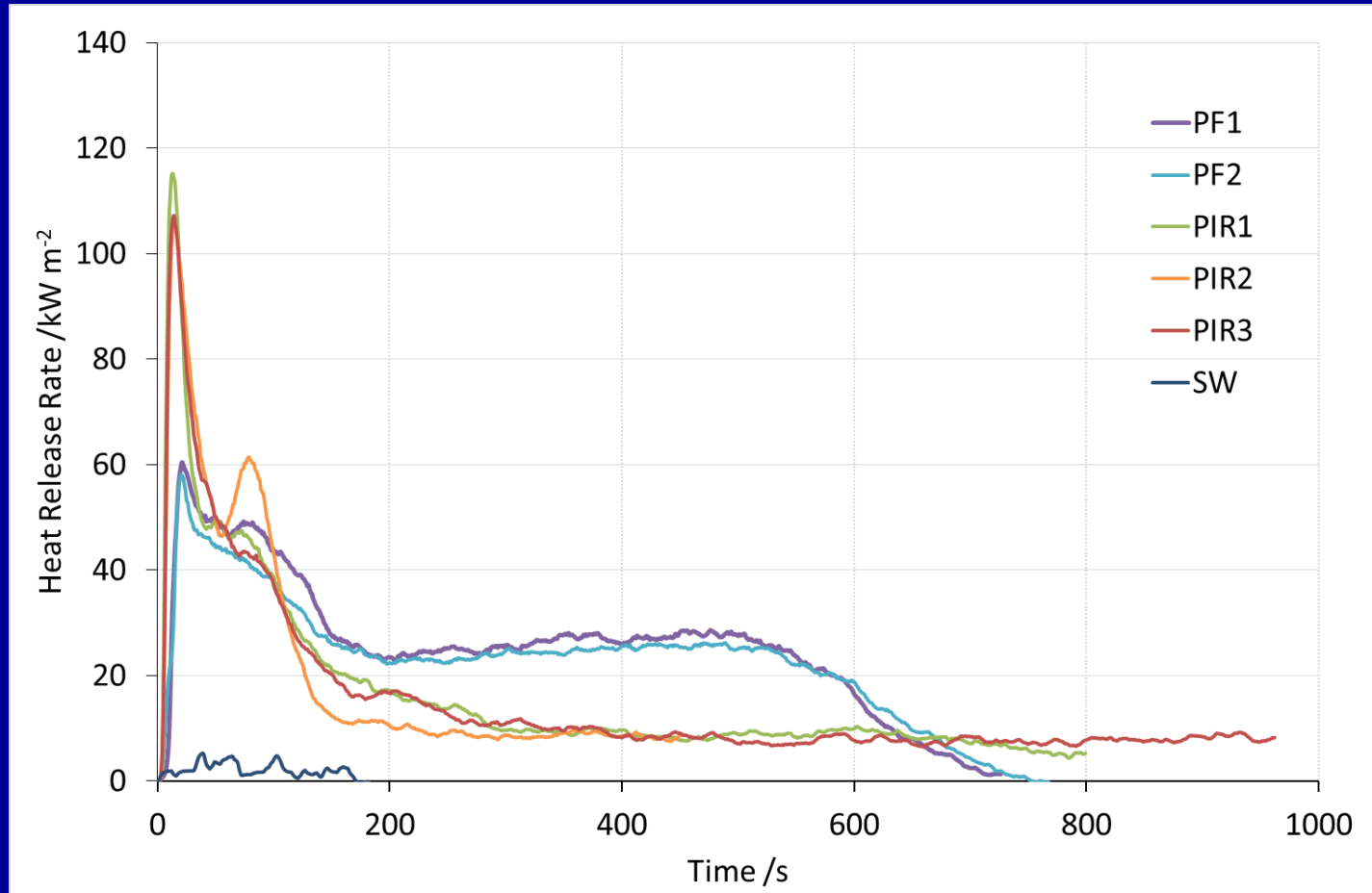
Insulation Materials

Code	Description
PF1	Phenolic foam
PF2	Phenolic foam
PIR1	PIR (polyisocyanurate) foam
PIR2	PIR foam
PIR3	PIR foam
SW	Stone Wool

Thermal Decomposition of Insulation Materials (TGA)



Cone Calorimetry of Insulation Materials



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PIR and Stone wool in cone calorimeter

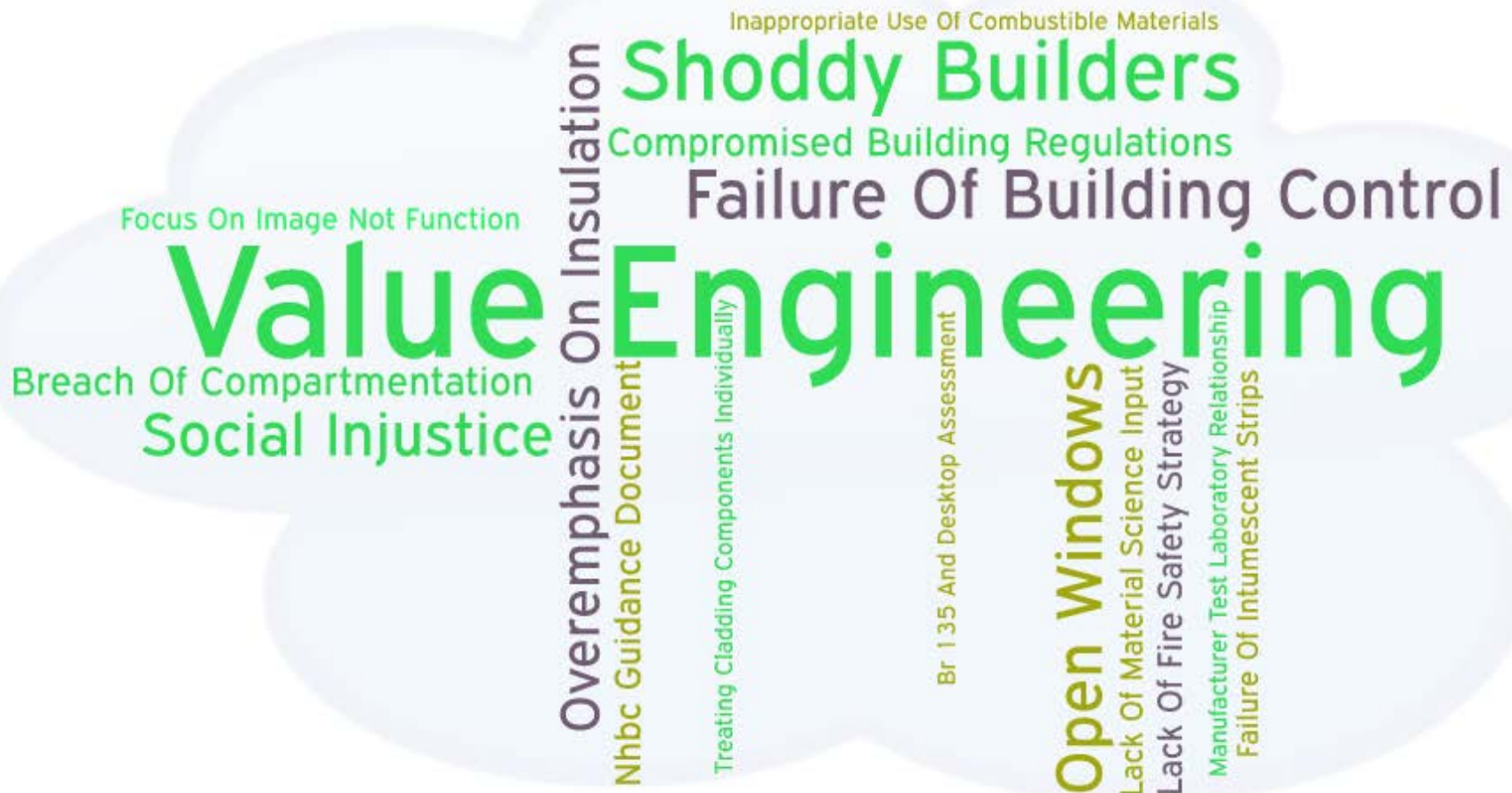


PIR - ignites after 3 seconds



Stone wool - no ignition

Causes of the Grenfell Tower Tragedy – it isn't possible to isolate a single cause

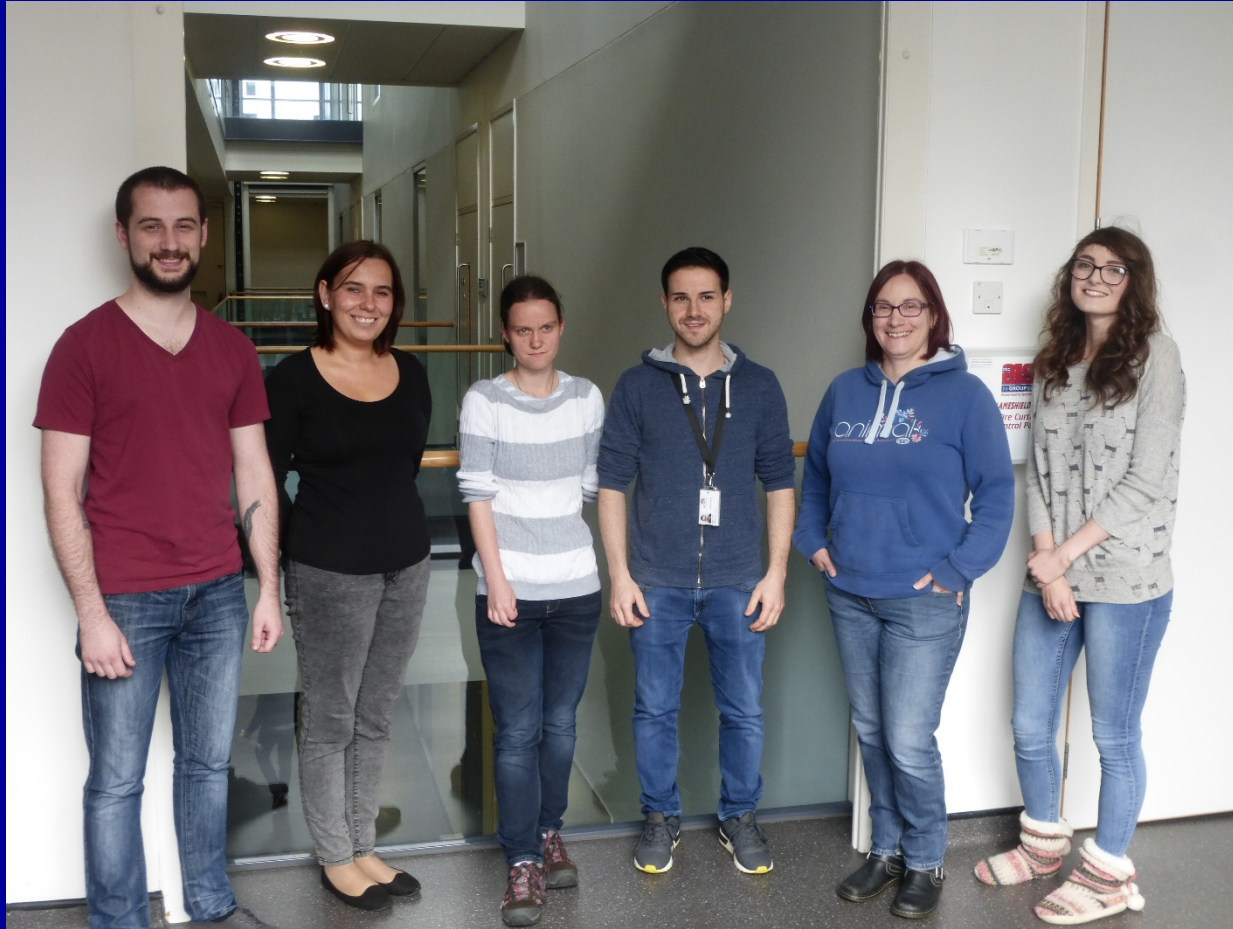


Conclusions

- Above all, the use of combustible cladding allowed the Grenfell Tower tragedy to occur.
- The convoluted UK Building Regulations, citing BCA Tech note 18 and BRE's BR 135, allowed "combustible" to be considered as "non-combustible".
- The emphasis on insulation over fire safety left the Building Regulations behind modern building practice.
- Assessing non-combustibility isn't rocket science! Simple tests show a material's contribution to a fire.
- Plastic foam insulation ignites easily and burns very quickly.
- Grenfell Tower proves that the measures designed to ensure fire safety of combustible cladding cannot be relied on in practice.

Acknowledgements

Thanks to the team who did all the work!



Questions?

Or email me

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