



**On a warm spring afternoon in November 2018, a large fire broke out at a Polyaire commercial complex at Seven Hills in western Sydney. Moving quickly, the fire destroyed two large warehouses, an area of over 5000 square meters, and caused between \$30-50 million worth of damage.**

Security camera footage showed the fire originating from near some pallets stored in the outdoor yard that contained polyethylene Y-fittings for ducted air-conditioning. The fire appeared to develop from the stack top of the pallets though there was no sign of human activity other than a truck parked nearby. There was no evidence of an ignition source; interestingly though, there were signs of water on top of the transparent wrapping.

## A DEVASTATING FIRE

NSW Police, NSW Ambulance, and Fire and Rescue NSW all attended the site. Some 100 firefighters and 25 trucks worked in rotation to extinguish the blaze despite scorching 30-degree weather conditions - three buildings were destroyed within the complex. There was no indication as to how the fire had started so GKAIG were asked by the insurance company to attend.



The aftermath of the fire at the Polyaire Seven Hills NSW warehouse complex



The fire damage in the pallet storage area

## A STRANGE COINCIDENCE!

The Seven Hills fire was not the first time this had happened. An identical fire had occurred two months earlier at another Polyaire warehouse, near Newcastle.

The pallets, containing the same product as the Sydney blaze, also ignited while stored outside. The cause wasn't investigated, or ignition source determined but the fire did, apparently, destroy the pallets.

Apart from the product and packaging being identical, a close look at the weather revealed some interesting correlations: it rained at both sites in the days before the fires and was sunny and windy the days of the fires.

"We began to wonder if the small puddles of rainwater on top of the clear pallet wrapping had formed an aqua lens? And, could this aqua lens perform as a magnifying glass?"

- Nick Sutarov, Forensic Fire Examiner, GKA Investigations Group.

### In both situations:

- the products were made in Malaysia and shipped to Australia on pallets;
- a clear pallet wrapping was used;
- the pallets were stored outside, exposed to the elements;
- it rained during the days before the fires;
- it was warm, sunny (21-33°C.) and windy on the days of the fires;
- the fires occurred between 12 and 2.30pm; and
- there was no sign of an ignition source.

"The company had never had an issue like this before but there had been one significant change that year – in May 2018 manufacturing of the Y-fittings moved from Adelaide to Malaysia."



Evidence of water on top of the pallets with Y-fittings

## SO, WHAT HAD CHANGED?

**Adelaide:** fittings were blow-moulded, stored in cages or loosely packed in metal cages or shipping containers, before being sent to the warehouses.

**Malaysia:** fittings were injection moulded and loaded onto pallets for transportation. Each pallet contained 63 fittings (7 layers high, 9 per layer) with sheets of corrugated cardboard separating each layer. The pallets were wrapped in a transparent film and loaded into shipping containers. It took approximately 6 weeks from production to delivery, arriving at the warehouses 3 days prior to fire. The packing!

A hypothesis was developed, researched ... then tested.

"Our theory was that the rainwater that had accumulated in pools on top of the clear pallet wrapping acted as a lens, magnifying the sun's energy onto a focal point and igniting the materials inside. The same process as when using a magnifying glass to ignite paper, yet the water acted as the lens."

## THE ACADEMIC BASIS

**GKAIG's ignition theory was backed up by published data confirming that:**

"The radiant heat flux from the sun reaching earth is between 0.7 – 1 kW/m<sup>2</sup>, depending on the season. The heat release from the sun cannot be increased but the heat influx from the sun can be increased by focusing the energy from a larger surface area onto a smaller surface area, by using a concave mirror. Focusing the energy heat flux onto a smaller area, the radiant heat flux can increase to 25 kw/m<sup>2</sup>, generating enough energy to ignite most combustibles." <sup>1</sup>

<sup>1</sup> Lentini, John J. 2018, Scientific Protocols for Fire Investigations, CRC Press, Boca Raton London New York

## THE RESEARCH

Weather records for the day and time of both fires were consulted to establish the prevalent conditions - confirming the amount of rain, direction and intensity of the sun in the days of and leading up to the fires.



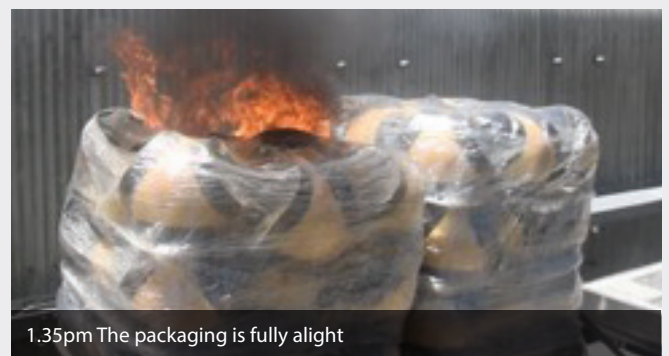
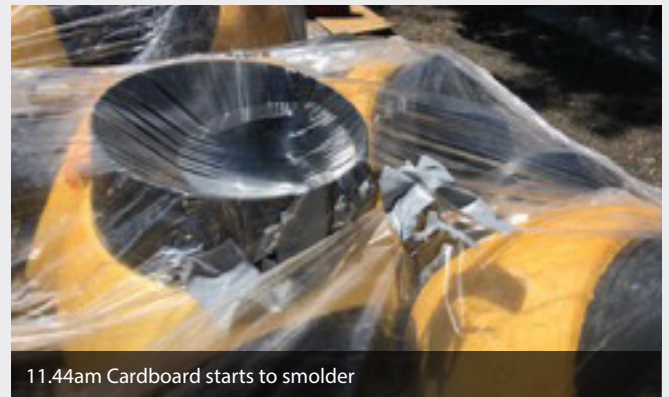
Proving an aqua lens could form

## THE RE-CREATION

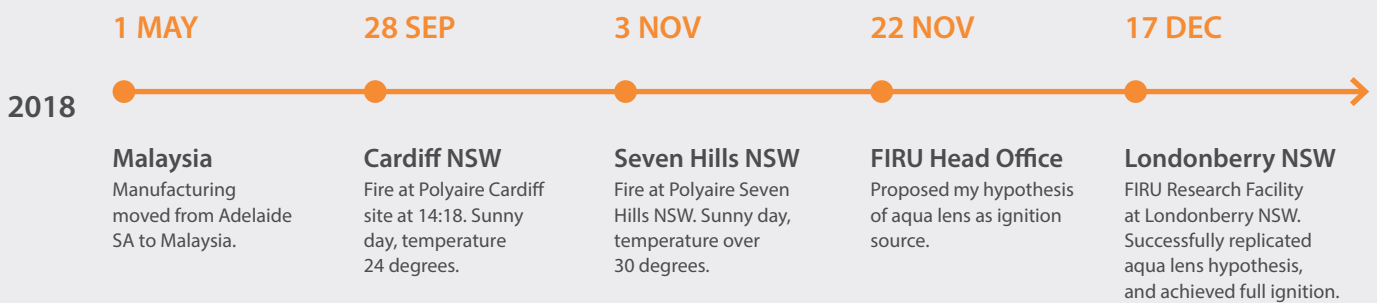
**In December last year 2018, two identically packaged pallets were used for a re-creation. Water was poured onto the top of one and as the temperature rose to 30°C, with a light breeze, the focal point created by the water scorched the top layer of cardboard, which began to smolder before shortly stopping.**

As the sun moved, so did the focal lens but as it moved it scorched the cardboard.

Closer to the middle of the day a little pool was created on top of the second pallet and just before noon the top layer of cardboard started to smolder. There was still a light breeze and the temperature had risen to 33°C. Shortly after noon, smoke began to vent from the pallet and thicken inside. An hour later a fan was used to increase the breeze and within quarter of an hour, the pallet ignited – confirming the theory possible probable.



## SUMMARY OF EVENTS



## LESSONS LEARNT

The aqua lens fires may appear rare. It's quite possible though that businesses across the country are running risks daily with the storage of their stock and that fires may have occurred from such situations that were never resolved.

Why the initial Polyaire fire was not investigated is unknown but what is known is that there's no substitute for a forensic investigation that would have uncovered the source of the fire and most likely prevented the second.

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