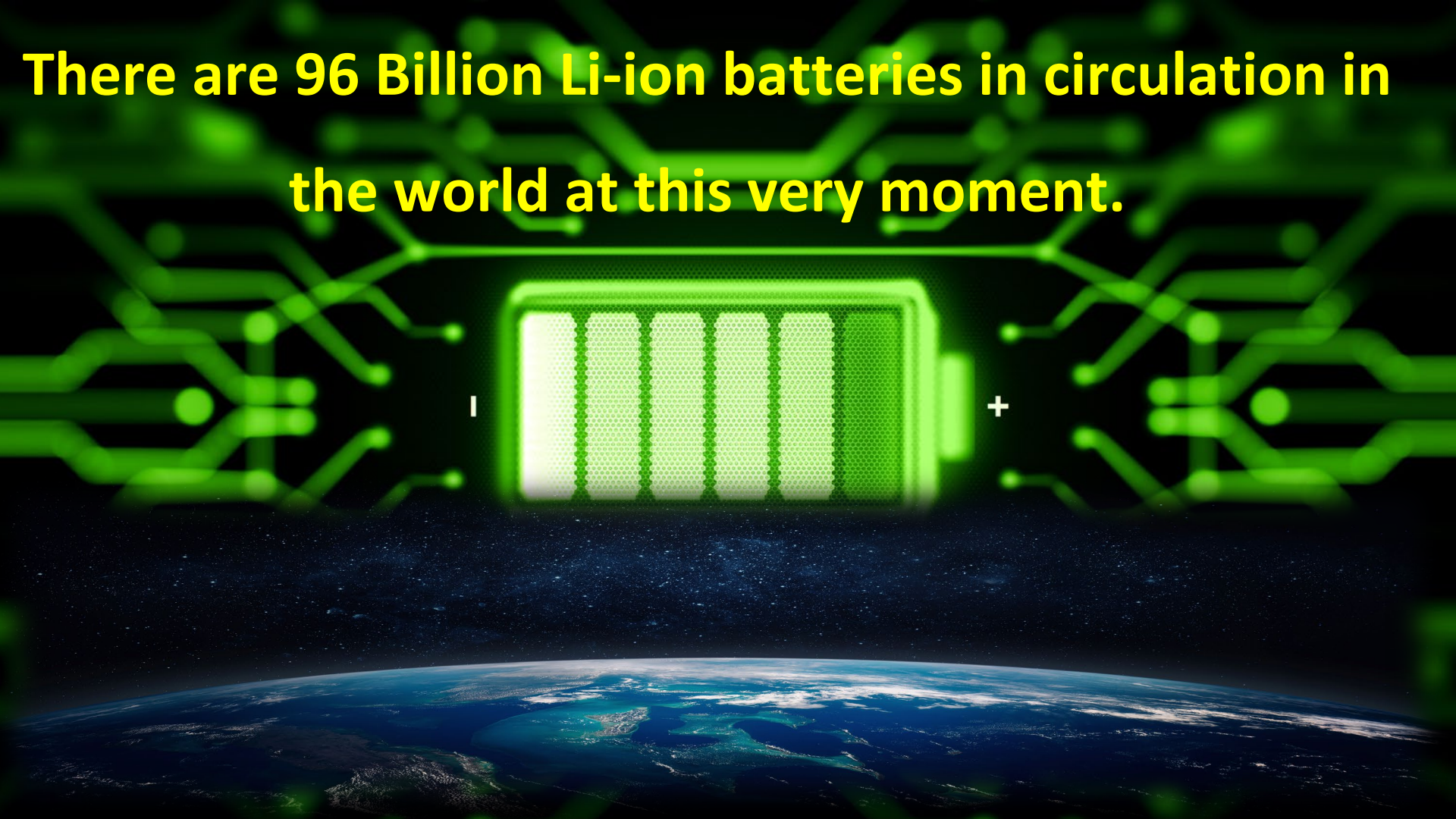
THE EVOLUTION OF LITHIUM-ION BATTERIES
NISG 2023

EVOLUTION OF LITHIUM-ION SOLUTIONS


EHS
Success
Idea
INNOVATION
Vision
Inspiration
Development
We are innovators at EHS International

Some of our lithium-ion clients


There are 96 Billion Li-ion batteries in circulation in the world at this very moment.
-
+

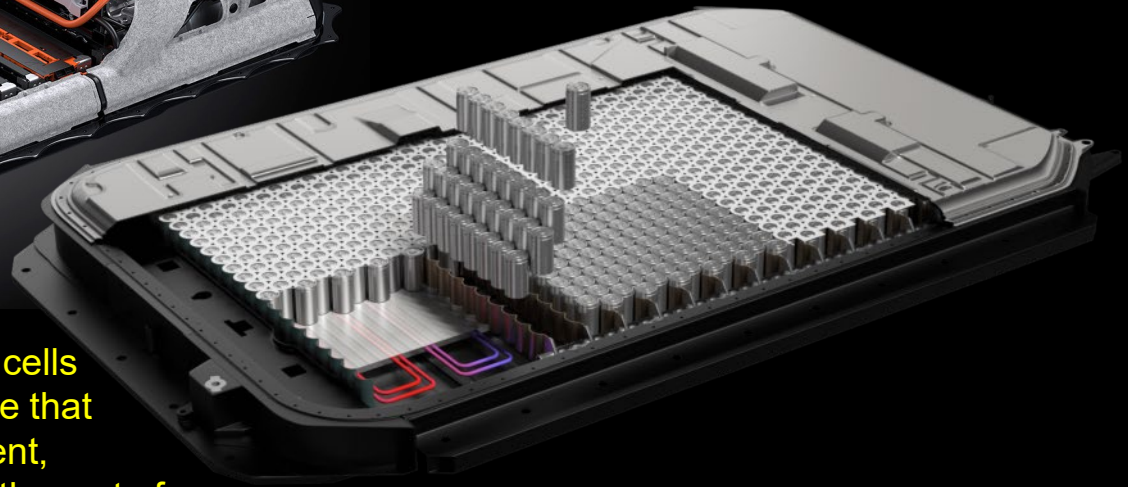
Only 5% are currently being recycled.

5.6 BILLION PHONES ON THE PLANET

1 Million fully electric EV cars on UK & Irish roads in 2023.

BATTERY MODULES IN EVs

Multiple modules make up the battery pack anywhere from 3,000 to 6,000 individual cells



Most EV battery packs are built from groups of cells housed in modules interconnected within a case that provides structural support, thermal management, environmental protection and connectivity with the rest of the drivetrain.

2,000 fully electric semi-trailers on UK roads by 2024.

There are over 32,000 individual lithium-ion cells welded together in a battery pack.

Spirit of Innovation

The aircraft, named Spirit of Innovation, achieved its goal on 16 November 2021 when it registered a maximum speed of 623 kph (387.4mphThe record makes it officially the fastest electric vehicle in the world,

Li-ion Batteries as Cargo

Also 1.8 million e-bikes and e-scooters, which become legal on UK roads May 2024

E-bikeGlobal
leader in e-bikes

Lithium-ion Battery Technologies & Applications

Battery Energy storage systems (BESS) modules

Where the risks are?

Lithium-ion in your environments.

So how, do you manage your Lithium-ion risk on your site?

- Education- Laptops, e-scooters, e-bikes, ev-charging
- Industry - Laptops, e-scooters, e-bikes, ev-charging
- Maritime - Roll-on Roll-off, super yachts, distribution, EV transportation.
- Transport- Evs, Buses, Trains,
- Battery production – Belfast and Newry and Universities research
- Recycling – One of the Biggest issue for recycling.
- Fire & Rescue – Struggling with this issue.
- Power and Utilities - Battery Energy storage Solutions (BESS)
- Hospitals and Medical – Battery's are being collected

LETS, HAVE A LOOK AT SOME ISSUES WITH LITHIUM-ION

SOME - LITHIUM , LITHIUM-ION SCIENCE

What is the difference between Lithium cells and lithium-ion cells

- Lithium-ion batteries **are rechargeable, while their counterparts are Not.**
- Lithium-ion cells have charge/discharge cycles that go on and on up to thousands of times.
- A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry.
- Watt-hours are used to measure battery capacity and battery life, estimates the number of times the battery can recharge a device and provide a metric for comparing battery performance.
- A BMS (Battery Management System) is what your phone has and is essential in a Lithium-Ion battery system controlling overheating

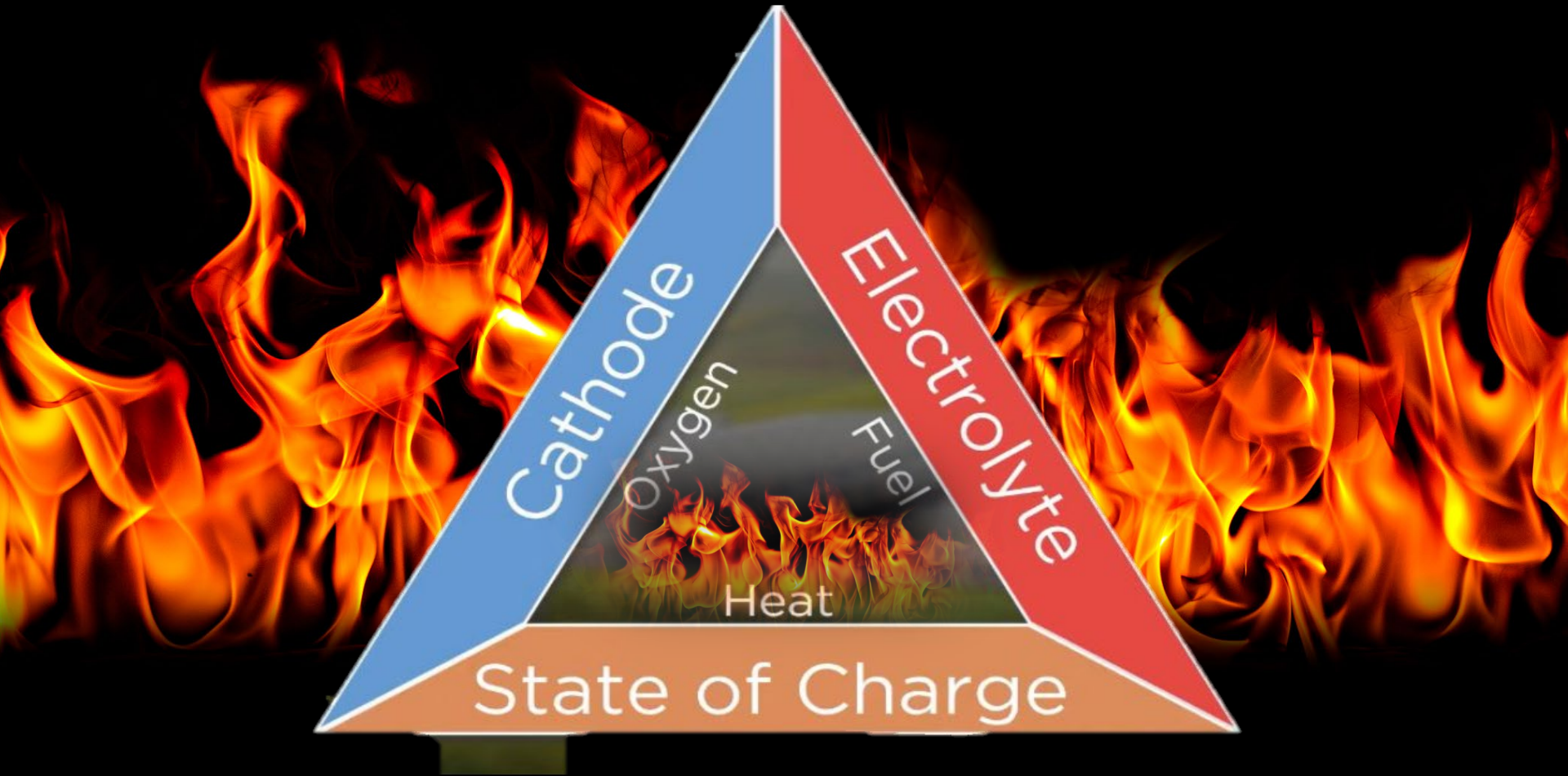
Lithium-ion Batteries Risks

- The presence of li-ion batteries and the subsequent fire risk is something that should be addressed as part of your policy and in your fire protection and emergency response arrangements.
- Whilst its difficult to cover every aspect of risk management plan, we would suggest that raising awareness is a minimum of risks should include:
- Policy And Fire Risk Assessment – This will become a requirement from your insurance company.
- Emergency Response Plan to tackle damaged or overheating li-ion batteries.
- Hazard Control Plan to manage includes- Training, Storage & Handling, Charging And Discharging, Fire Safety, Temperature Control, Manufacturing Defects, Chemical Leaks.


LITHIUM-ION
BATTER FIRE RISK

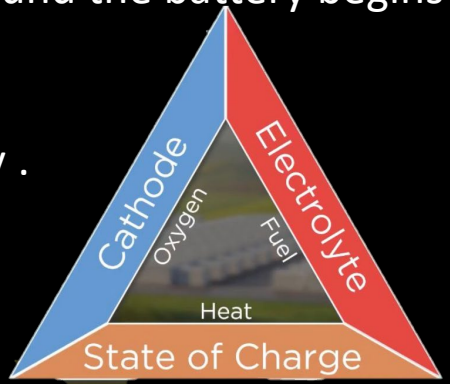

In the Home, Statistics also tell us that our children's bedrooms and our bedrooms are now the MAIN FIRE RISK AREA in the house.

THE FIRE TRIANGLE FOR LITHIUM-ION BATTERY'S HAS CHANGED



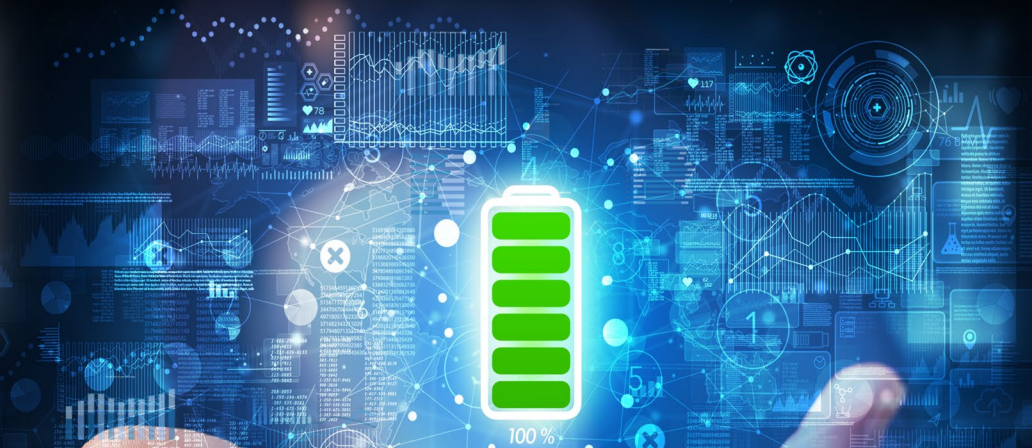
The fire triangle has a different look when it comes to Lithium-ion batteries

- Where fuel was in the triangle, we now have **Electrolyte** and the battery itself.
- **Cathode** is self propagating and produces its own oxygen
- The **Cathode releases oxygen** as a by-product during this process. This oxygen comes from the oxygen atoms in the lithium compound itself
- During the thermal runaway of a battery, the chain reaction **vaporizes the organic electrolyte** and pressurizes the cell casing. If or when the case around the battery begins to fail, the flammable and toxic gases within the cell are released.
- The state of charge is defined as the ratio of the available capacity .
- This will also be what we call **stranded energy**

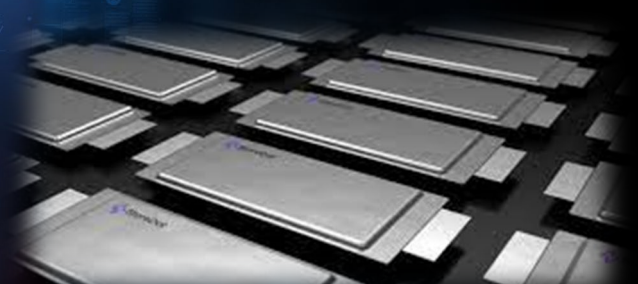


BATTERY TECHNOLOGIES

Pouch, Prismatic, Button, Cylindrical



we have them with us every day



SO WHY DO WE HAVE LI-ION BATTERIES FIRES

Battery formats

- Cylindrical
- Prismatic
- Button
- Pouch

- You can have them all in one EV car, in your workplace and your home.
- So, now the waste industry must watch out for the onslaught of EV cars, vans, buses and trucks and recycling loads.

In what seems to be an unclear incident, a **ship** transporting containers carrying **lithium batteries** en route to port in Mumbai …

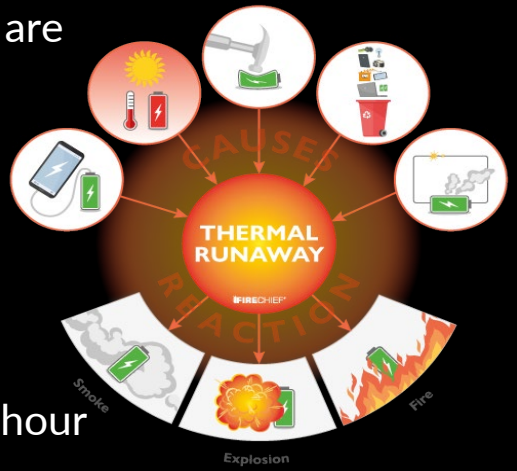
AVENGER
FIRE ROBOT

SO, WHAT IS THERMAL RUNAWAY?

What is thermal runaway?

Thermal runaway is the chemical process within the battery that produces heat and chemical gases very quickly before any flame appears.

These gases are not something you would want to be exposed to. They are vented from the cells as a vapour cloud.



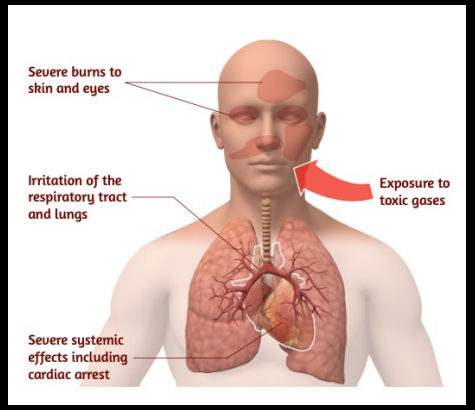
- You will get little warning - smoke or flame
- Rapid heat acceleration from 0 to 800 degrees in milliseconds
- Smoke - So how much smoke will it give off? 7 lts of smoke per watt hour

  so every 1 kWh will be 700lts, so a 100kwh will be 7000lts.


The Telegraph

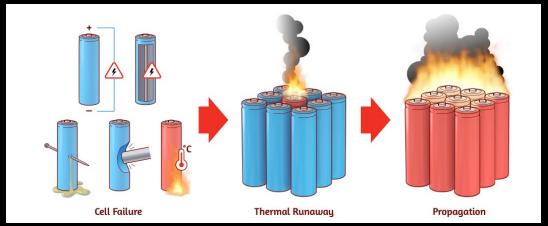
Batteries & their Fires Are Highly Toxic

- In addition to the fire and explosion risks, vented gasses are highly toxic.
- They include hydrofluoric acid (HF), which can cause severe systemic effects (including cardiac arrest) and severe burns to the skin, eyes or digestive tract.
- If inhaled, HF can also cause irritation of the respiratory tract, including pulmonary oedema caused by too much fluid in the lungs.



CAUSES BATTERY FIRES

- **Overcharging** – Phones, laptops ect
- **Extreme energy extraction -** demand higher than out-put
- **Overheating** - external heat, fires, sitting in the sun
- **Penetration** - sitting on the phone, stabbing the pouch, car crash.
- **Crushing** - recycling, accident,
- **Short circuit** - dry from the solvent as the BMS (Battey management system can cope any more).




BOLLORÉ
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BATTERIES EXPLOSION

Recycling

- A study from Australia found that 98.3 percent of lithium-ion batteries end up in landfills, which increases the likelihood of landfill fires that can burn for years.

- Lithium-ion batteries contain metals such as cobalt, nickel, and manganese, which are toxic and can contaminate water supplies and ecosystems if they leach out of landfills.

- Additionally, fires in landfills or battery-recycling facilities have been attributed to inappropriate disposal of lithium-ion batteries.

RESPONSE-CONTROL-CONTAIN–EXTINGUISH

- Rapid response is vital- as propagation from one lithium –ion fire to another can be as little as 4 mins.
- Team controlling - the fire and cordoning off the area from toxic smoke
- Contain the fire - until emergency services arrive or your fire team
- Extinguish the fire - if you have the right media.

THE EVOLUTION OF FIREFIGHTING
THE FIRE CONTROL & EXTRACTION CHALLENGES OF EVS

THE FIRST ROBOTIC SUPERHERO MADE IN CORK, THE FIRE AVENGER

SOME OF THE SOLUTIONS WE CAN USE TO CONTAIN AND PUT OUT A LITHIUM FIRE

PYRO-CLOUD FIRE SUPPRESSION

Ferndale Fire PyroFlow Fire Suppression Granules

The most affordable, effective way to contain and isolate Lithium-ion battery fires

Put fire safety first with Firechief PyroFlow granules

PYROFLOW MAXI

FIRE SUPPRESSION GRANULES

Firechief PyroFlow Fire Suppression Granules

An innovative addition to the Firechief Lithium-ion Battery (LBR) Safety Range

Instantly contain, suppress & isolate Li-ion battery thermal runaway fires

An ideal solution for organisations who handle, transport or manufacture products using Lithium-ion batteries

12.5 kg Bags

Buy in Bulk

(30 bags per pallet)

- **Green-Ex** offers fire suppression systems for compartments like storage tanks, engine compartments and control rooms. Each system is selected and designed to meet the demands of your unique situation. All GreenEx solutions for marine applications have been carefully reviewed with regards to quality, durability, weight and logistic restrictions, environment, personal safety, international certification and costs.

Green-Sol suppression technology is based on the chemical reaction of solid energetic materials that generate, via the combustion process large amounts of a highly efficient, cost effective, powdered aerosol that acts chemically and physically on the fire to extinguish within seconds. Potassium nitrates

CONTAINMENT OF A LITHIUM FIRE IN DOCKS AND ON ROLL-ON AND ROLL-OFF?

We can contain with Fire blankets until the robotics team arrive

Extinguishment of Lithium-ion fires

AUTHORISED DISTRIBUTOR

FIRECHIEF®

LITHIUM BATTERY SAFETY RANGE

HOW TO PUT OUT OR CONTROL A LITHIUM FIRE?

WHAT IS AVD MADE OF?

- AVD is an aqueous dispersion of chemically exfoliated vermiculite come from mica rocks.
- **AVD** is a mineral. By its chemical composition
- It is applied to lithium battery fires as a mist.

- Vermiculite is the name given to a group of hydrated laminar aluminium-iron-magnesium silicates.
- It consists of thin, flat flakes containing microscopic layers of water.
- The chemical exfoliation of vermiculite produces microscopic, individual platelets that are freely suspended in water.
- This yields a stable aqueous dispersion of vermiculite to be used as a lithium battery fire extinguishing agent.

PPE -PROTECTION FROM TOXIC SMOKE IN LITHIUM BATTERIES BEFORE WE ATTACK

SO, HOW DO WE CONTROL AN EV/OR LITHIUM FIRE IN SHIPPING

Our team has developed a procedure in several ways TO SAVE TIME as its the most important issue on board a ferry or any type of vessel with a suspect EV.

1. Alarm sounds and fire team reacts - we calculate that it only takes 4 minutes for an EV to propagate and spread to the next EV.
2. The sprinkler system starts the cooling, Fire team Don fire gear and Rebreather BA set (30 min duration)
3. Fire team arrives at the EV and deploys the FIRE BLANKET from a safe distance and 2-3 cars width. We also now cool if required and deploy several other fire blankets to protect other EVs. Radiative heating cools from 800 to 100 degrees.
4. Fire now under control in seconds and monitored with a thermal camera and keep cooling
5. Captain then makes the decision to go to the nearest port.

EHS International
Founded by Chris Mee

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