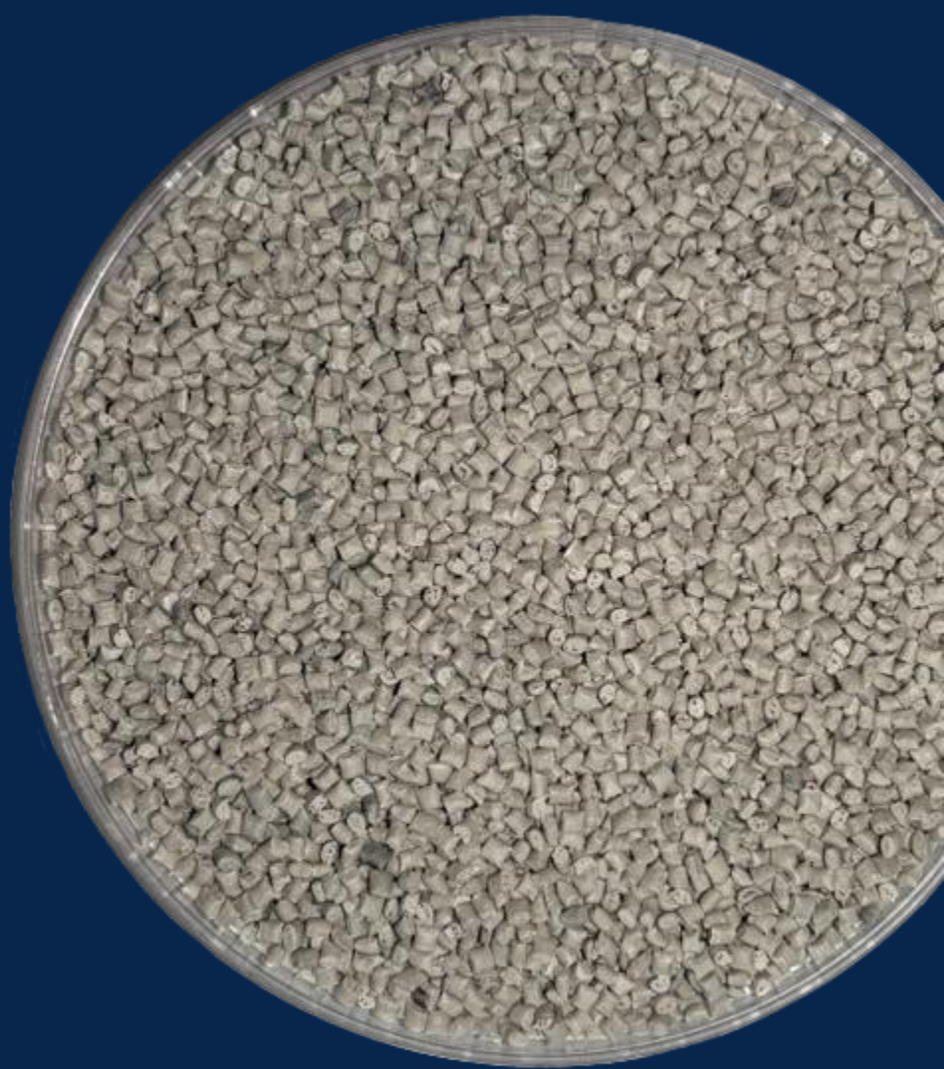
Fire Retardant ABS

PYRONIX resin

Introduction to Innovative
Fire Retardant ABS



Fire Retardant Plastic : PYRONIX resin

Fire Retardant ABS

PYRONIX resin

Problem Statement

- EVs using lithium-ion batteries have the potential for thermal runaway, which increases the risk of fire hazards and leads to fires that are challenging to control

Cause and Effect to Resolution

Root Cause

- Occurrence of physical and chemical defects in lithium-ion batteries due to instability caused by both internal and external factors
- Exposure to fire risk caused by battery overcharging and short-circuiting
- Insufficient precautions against fire resulting from the limitations of oxidation and thermal stability in battery materials

Cause and Effect to Resolution

Current Lithium-ion Battery Enclosure in EVs

Aluminum Alloy Material Enclosure

- Aluminum alloy materials exhibit a significant reduction in strength when exposed to high temperatures due to their low melting point.
- The ALDC12 model of aluminum alloy is utilized for die casting to achieve high strength; however, it has the drawback of low heat dissipation properties.

Solution

- Development of external battery materials designed for fire suppression in battery components (metals)
- Development of lightweight materials with maximized impact resistance
- Development of application technologies for battery housing employing flame-retardant materials

Cause and Effect to Resolution

Effect of applying to new invented polymer composite material based on Acrylonitrile Butadiene Styrene (ABS) for covering Lithium-ion Battery

Classification	Aluminum alloy-based battery Housing	Polymer composite material-based battery housing
Cost	**Approx. 500 to 600 USD** (Price increase due to the addition of copper, iron, and other metallic substances to aluminum)	**Approx. 360 to 450 USD** (Polymer composite material is 50% lighter than aluminum, and the additives are approximately 30% lighter than metal alloy)
Weight(kg)	100~200 kg	Under 100kg
Processability	Molding temperature ➡ 700°C ~ 1200°C	Molding temperature under 250°C [Facilitated processability]
Fire hazard	In the event of an electric vehicle fire, the reaction between aluminum alloys and water generates hydrogen ➡ Increased explosion risk	Reduction of explosion risk due to flame retardant and extinguishing properties

Fire Retardant ABS

PYRONIX resin

Testing standards

Specifications for expanded graphite material Certification

Flame retardancy

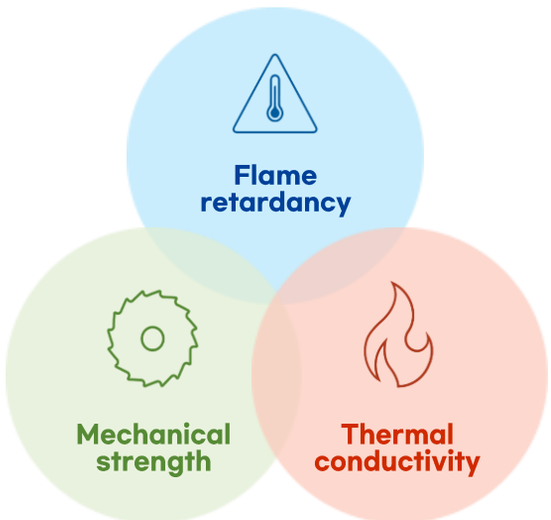
- ☑ International flame retardancy testing standard UL 94 Test

Mechanical strength

- ☑ ASTM D3039 Composite Material Tensile Test
- ☑ Fatigue strength
- ☑ Fatigue properties

Thermal conductivity (thermal exposure test)

- ☑ ASTM E1530 Thermal Conductivity Measurement
- ☑ Regulation No. 48 on the performance and standards of automotive and automotive components.



Test Report

Specifications for polymer composite material Certification ➡ UL-94 test verification method

1. When a flame is applied vertically to the sample, evaluate the sample's combustion pattern and the extent of flame propagation to the surroundings.

① Sample Bar ➡ shaped sample

② Sample specifications ➡ 125 (mm) X 13 (mm) X Thickness (mm)

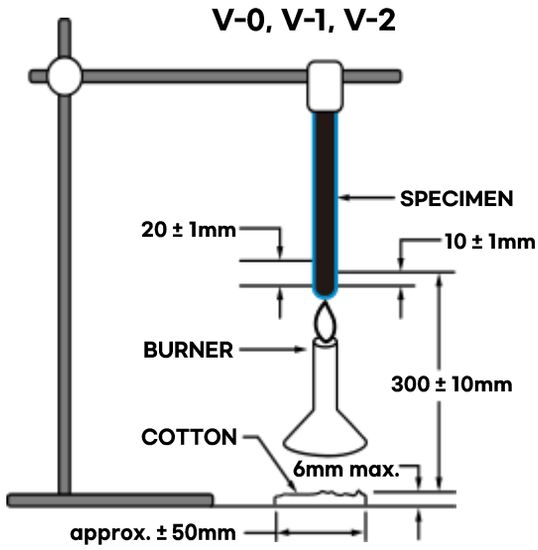
2. Test method

① After applying a 20 mm flame to the sample for 10 seconds, measure the combustion time t1 and record the combustion pattern.

② If combustion ceases after the first flame application, reapply the flame for 10 seconds. Measure the sample's combustion time t2 and glowing time (spark retention time) t3 and record the combustion pattern.

③ Evaluate the combustion t1, t2 and t3 assess the combustion pattern, including factors such as ignition of cotton by dripping and flame propagation to the clamp. Based on these observations, determine the rating (V-0, V-1, V-2).

UL94 Vertical Burn Test for V-0, V-1, V-2



Fire Retardant ABS

PYRONIX resin

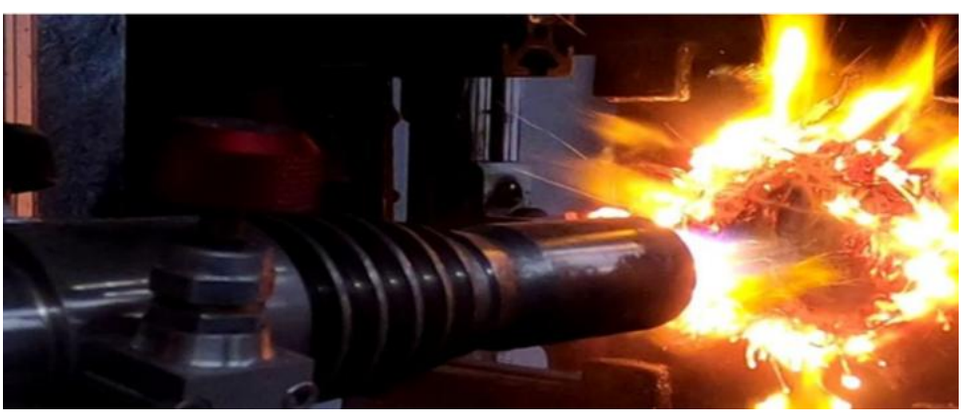
Application of PYRONIX for enclosing lithium-ion battery

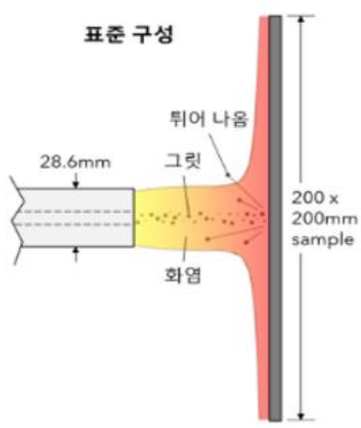
Objectives

- The prevention of thermal runaway propagation and fire suppression in lithium-ion battery packs in electric vehicles by using the battery housing based on the **PYRONIX**.
- Minimizing human and material damage through the prevention of thermal runaway propagation and fire suppression.
- The **PYRONIX** based on expanded graphite is anticipated to improve flame resistance and provided effective extinguishing capabilities, facilitating initial suppression and prevention of fires upon occurrence.
- Contribute to the extension of the electric vehicle market by **PYRONIX** technologies that enhance safety and thermal runaway management through the prevention of battery fires and propagation.

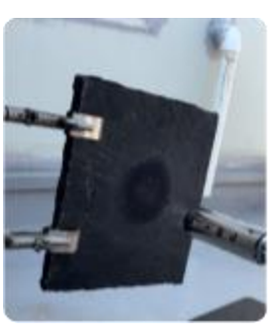
Torch Test

Specifications for polymer composite material Certification ➞ UL 2596 verification method - not introduced domestically

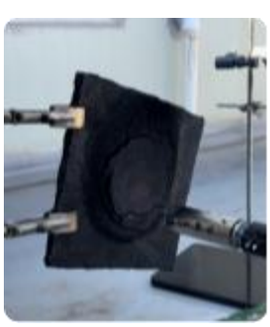




Development material torch test conducted using a homemade torch test.
(240 mm x 240 mm x 10 mm)

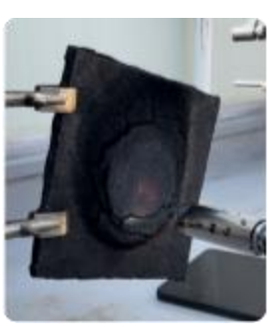


Start the test



After 10 min

After 20 min

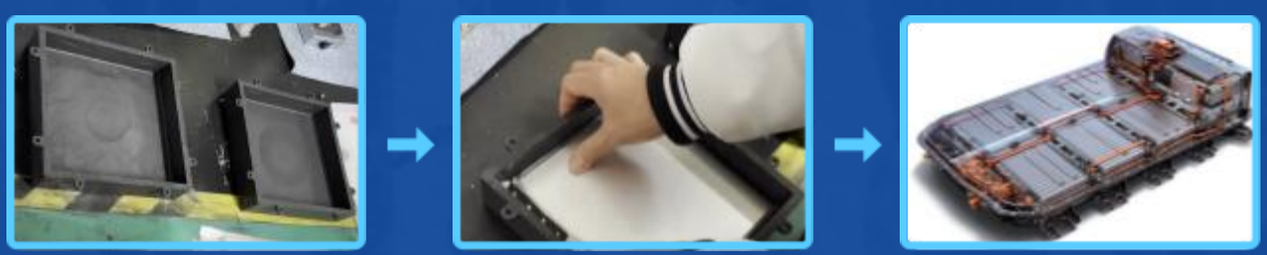


After 30 min

The sample based on the PYRONIX resin showed no significant physical defects, even when heated with over the 1300 °C gas torch.

Related Application

◆ Available Application: Lithium-Ion Battery Enclosure made by IGNIX resin



◆ Future Applications by IGNIX resin

1. **Energy Storage (ESS)**
   Thermal insulation in EV battery packs and ESS
2. **Hydrogen & Fuel Cells**
   Thermal management in hydrogen storage and fuel cells
3. **Electronics & Semiconductors**
   Battery protection in smartphones, laptops, and power semiconductors
4. **Aerospace & Defense**
   Thermal protection for spacecraft, satellites, and military equipment
5. **Electric Vehicles (EVs) & Mobility**
   Flame-retardant and thermal barrier materials in EVs and drones
6. **Chemical & Industrial Processes**
   Temperature control in hazardous material storage and reactors
7. **Construction & Fire Safety**
   Fire-resistant materials in buildings and industrial sites

Contact

Division of Energy Engineering, Daejin University, Republic of Korea
Associate Prof. Hyeon Taek Jeong (Ph.D.)
Email : jht4321@daejin.ac.kr