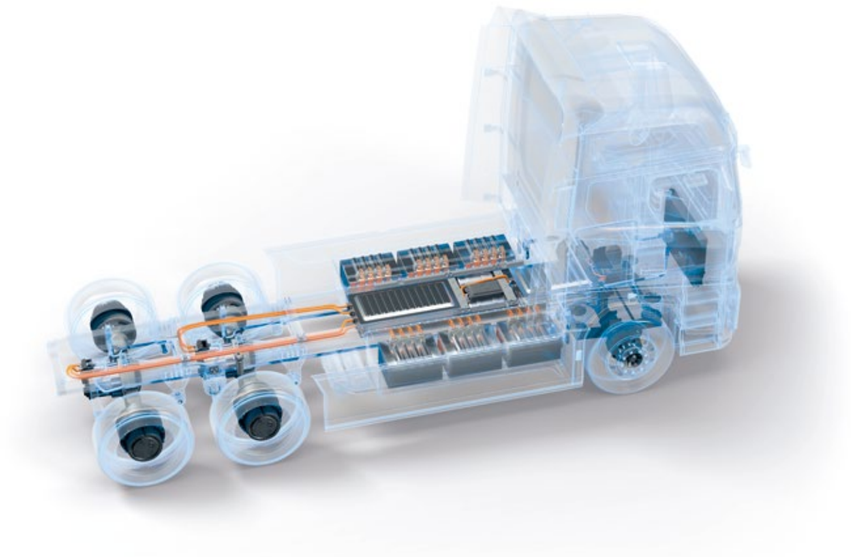
RUBIA
EV FLUID

Fluids for electric on-road equipment

TotalEnergies

Focus on battery cooling

Today, **the current cooling technologies are not able to fulfill the specifications of the new generation of batteries** with a satisfactory level expected for on-road equipment.



What does your customer want?

A safe equipment

Fluid stable at very high temperature

Stop thermal runaway propagation

Reduced charging time

Fluid with high performances

Able to extract heat from 350 kW fast charge

Low power pump and volume required

Low CO_2 impact

Environmentally friendly product

Low energy process

Durability improvement

Improved durability

The optimized cell operating temperatures guarantee long-term battery capacity and performances.

Why is immersion cooling the best choice:

1

Safe operation of batteries

There is a large variety of Li-ions batteries (energy, cells type, size, ...) but in all cases: **a cooling system is necessary** (for safety issues).

A lithium battery **MUST always work** inside this temperature range:

***In case of cell failure,** a thermal runaway can occur, causing an important emission of gases and a possible fire.*

2

Better heat exchange

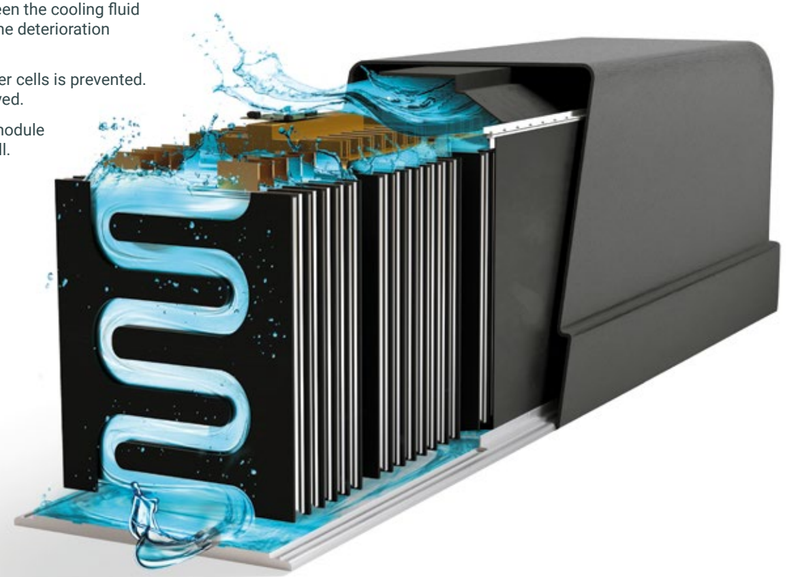
The immersion cooling is the solution to increase the heat exchange.

Immersion cooling is the solution to avoid thermal runaway.

Thanks to the direct contact between the cooling fluid and the cells, the heat caused by the deterioration of a cell is easily removed.

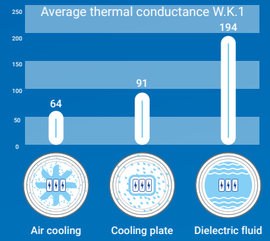
The propagation of the heat to other cells is prevented. The safety of the battery is preserved.

A dielectric fluid circulates in the module and is in direct contact with the cell.



Advantages

- High heat exchange
- Low quantity
- High electric power applications possible



3

Higher durability

- Thermal management of batteries is a major functional aspect of lithium-ion batteries.
- Temperature is a key element in the durability of the battery.
- Charging and discharging cycle are performed in the adjusted temperature range will maintain the battery's capacity and performance.

4

Fast charging

- Immersion cooling can manage all scenario of electric solicitations: very fast charge, high load, ...
- Immersion cooling allows a perfect contact with cells
- Fluids are designed to maximize heat exchange
- **The system limitation is now the cell**

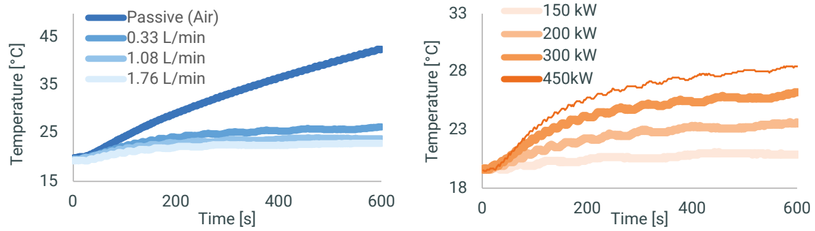
Fluids for thermal management

Physical characteristics

	Eco-Friendly	Cell-Shield
Special characteristics	• Low viscosity • **Negative carbon footprint** • Made from renewable carbon • Readily biodegradable	• Low viscosity • **High auto-ignition temperature** • Thermal runaway propagation and fire prevention • No fluorine, no safety pictogram
Viscosity at 25 °C (mm².s-1)	4.3	6.6
Viscosity at -25 °C (mm².s-1)	26	55
Thermal Conductivity at 25 °C (mW.m-1.K-1)	138	111
Volumic Specific heat at 40 °C (kJ.L-1.K-1)	1.68	1.63
Breakdown voltage at 25 °C (kV)	> 60	> 60
Pour point (°C)	< -60	< -60
Flash point (°C)	140	154
Boiling point (°C)	260	290
Auto Inflammation Temperature (°C)	220	403

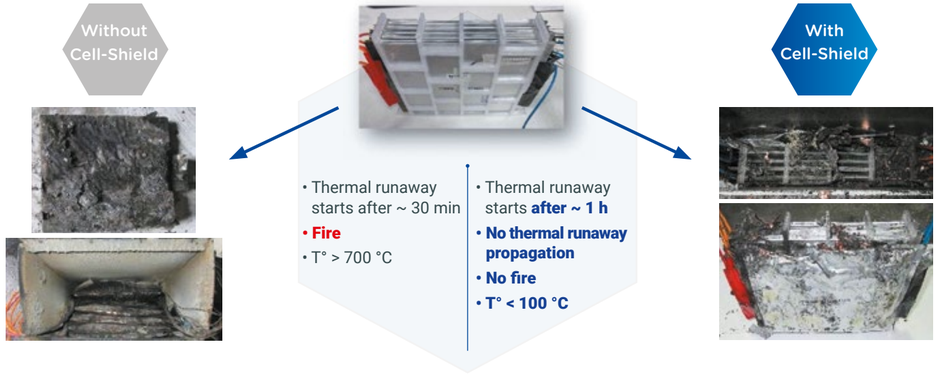
Cooling performances compatible with any fast charge scenarios

Cell temperature of a 40 kWh battery pack cooled by immersion with TotalEnergies fluids.



The Cell-Shield, a safety enabler for a battery without any risk!

Module overcharged in air and with Cell-Shield circulation between the cells.



BATTERY POWERED
ON-ROAD VEHICLES

Rubia EV-Battery range

Rubia EV-Battery D

- Protect against the risk of fire and cell thermal runaway propagation thanks to a very high thermal stability of the fluids
- High cooling efficiency with a low volume of fluid
- Preserve the environment and risk of injury by an absence of fluid toxicity
- Provide high level of stability in time

Rubia EV-Battery I

- Reduced electrical conductivity to mitigate hydrogen formation
- High cooling efficiency with inherently thermal properties
- Compatibility and easy implementation with standard BEV components
- Balanced corrosion protection

Take away message

Immersion cooling can manage all scenario of electric solicitations: very fast charge, high load, …

- Immersion cooling allows a perfect contact with cells
- Fluids designed to maximize heat exchange

Cell is the limit!

Immersion cooling allow to simplify the battery design

- Low volume and simplified internal design (cell to pack)
- Low viscosity

Price and weight reduction of the battery pack

Immersion cooling can bring the safety level expected by the customer

- High thermal stability avoiding TR propagation
- No human hazard, negative carbon footprint

Safety can be improved using a dedicated fluid

New EV fluid requirements

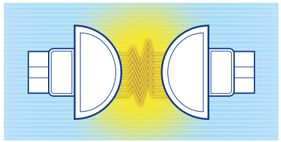
Hybrid Electric Vehicles (**HEV**s) and **Plug-in Hybrid Electric Vehicles** (**PHEV**s) are equipped with an Internal Combustion Engine (ICE) and an electric motor. Two different sources of energy can be used: fuel and/or electricity.

Battery Electric Vehicles (**BEV**s) use one or two electric motors powered by electrical energy, stored in batteries.

The electric motor converts electrical energy into mechanical energy with an efficiency of around 90 %, while Internal Combustion Engine only achieves 35 % of efficiency.

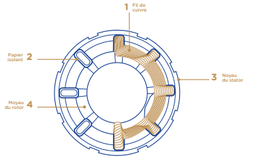
The new technical constraints for the electrification of vehicles require the development of new fluids that must meet the following properties:

Dielectric properties



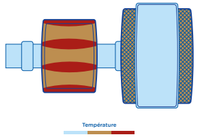
Fluids used in electric vehicles require electrical insulation properties.The fluid must be insulating to prevent any arcing since it is going to be in close contact with the electrical and/or electronic components of the vehicle.

Compatibility with materials



The fluid and new components of the electric vehicle are in direct contact. New challenges must be faced in terms of the fluid being compatible with different types of materials in order to avoid swelling, breakage, corrosion etc. Copper is a key material for these applications.

Thermal properties



Power electronics and the electric engine must operate within a defined temperature range. Operating at higher than the desired temperature range inevitably reduces the vehicles' service life, efficiency and power. The fluid must therefore ensure efficient heat evacuation at temperatures up to 180 °C.

Electric vehicles are a concentrate of innovation with high new technical requirements. As a result of TotalEnergies' commitment to continuous innovation, our **Rubia EV Fluid** range introduces very unique technological benefits to reach a new level of performance in the EVs market.

INSULAT·ION AUGMENTED

Prevent Short-circuits and Static Charge build-up

THERMO·CONTROL AUGMENTED

Heat Transfer & Cooling Capability

COMPATIBILITY AUGMENTED

Compatibility with Copper & Insulating Materials

ELECTRIC & HYBRID
ON-ROAD VEHICLES

Electric transmission range

Rubia EV-Drive MP

Rubia EV-Drive MP is specially designed with **Insulat.Ion Augmented** technology for **reducers, electric engines** and **power electronics.** This product fits perfectly with the requirements of those components with outstanding performances.

Insulat.Ion Augmented technology is designed to address specific electrical, thermal and friction constraints of electric powertrains. It insulates electric circuits' components to reduce wear, prevent shortcuts and improve vehicle performance.

- Protect against shortcuts and static electricity
- Provide optimal temperature control eveAn at sharp acceleration and fast charging operation
- Maintain excellent compatibility with copper coils and polymer material
- Ensure excellent anti-wear properties for gears and rolling bearing

Rubia EV-AT

Rubia EV-AT is specially designed with **Compatibility Augmented** technology for **hybrid automatic transmissions.**

Compatibility Augmented technology is designed with optimized formulation that is perfectly fitting with all hybrid electric transmission materials, providing maximum protection of copper and elastomer materials present in the e-transmission.

Ensure optimal level of friction and friction durability for a smooth gear shitting

Show optimal anti-foaming and air release properties through the entire lifetime of the vehicles

Ensure material compatibility with copper wires and elastomers

Designed for excellent pumpability even at very low temperatue

Rubia EV-Drive R

Rubia EV-Drive R is specially designed with **Compatibility Augmented** technology for electric drivetrain reducers. This product is a synthetic fluid formulated for new generation of electric drivetrain reducers operating under extreme conditions.

Compatibility Augmented technology is embedded in order to fit perfecty with new material types such as high-performance polymers, thermoplastics and seals being used in electric transmissions.

Ensure durability of gears and rolling bearings rotating at very high speed

Show optimal anti-foaming and air release properties through the entire lifetime of the vehicles

Design for excellent pumpability even at very low temperature

TotalEnergies

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