Factsheet

Contamination of fire water runoff and cooling water in Li-ion battery- and EV-incidents

Fire water runoff is the water left in the surrounding area after extinguishing battery fires. Cooling water is the water in a tank or submersion container used to submerge (damaged) battery cells or electric vehicles for cooling purposes. Following incidents involving Li-ion batteries and electric vehicles, this water can become contaminated with harmful substances. This factsheet is intended for emergency responders and other professionals dealing with contaminated fire water runoff and cooling water after such incidents. It is based on literature research and eight field measurements and provides insight into the concentrations of selected harmful substances found in contaminated water after battery-related incidents and electric vehicle fires involving Li-ion battery packs.

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Contamination of fire water runoff after battery fires

Literature study

The literature shows that the following substances can contaminate fire water runoff:

- Heavy metals: particularly nickel, manganese and cobalt
- lithium
- PFAS
- fluoride
- In addition, an elevated pH value is often observed.

The following table provides an overview of the ranges of all reported concentrations of substances in fire water runoff and cooling water associated with NMC batteries in the literature. In the left column, the number of experiments (n=...) on which each range is based is indicated per substance. In addition to the measured substances, a column has been included presenting the various standards for the selected substances as reference values. These are derived from various laws and guidelines included in the RIVM *Substance Risk Search System*. Drinking water standards are generally the most stringent, followed by standards for surface water and signal values for groundwater. Not all substances have standards within every guideline or legislative framework.

Substance	**Range**[1]	**Outliers**	**Standards**	
Nickel (n = 11)	0,08 – 60 mg/l	920 mg/l	0,075 mg/l 0,034 mg/l 0,020 mg/l	Indicator parameter remediation[2] MAC-MKN surface water Drinking water requirement
Manganese (n = 11)	0,1 – 36 mg/l	82 mg/l	0,5 mg/l 0,050 mg/l	Surface water for drinking water[3] Drinking water requirement
Cobalt (n = 11)	0,003 – 36 mg/l	152 mg/l	0,1 mg/l 0,0014 mg/l	Indicator parameter remediation MAC-MKN surface water
Copper (n = 10)	0,002 – 1,7 mg/l	30 mg/l 42 mg/l	2,0 mg/l	Drinking water requirement
Lithium (n = 11)	4,1 – 676 mg/l	1460 mg/l	0,120 mg/l 0,0035 mg/l	Surface water salt Surface water sweet
Fluoride (n = 8)	8 – 160 mg/l	330 mg/l	1,5 mg/l 1,0 mg/l	MTR surface water Drinking water requirement
Chloride (n = 6)	2 – 140 mg/l	359 mg/l	200 mg/l 150 mg/l	MTR surface water Drinking water requirement
PFAS (n = 3)	0,196 – 4,7 µg/l	No outliers	0,1 µg/l	Drinking water requirement
pH-value (n = 8)	5,9 – 13	No outliers	7 – 9,5	Drinking water requirement

Range of reported concentrations of contaminants in fire water runoff and cooling water associated with NMC-batteries in the literature.

[1] All values within 1,5 times the interquartile range, see section 4.1 of the report for further explanation.
[2] Indicator parameter for groundwater remediation assessment.
[3] Surface water for drinking water abstraction.

The table shows that the measured concentrations of contaminants generally exceed the environmental standards, while some of the lowest measured concentrations remain below these standards. At the same time there is a large spread with clear outliers.

> The most notable outliers, the levels of nickel, manganese and cobalt, originate from measurements taken following an intervention on an electric vehicle using an ultra-high pressure extinguishing system, which involved very intensive contact between the fire water runoff and the (damaged) battery cells. Cooling water in which (damaged) battery cells have been submerged for an extended period can also become heavily contaminated due to this prolonged contact.
> The lower limit of the measured concentrations stems from experiments in which the water barely came into contact with battery cells during the fire, because the casing of the battery pack prevented extinguishing water from reaching the batteries.
> While more effective cooling is achieved when water comes into direct contact with battery cells, this can result in heavily contaminated water; conversely, fire water runoff and cooling water that only contacts the casing, and thus has a limited cooling effect, becomes less contaminated..

Field measurements

The following table provides an overview of the concentration ranges of the substances measured in cooling water samples from submerging containers, involving 8 incidents of vehicles with the battery being involved. The relevant standards are also included for reference.

Substance	**Range[4] (n = 8)**	**Outliers**	**Standards**	
Nickel	0,865 – 11,56 mg/l	No outliers	0,075 mg/l 0,034 mg/l 0,020 mg/l	Indicator parameter remediation[5] MAC-MKN surface water Drinking water requirement
Manganese	1,105 – 3,75 mg/l	No outliers	0,5 mg/l 0,050 mg/l	Surface water for drinking water[6] Drinking water requirement
Cobalt	0,266 – 1,35 mg/l	4,50 mg/l	0,1 mg/l 0,0014 mg/l	Indicator parameter remediation MAC-MKN
Copper	0 – 0,69 mg/l	1,7 mg/l	2,0 mg/l	Drinking water requirement
Lithium	2,40 – 70,5 mg/l	200 mg/l	0,120 mg/l 0,0035 mg/l	Surface water salt Surface water sweet
Fluoride	4,49 – 24,2 mg/l	68 mg/l	1,5 mg/l 1,0 mg/l	MTR surface water Drinking water requirement
Chloride	25,05 – 69,7 mg/l	100,4 mg/l	200 mg/l 150 mg/l	MTR surface water Drinking water requirement
PFAS	0,0247 – 2,096 µg/l	3,271 µg/l	0,1 µg/l	Drinking water requirement
pH-value	8,05 – 10,87	No outliers	7 – 9,5	Drinking water requirement

Field measurement results of cooling water in EV submersion containers

The variation in measured concentrations may potentially be explained by differences in the conditions under which the vehicles were placed in the immersion container. Factors such as the extent of damage to the battery pack, the duration of submersion and the degree to which water actually comes into contact with the battery cells likely play a role. The (re)use of the same submersion container, for instance when

[4] All values within 1,5 times the interquartile range, see section 4.1 of the report for further explanation.
[5] Indicator parameter for groundwater remediation assessment.
[6] Surface water for drinking water abstraction.

multiple vehicles are submerged in the same water sequentially, can also contribute to variations in the measured concentrations.

Key conclusions

- Based on the findings of the literature study and the field measurements, we can conslude that the extinguising and cooling water used during incidents involving Li-ion batteries and electric vehicles is often contaminated with substances that are potentially harmful to the environment.
- As the pH of the cooling water can rise to alkaline levels, it may acquire corrosive properties. This can pose risks to emergency responders and recovery personnel.
- The literature shows that consistently elevated concentrations of battery-related substances are found in experiments, with a high degree of variability. In most cases, these concentrations exceed environmental standards, indicating a significant level of contamination.
- Experiments involving the injection of extinguishing water into the battery pack, or prolonged contact between (damaged) battery cells and cooling water, show higher concentrations than situations where the casing remains intact and contact with water is limited.
- Field measurements using cooling water from submersion containers confirm the findings reported in the literature. In all cases examined, elevated concentrations of the various substances analyzed were detected relative to environmental standards. A clear variation in the measured concentrations was also observed.
- Fire water runoff and cooling water generated during battery fires is often contaminated. For several substances, measured concentrations consistently exceed established standards. This indicates both potential local environmental risks and the need for careful handling of this contaminated wastewater. Cooling water from submersion containers requires deliberate decisions regarding collection, disposal, and treatment.
- It is advisable for those involved to be aware of potential exposure and spread, and to pay attention to the use of personal protective equipment and occupational hygiene measures when coming into contact with contaminated fire water runoff and cooling water.

Colophon

This factsheet is based on the report *Vervuiling van blus- en koelwater bij lithium-ion batterijen en elektrische voertuigen* (NIPV, 2026).
You can download this report on www.nipv.nl.

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