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Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

Fifty-seventh session
Geneva, 29 June-8 July 2020
Item 4 (e) of the provisional agenda
Electric storage systems: sodium-ion batteries

Sodium-ion batteries – Creation of a dedicated UN number and related special provisions

Transmitted by the experts from France and the United Kingdom*

Introduction

1. At the fifty-fifth session, France, with the support of the United Kingdom, presented an informal document (informal document INF.38 (55th session)) to suggest a new approach concerning sodium-ion batteries. The Sub-Committee agreed to follow the approach presented in this document (see ST/SG/AC.10/C.3/110, paras. 60 to 62)

2. It was clarified that the aim of the proposal to draft was to create a separate entry for sodium-ion batteries and to establish the corresponding transport conditions. The Sub-Committee recommended to take a careful approach on this subject and to consider also intrinsic hazards to achieve a proper classification

3. This would be based on the principles laid out in informal document INF.38 (55th session) especially the intrinsic hazards would be assessed by using the well-known testing scheme of 38.3 of the manual of test and criteria, as proposed in paragraph 15 of that document, with some changes to make it more suitable to the level of risk posed by sodium-ion batteries

4. It has also been noted that it is a well-known fact that sodium-ion when discharged poses very little to no electrical risk. It is therefore proposed to introduce an exemption with a minimal set of requirements for shorted batteries, shorting being a way to ascertain discharge. Indeed, there is no easy way to verify the states of charge of a battery during transport. Short circuit is proposed as a way to ascertain that the transported battery is fully discharged. It is however to be demonstrated that sodium-ion batteries can be over discharged without risk. Other practical methods to ascertain that the battery is fully discharged can be discussed.

* 2020 (A/74/6 (Sect.20) and Supplementary, Subprogramme 2).

5. It was agreed that France and the United Kingdom would work together and with other concerned parties make a detailed proposal for the transport of Na-ion batteries. In this respect, a battery company from the United States of America has contributed to the effort.

6. This process allowed to gather new information on sodium-ion batteries especially concerning their energy density which could have an influence on their related level of risk.

7. Sodium-ion batteries exhibit a wide range of energy densities corresponding to different applications. Batteries designed with low energy densities are for stationary use purposes whereas sodium-ion batteries with higher densities can be used in mobile products such as electric vehicles and portable electronics. Different energy densities may result in different risks in transport.

8. For reference purposes, certain lithium-ion battery chemistries may have an energy density in the range 190 Wh/kg to 250 Wh/kg. At present sodium-ion batteries currently available are reported to have energy densities from 22 Wh/kg to 150 Wh/kg. Understandably the batteries on either end of the range may have widely different intrinsic hazards and due to the different degree of hazard posed, some presenting a lower degree of risk may be subject to a simplified requirement.

9. To take this factor into account, proposal 5 contains a special provision to exempt sodium-ion batteries that have a low energy density even from testing. However, at the time this document is drafted it is felt that more supporting data would be needed to decide on this principle, as well as on the threshold, in terms of energy density, that would be relevant. Therefore, this proposal is still considered as optional in the context of this document.

10. A decision could be made if enough data showed that, in all cases, low energy density sodium-ion batteries would not cause any dangerous electrical reaction.

11. In general, the proposals contained in this document shall be considered as a frame to start discussion for this item. They are a first draft and may be completed with informal documents, with supporting data and possible improvements as suitable.

Summary of the proposals

12. The proposal aims at modifying the UN 3292 entry to exclude Na-ion batteries. For this reason, the proper shipping name of UN 3292 should be changed from: “BATTERIES CONTAINING SODIUM or CELLS, CONTAINING SODIUM” to “BATTERIES CONTAINING METALLIC SODIUM OR SODIUM ALLOY or CELLS CONTAINING METALLIC SODIUM OR SODIUM ALLOY”.

13. It is then necessary to create a new entry for Na-ion batteries. The description of this entry would be “SODIUM ION BATTERIES USING ORGANIC ELECTROLYTE”. Many points such as packing group, special provisions, limited and excepted quantities would be similar to the one applicable for Li-ion batteries. An additional special provision is to be developed to include the possibility to transport Na-ion batteries shorted with a minimal set of requirements as mentioned in paragraph 4 above.

14. Additional points still must be clarified such as:

- The possibility for sodium-ion batteries using an aqueous alkali electrolyte to be transported under UN 2795 and P801.
- The specific case of sodium-ion batteries using an aqueous electrolyte that are liable to emit cyanide (containing Prussian blue).

Proposals

Proposal 1

15. In 3.2.2 change the proper shipping name of UN 3292 to read "BATTERIES CONTAINING METALLIC SODIUM OR SODIUM ALLOY or CELLS CONTAINING METALLIC SODIUM OR SODIUM ALLOY"

Proposal 2

16. In 3.2.2 add two entries in the dangerous goods list as follow:

UN No.	Name and description	Class or division	Subsi-diary hazard	UN packing group	Special provisions	Limited quantities	Packaging and IBCs	
							Packing instruction	Special packing provisions
XXXX	SODIUM ION BATTERIES USING ORGANIC ELECTROLYTE	9			188 230 310 348 376 377 384 XXX XYY	0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906	
XXXY	SODIUM ION BATTERIES USING ORGANIC ELECTROLYTE CONTAINED IN EQUIPMENT or SODIUM ION BATTERIES USING ORGANIC ELECTROLYTE PACKED WITH EQUIPMENT	9			188 230 310 348 360 376 377 384 XXX XYY	0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906	

17. It is envisaged to apply the special provisions and packing instructions that are applicable for Li-ion, where the word Li-ion would be replaced by Na-ion. This would be drafted after the agreement of the principle by the Sub-Committee.

Proposal 3

18. In Chapter 2.9, add a new 2.9.5 as follows:

"2.9.5 Cells and batteries, cells and batteries contained in equipment, or cells and batteries packed with equipment, which are a rechargeable electrochemical system where the positive and negative electrode are both intercalation or insertion compounds (intercalated sodium exists in an ionic or quasi-atomic form in the lattice of the electrode material) constructed with no metallic sodium (or sodium alloy) in either electrode and using an organic non aqueous compound as electrolyte, shall be assigned to UN Nos. XXXX or XXXY as appropriate.

They may be transported under these entries if they meet the following provisions:

(a) Each cell or battery is of the type proved to meet the requirements of applicable tests of the Manual of Tests and Criteria, part III, sub-section 38.3. Applicable tests are given in the following table:

<table>
<tr><th colspan="2"></th><th>T1</th><th>T2</th><th>T3</th><th>T4</th><th>T5</th><th>T6</th><th>T7</th><th>T8</th><th>Total</th></tr>
<tr><td rowspan="2">Cells not transported separately from a battery</td><td>First cycle, 50% charged state</td><td></td><td></td><td></td><td></td><td>[3]</td><td></td><td></td><td></td><td rowspan="2">[6]</td></tr>
<tr><td>25th cycle, 50% charged state</td><td></td><td></td><td></td><td></td><td>[3]</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Cells</td><td>First cycle, fully charged state</td><td colspan="5">[3]</td><td>[3]</td><td></td><td></td><td rowspan="2">[12]</td></tr>
<tr><td>25th cycle, fully charged state</td><td colspan="5">[3]</td><td>[3]</td><td></td><td></td></tr>
<tr><td rowspan="2">Single cell batteries</td><td>First cycle, fully charged state</td><td colspan="5">[3]</td><td>[3]</td><td>[3]</td><td></td><td rowspan="2">[15]</td></tr>
<tr><td>25th cycle, fully charged state</td><td colspan="5">[3]</td><td>[3]</td><td></td><td></td></tr>
<tr><td rowspan="2">Small batteries</td><td>First cycle, fully charged state</td><td colspan="5">[3]</td><td></td><td>[3]</td><td></td><td rowspan="2">[12]</td></tr>
<tr><td>25th cycle, fully charged state</td><td colspan="5">[3]</td><td></td><td>[3]</td><td></td></tr>
<tr><td rowspan="2">Large batteries</td><td>First cycle, fully charged state</td><td colspan="5">[2]</td><td></td><td>[2]</td><td></td><td rowspan="2">[8]</td></tr>
<tr><td>25th cycle, fully charged state</td><td colspan="5">[2]</td><td></td><td>[2]</td><td></td></tr>
<tr><td>Batteries assembled with tested batteries < 6200 Wh</td><td>Fully charged state</td><td></td><td></td><td colspan="3">[1]</td><td></td><td>[1]</td><td></td><td>[2]</td></tr>
<tr><td>Batteries assembled with tested batteries > 6200 Wh</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>[0]</td></tr>
</table>

[The number of samples in this table are indicative and they might change according to results of abusive tests. Depending on abusive tests results, a reduction of the number of tests might be relevant.]

(b) Each cells and battery incorporate a safety venting device or is designed to preclude a violent rupture under conditions normally encountered during transport;

(c) Each cell and battery is equipped with an effective means of preventing external short circuits;

(d) Each battery containing cells or a series of cells connected in parallel is equipped with effective means as necessary to prevent dangerous reverse current flow (e.g., diodes, fuses, etc.);

(e) Cells and batteries shall be manufactured under a quality management program that includes the same items as for Li-ion cells (2.9.4 (e) i to ix);

(f) Manufacturers and subsequent distributors of cells or batteries shall make available the test summary as specified in the Manual of Tests and Criteria, Part III, sub-section 38.3, paragraph 38.3.5.”

Proposal 4

19. It is proposed to add in 3.3.1 a special provision XXX for the transport of shorted sodium-ion cells and batteries.

“XXX Organic sodium-ion cells and batteries and organic sodium-ion cells and batteries contained or packed in equipment, prepared and offered for transport short-circuited, in a way that the system (cell or battery) does not contain electrical energy, are not subject to other provisions of these Regulations if they meet the following:

(a) The short-circuiting of the cell/battery is easily verifiable (e.g., busbar between terminals…)

(b) Each cell or battery meets the provisions of 2.9.5 (a), (e), (f);

(c) Each package shall be marked according to 5.2.1.9;

(d) Except when cells or batteries are installed in equipment, each package shall be capable of withstanding a 1.2 m drop test in any orientation without damage to cells or batteries contained therein, without shifting of the contents so as to allow battery to battery (or cell to cell) contact and without release of contents;".

Proposal 5

20. If the data allows to make a positive decision in relation to paragraphs 9 and 10 above, it is proposed to adopt a new special provision YYY under new entries XXXX and XXXY prescribing requirements for low energy batteries as follows:

> "YYY Sodium ion cells and batteries that have an energy density of [XX Wh/kg]* or less and when protected against short circuit shall, if containing a dangerous good, be transported as articles under an appropriate entry for that dangerous good or if not containing any dangerous goods may be transported as not subject to these regulations. Equipment containing either of these types may be transported as not subject to these regulations provided installed batteries are protected against short circuit."

** The value of the energy density must be precisely defined according to test data.*