Trouble in Store

Defusing the Battery Problem at the Technical Museum Vienna

Chris Clouter, Georg Kräutel-Höfer, Friedrich Prohaska, Andreas Weiß

Technisches Museum Wien
Konservierung & Restaurierung
Mariahilfer Straße 212, 1140 Wien, restaurierung@tmw.at

1. Introduction

Like a clock's mainspring, batteries as energy source and storage are indispensable evidence of technical function both as objects in their own right and component parts. They can also be essential to structural and aesthetic design. However, practical and ethical considerations have hampered their collection in the past **FIGS. 3A/B** and continue to plague it at present **FIGS. 4A/B**.

The problems they present for museums of technology is growing at a parallel rate to exponiential industrial innovation with the increased reliance on mobile devices and a drive from fossil fuels. Without a concept to ensure safe and effective collection, display and preservation, these artefacts will not be available for research and contextualisation in the future.

2. Outline of the challenges batteries represent in museum institutions

To collect or not to collect? Risk identification is the determining factor **FIG. 1**. The hazards inherent in batteries are well documented and not only pose questions for storage but legal obligations for handling, transport and exhibition*. Health risks such as inhaling heavy metal dust **FIG. 2**, potential damage to objects through acid or alkali leakage, fire from short circuiting or fire accelleration through lithium – these are the dangers faced when collecting batteries.

Although the goal is to collect and provide an infrastructure in which to do so, the first duty is to banish inestimable risk and pay due consideration to the stark realities limiting preservation goals. When the prototype of an E-motorbike was acquired, the accumulator packs were of unknown provenance, self-packaged and deemed too hazardous to be collected, so they were documented and replica surrogates constructed from scratch **FIGS. 4A/B**.

3. Developments in the storage and exhibition of batteries to date

To preserve or not to preserve? Although no formal decision has ever been taken in regard to the functionality of accumulator batteries, the periodic charging option to extend their limited operative lifespann was dismissed as risky, impractical and not in line with museal decommissioning practice. Normal practice since 2013 the removal batteries from objects where possible for separate storage in cupboards in a designated area for ease of monitoring and risk containment **FIG. 5**.

If separation is not possible, the whole object is treated as a battery and likewise removed from the general storage population. Some batteries can be returned to objects after treatment has succesfully defused the danger of contamination. Some batteries cannot be defused and therefore alternatives for exhibition are necessary.

4. Surrogates for display in public spaces

If a removed batterypack was essential to the artefact's structural or aesthetic design, surrogates have proven to be a good option for stability, legibility and documentation in exhibition. Context, opportunity and narrative intention all play a role in the choice of surrogate type. Should a surrogate quietly integrate itself or stand out? Should it totally fullfil the structural or aesthetic role of the original? Can an industiral dummy be acquired? For instance, the TGM Kijon had unique battery packs that were not collected, so the surrogates as 'physical documentation', although hidden, had to reflect the originals in detail **FIG. 4B**. In the case of a hybrid electric car **FIGS. 6A/B** the nickel-metal hydride battery was collected but removed, so the hidden cavity was filled for structural support.

As the Segway li-ion accumulator battery formed the silhouette of the footboard, it was originally exhibited in the object, monitored and even trickle charged. However, an alternative was necessary to reduce risk and labour investment, so an industrial dummy was acquired for display and the original stored **FIGS. 7A/B**.

5. Preservation treatment options

To date the longterm problems lithium-ion batteries pose have been met with separate storage, and only improvements in storage conditions rather than practical treatment options seem to be a realistic goal. All batteries undergo a process of active discharging when entering the collections. This safety measure can be augmented by isolating the poles. Deposits of migrated toxic materials, such as lead compounds, are removed from external surfaces **FIGS. 8A/B/C**.

To eliminate the risk of cross-contamination, the liquid electrolyte** is removed from batteries destined to be reinstalled in an object and is performed only without damaging the case. If there is apparent or likely leakage, the procedure is also performed and the case resealed after rinsing to prevent the escape of residual toxic compounds.

6. Past and present research

Although research has been conducted on conventional starter batteries to confirm the necessity of practical intervention***, the complex problems posed by pouched accumulator batteries remain a stumbling block. Now that immediate safety issues are being adequately addressed, the matter of optimal longterm preservation in respect to ambient shared conditions is now the focus of current research. To this end, the TMW has partnered with TÜV Austria to optimise procedures for identification, risk assessment and existing precautionary measures to conform with current legislation whilst fulfilling museal preservation requirements.

*Used open system accumulator batteries are categorised as dangerous goods/hazardous material class 8 C11 ADR 2.2.9.1.2 in the EU, partially emptied and untight batteries. There is a special regulation governing closed system accumulator batteries with intact cases as well as for used starter and appliance batteries with undamaged cases. Under certain circumstances these are not categorised as dangerous goods. Li-ion accumulator batteries are generally classified as dangerous goods class 9 ADR 2.2.8.3 (cf ADR - Agreement concerning the International Carriage of Dangerous Goods by Road).
**If the electrolyte is removed, then the casing undergoes a series of rinses to ensure removal is as complete as possible to reduce the risk of any detached toxic compounds remaining inside. Finally the case is hermetically sealed and the poles are coated to prevent the reccurance of oxidative degeneration on the electrodes.
*** specifically into isolating the electrode surfaces and to assess viable treatment options such as coating or submersion.

References

ADR - Agreement concerning the International Carriage of Dangerous Goods by Road, Vol 1., United Nations, 2020 -https://unece.org/sites/default/files/2021-01/ADR2021_Vol1e_0.pdf

FIG. 1. *Caution label from the nickel-metal hydride battery belonging to inv. no. 95217 . Toyota Prius 1,5 VVT-i Hybrid „ECO"*

FIG. 2. *Daniell cell battery inv. no. 108186 showing the problem of exposed toxic compounds on a historic object*

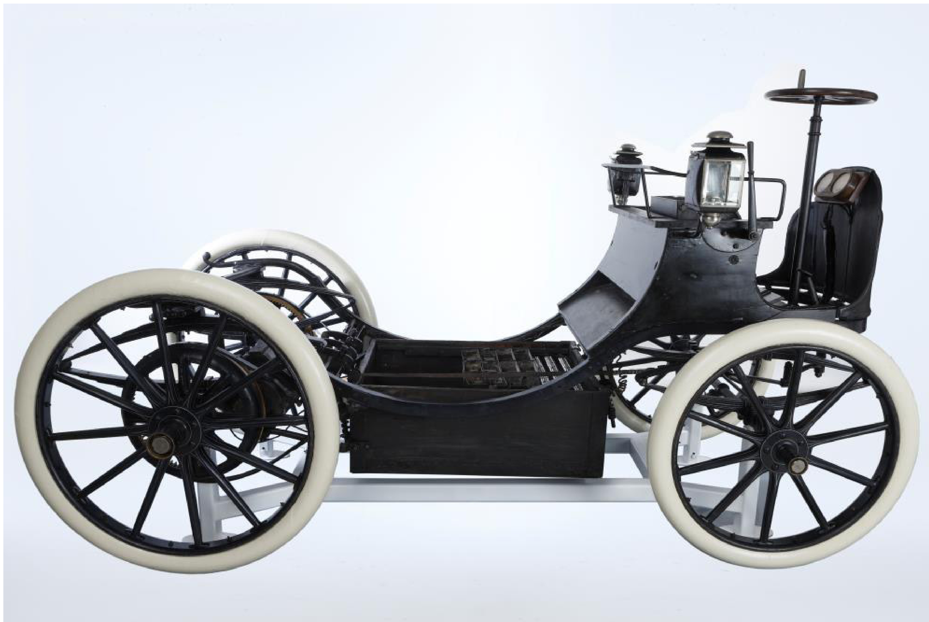

FIG. 3A. *The Egger-Lohner electric car inv. no. 1437 entered the collection at its foundation with an incomplete batterypack. A hundred years later no battery-driven car can be displayed with an installed batterypack.*

FIG. 3B. *Incomplete portion of the original battery of lead-acid cells belonging to inv. no. 1437*

FIG. 4A. *TGM Kjion E-Bike inv. no. 95651*

FIG. 4B. *Replica surrogates of the self-packaged pouched accumulator packs installed in inv. no. 95651*

FIG. 5. *Accumulator batteries are isolated in metal cupboards and stored in trays to contain possible contamination*

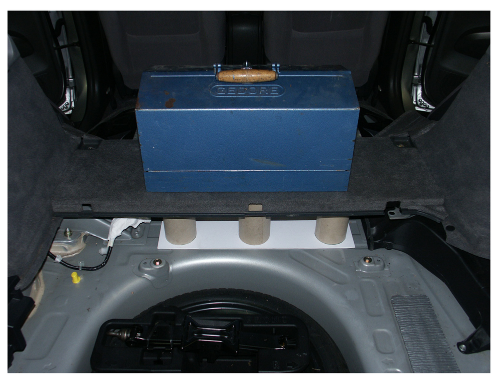

FIG. 6A. *Toyota Prius 1,5 VVT-i Hybrid „ECO" inv. no. 95217 showing the position of the installed traction battery with the trunk floor removed*

FIG. 6B. *Structural compensation to support the trunk floor and toolbox after battery deinstallation inv. no. 95217*

FIG. 7A. *Segway PT i2 inv. no. 95220*

FIG. 7B. *Segway original lithium-ion accumulator battery inv. no. 95220/2*

FIG. 8A. *Clearning battery parts in a fume cupboard – in the foreground the battery cells of the Dostal Elektro LKW El 3000 inv. no.39260*

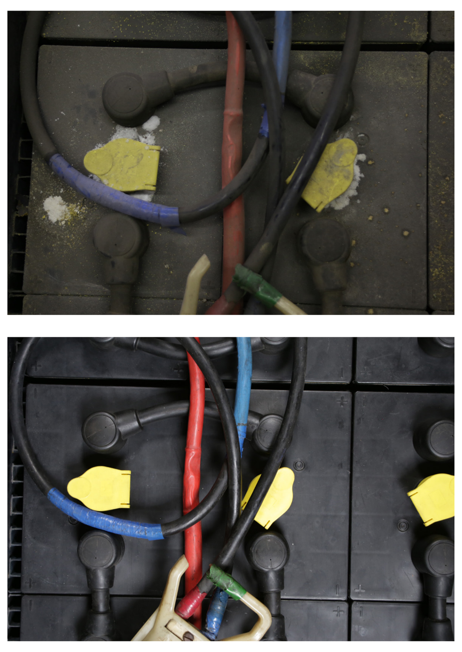

FIG. 8B/C. *Details before and after treatment of the top of the battery case belonging to inv. no. 39260*

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