Webinar „Energy systems for industrial trucks put to the test"

- Tuesday, 09/28/2021 -

Q&As

Questions regarding the lead-acid battery

Recycling a lead-acid battery requires energy, but the battery gets a second service life. Can a Li-ion battery be recycled?

For one thing, Li-ion batteries have a much longer service life, usually at least twice as long, and therefore the need for recycling occurs much later. In addition, the definition of "EOL" (End-of-Life) in our vehicles does not mean that the battery / cells are no longer usable. Rather, they can be further used in appropriate products (e.g. energy storage). The bottom line is that the service life is many times longer and Li-Ion batteries are already being recycled today.

Li-ion batteries have a BMS with balancer. Would it be possible to optimise lead-acid batteries with a BMS+balancer? That would at least drastically reduce the problem of the cell voltages drifting apart and thus improve the overall availability due to the series connection.

Optimisation may well be possible. However, the costs and benefits must be questioned. The lead-acid battery would have to be supplemented by the control and power electronics so that the PzS cells are balanced. The same can already be done with an equalisation charge.

Could temperature (working outdoors in sunlight) affect battery performance? What are the best weather conditions?

The generally valid technical data are based on a battery/cell temperature of around 25°C. Deviations to higher and lower temperatures can influence the performance data, e.g. the charging power. With regard to outdoor use, usually there is no direct sunlight on the batteries to heat them up in addition to the vehicle use. For this reason, outdoor use is usually not a problem.

Questions on the topic " Operation below freezing point"

Do you have a forklift truck with fuel cells for outdoor use at temperatures down to -30 degrees Celsius?

The use of a fuel cell at temperatures below the freezing point is possible. However, this requires an appropriately configured industrial truck as well as a suitable BRM system. However, parking the vehicle outdoors is not recommended, as the process water may freeze on the stacks or in the dehumidifier.

Is Li-ion technology suitable for cold storage at -24C?

Depending on the battery capacity, Li-ion technology can be used at temperatures as low as -20°C. Please note that the largest available capacity is always used and charging times will be longer.

How do lithium batteries work at -22 degrees Celsius?

Li-ion batteries lose part of their battery capacity in deep freeze conditions and the charging time is extended because of the low temperatures. For these reasons, it is important to ensure that the largest possible Li-ion capacity is always used in deep-freeze applications.

Can lead-acid batteries also be used below zero degrees Celsius?

Lead-acid technology is already used in deep-freeze applications today. The use shortens the service life and other points, such as a different charging curve, must be taken into account.

Questions on Li-ion technology

At the moment, we see a pretty big disadvantage of Li-ion batteries in the charging process. No matter how safe the system is, there is always a risk that the battery will burn. And if it starts burning, there is no real way to put it out. Consequently, the infrastructural requirements can be quite expensive.

No, as long as the appropriate charger is used with the Li-ion battery, the charging process is safe. For this reason, you will always only receive "pairs" of battery and charger in the market. This ensures that the battery is not charged incorrectly. In addition, the Li-ion battery tells the charger how the charging process should be carried out. If limit ranges are reached or detected, charging is either not started or interrupted.

Charging a Li-ion takes place when employees interrupt their work. Doesn't the rapid charging of the battery cause an enormous peak load on the network? What solution is there for this?

Every STILL Li-ion charger has adjustable options for the charging power control ex works, i.e. with this the total energy demand of the Li-ion chargers can be controlled and peaks can be avoided or even resolved.

The problem with Li-ion batteries remains fire, the burning is unstoppable. How can we convince insurance companies that this risk is low? What are the means to fight the fire?

Experience shows that a presentation of the technology, construction of the battery and the safety system is helpful to promote understanding. In addition, Li-ion technology is now widely used and accepted.

In a 3-shift operation you need 8 h charging time with Li-ion if you say that 1 h charging time covers 3 h driving time, however, I can't cover a 3-shift operation with that, how do you explain that?

The statement "1 h charging = 3 h driving time" refers to the RX20 at a charging power of 9 kW. Here we are within the range of 48V vehicles and a charger with 18 kW charging power is also available. This means that 1 h charging = 6 h driving time. This halves the charging time required to match vehicle availability. And for further clarification: The statement refers primarily to the comparison with lead-acid technology: 8 h charging time corresponds to approx. 6 hours driving time.

Onboard charger and the accompanying flexibility are all well and good. What are the general conditions to be observed during the charging process with regard to distances from combustible materials?

The specifications of around 2.5 m safety distance must still be observed here - even with an integrated charger.

How will lithium-ion batteries be disposed of in the future?

In Europe, Li-ion batteries must be returned to the manufacturer and the manufacturer must take them back.

Does the truck operator become dependent on the truck manufacturer for the use of Li-ion batteries? Or are freely available Li-ion batteries compatible with STILL vehicles for instance?

In contrast to lead-acid batteries, there are neither standards nor consistent characteristics for the use of Li-ion batteries in industrial trucks. In order to guarantee safety in operation, the CE ex works on the part of STILL applies to the Li-ion batteries available from us.

Thank you very much for this interesting presentation. How can we ensure Lithuim longevity over 10 years with only a few years of feedback with this technology?

The batteries and cells are and will be subjected to so-called "life tests", i.e. an abbreviated 10 years of use in continuous operation is carried out. This is how we guarantee their operation. It should also be mentioned once again that after this application, the battery or Li-ion cell can be used for other applications.

What about the use of Li-ion batteries in warm environments?
For example, in a glass factory where there is a 1600° Celsius furnace nearby.

The temperature range is comparable to that of a lead-acid battery. However, depending on the battery variant, a reduction in performance can occur at battery temperatures of more than 50°C.

Can Li-ion batteries be replaced by other batteries or energy systems?

A part of our product portfolio can be used across technologies, i.e. the vehicle recognises the battery technology and automatically sets the parameters. This is possible with the RX20 and RX60, among others.

Are trolleys & tow tractors available with Li-ion batteries?

The STILL product portfolio is almost complete, although some variants are still being worked on. The majority of the trolley/tractor portfolio is available with Li-ion.

For the lifetime of a Li-ion battery, what should logistics managers, for example, look out for when investing in or converting energy systems?

You should analyse the transport processes precisely in order to determine the energy capacities that are really needed and then be able to control them according to demand. In addition, invest today in vehicles that are equipped in such a way that they will also allow a change of energy source in the future. Furthermore, care should be taken to ensure that the interfaces of vehicles, batteries, chargers and the control software are optimally coordinated in order to ensure smooth and efficient interaction. In conclusion, one should not be confused by the numerous options, because the most technically innovative solution is not always the one that makes the most economic sense for the individual transport task. Therefore, my advice: get competent advice.

Can lithium-ion technology also be used at temperatures below 0 degrees Celsius?

Yes, you can use our orange luminous batteries ex works below 0 degrees Celsius. It is possible.

What about the safety of lithium-ion batteries? Do special measures need to be taken?

The lithium-ion batteries are of course safe. They are tested. There are requirements that are met, of course. You always have to keep in mind from what you read and hear that not every battery of this kind is comparable. There are different cells, different safety mechanisms, different packaging that are used. And we clearly benefit from this. Weight is our strong point. We can build a good steel trough around it. We can protect the whole thing from the outside, for example from other vehicles, so that nothing happens. Additional measures are not necessary. You can always stick to the lead-acid charging rules as far as distances and the like are concerned. Then you don't have to take any special measures if you have a regular logistical vehicle deployment.

Can vehicles be charged with lithium-ion batteries from any manufacturer?

First of all, you have to differentiate a little. Lithium-ion batteries are a new product, use new technologies, and compared to lead-acid batteries - especially to PZS batteries, which always have the same properties - this is not the case with lithium-ion. It's like the initial question about use in minus temperatures: one can do

it, the other cannot. And so a battery with lithium cells has a multitude of other different properties that affect the interaction or interplay between the vehicle and the battery. Of course, there are operating conditions that can be critical if they are not coordinated and tested. This means that there is no blanket approval or possibility that you can use any lithium-ion battery in an industrial truck. This always requires testing and must be technically evaluated so that the whole thing is simply safe.

Another question regarding the amount of energy. That is, I do not want to exceed a given amount of energy. How could I ensure that? And can vehicles then also be charged preferentially?

I don't want to exceed a given amount of energy - this is probably about the peak load and its amount of energy. I can only speak for our lithium-ion chargers. They have the factory configuration option of programming the charger with a maximum value that it can take from the socket at any one time. This means that if you specify that this socket has this capacity, we can incorporate this into the charger and then this amount of energy is also maintained. Possible with this ex-works solution. For many customers, we now have so-called power chargers/corners. That means several chargers are available. Some are calendared at a reduced power level due to the current load and some are power chargers. Of course, a preferred vehicle can always drive there and get the maximum charging power so that the vehicle availability is restored very quickly.

When will inductive charging be available?

It is already available today. For example, our tractor and tugger trains already moving inductively during operations. That means they have a predefined route. This is repeated. This works to the advantage of the tugger trains, which are then charged inductively. The solution is not available in the broad portfolio and, as is so often the case, you have to check the individual application to see whether inductive charging makes sense there. Is there enough charging time, is there enough charging power? Does it make economic sense? And then you have to check again whether you want to go down this inductive path.

What safety precautions are required when using lead acid and Li-ion?

As of today, there are no explicit rules / specifications on the subject of Li-ion charging from the professional association or similar. The current state of affairs is the adoption of the lead-acid specifications. In the event of special circumstances, the insurer / expert can be consulted individually.

What is the EUCAR Hazard Level of the Still Lithium-ion battery? If it is EUCAR Level 5, is it recommended for use in the chemical industry?

As an industrial product, no automotive standards apply to us. The developed batteries comply with the UN 38.3 standard and thus fulfil all relevant requirements.

Lithium, however, is unfortunately not easy to mine and is very scarce. Where it is mined, this is very bad for the environment. What do you say about this? Do you have recycling solutions?

Since the beginning of Li-ion development, we have considered the complete life cycle of Li-ion batteries. For this purpose, we cooperate with suppliers and recycling companies. The actual recycling event (the battery/cell can neither be used in an industrial truck nor in any other way) is only to be expected in 10+ years, based on our findings. Until then, the battery can be used both in industrial trucks and in other applications.

In lithium-ion batteries, there are additional components besides the cells, electronics, safety contactor, CAN bus connection. Do repairs have to be carried out? Are there any inspection obligations?

Li-ion batteries must be successfully tested on the basis of UN 83.3. If this is not done, the Li-ion batteries are not permitted in Europe.

According to your presenters, the cost of a Li-ion battery is about 2 - 3 times higher than that of a Pb battery. This means that if an exchangeable battery is required, the costs for a Li-ion battery are only about 50% higher than those of a Pb battery (with exchangeable battery). Assuming about twice the service life, the costs should be significantly lower than those of a Pb battery.

That is correct. What is always important here is the reference to battery capacity and service life, which must be taken into account.

What must be observed when charging the Li-ion battery outside the vehicle?

In contrast to lead-acid technology, there are no generally applicable rules for Li-ion (e.g. from a professional association). The operating instructions contain instructions for storing Li-ion batteries. In individual cases, an insurer or expert may call for further local measures.

What about the end of life of the lithium battery?

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Questions on the topic of "fire protection" with Li-ion

How should fire protection be implemented when charging and operating Li-ion batteries?

As of today, there are no explicit rules / specifications on the subject of Li-ion charging from the professional associations or similar. The current state of affairs is the adoption of the lead-acid specifications. In the event of special circumstances, the insurer/expert can be consulted individually.

What to bear in mind for a Li-ion battery in the event of a fire.

Attention should usually be paid at an earlier stage. In the event of a fault or damage (integrated shock sensor), information is already provided via the display and measures are also taken (e.g. driving speed reduction, stop). If this happens, previously defined parking spaces can help until the STILL Service carries out an analysis. In the event of a fire, water must be used for cooling.

What about the safety of the different battery types in case of fire?

The Li-ion battery has a variety of safety systems, whereas the lead-acid battery is neither secured nor protected in any way. In the event of a fire, the Li-ion battery, for example, requires a long time before flames caused by external heating can be detected. In the case of external energy supply to a lead-acid battery, the latter shows "flames" at an early stage. The background to the Li-ion battery is, for example, the trough construction with a 25 mm thick steel trough.

How do you assess the risk of Li-ion batteries in terms of flammability and extinguishability?

As far as safety measures are concerned, a Li-ion battery is many times safer than a lead-acid battery (no protective devices). When used properly, the Li-ion battery poses no risk. Regarding extinguishability, the recommendation is water. In general, the recommendation is that in the event of a warning message from the battery (visible to the driver on the vehicle display), e.g. previously defined parking spaces should be used until the STILL service department diagnoses the problem.

Questions on the topic "Chargers“

Is the charger compatible with several models and brands?

The Li-ion chargers can be used across the corresponding voltage class.

How high is the fuse rating of the Li-ion battery chargers, also 16/32 A?

The range of chargers extends from 16 A to 32 A and up to the largest charger with 63 A.

Questions on the topic "fuel cell”

Fuel cell: where is the "waste product" water disposed of?

The so-called process water evaporates in the air (water vapour) in smaller 24V systems. In 48/80V systems, the process water is extracted from the BRM during the refuelling process via a corresponding connection. There are two different connections here: RECTUS type 25 or 27. Which system is used must be determined with the H2 infrastructure manufacturer.

Generating hydrogen yourself: how good is the overall efficiency here all the way to the forklift?

The question here is where the system boundary is drawn for calculating the efficiency. When analysing efficiency from the wind turbine to the vehicle, the efficiency is around 30-40%.

Is fuel cell technology dangerous?

No, the technology is not dangerous. There are regulations and safety instructions that must be observed. If these are also observed, such as operating, service and maintenance instructions, fuel cell technology can be described as safe.

What is the capacity of the lithium-ion battery in the fuel cell battery? More or less.

The integrated Li-ion battery is a small buffer battery that is permanently electrically charged by the fuel cell and supplies the vehicle with a constant energy current. The battery's capacity is not comparable to that of a "normal" Li-ion battery that supplies the vehicle with battery power.

For which applications are fuel cells suitable?

For reasons of design, it is advisable to switch on a fuel cell in the morning and switch it off again at the end of the shift in the evening. This means that ideally the fuel cell runs permanently in order to generate energy, and these typically comprise applications that are above 1000 operating hours per year. That is, ideally, the 2- or 3-shift operation for which a fuel cell is designed.

How long can you drive with a fuel cell tank filling?

Up to 8 hours of driving are possible with one tank of fuel. However, the situation is comparable to the automotive sector: I can drive a car from Hamburg to Berlin with half a tank of fuel or a complete tank of fuel. And it is the same with our industrial trucks. It may be that I can drive for up to 8 hours straight. However, if I drive a lot of ramps and do a lot of lifting or accelerating, then the driving time can also be reduced to 4-5 hours. You can't say it precisely. It always comes down to an analysis of the working cycle and then you still come relatively quickly to the operating time that a fuel cell tank filling makes possible.

What vehicles are available with fuel cells?

Unfortunately, we are still a long way from a mass fuel cell market. We are currently in the phase of a market ramp-up. This means that not all vehicles are yet available with a fuel cell. With the vehicles from the areas of counterbalance trucks, low lift pallet trucks, high lift stackers, order pickers, tractors and reach trucks, we cover around 80-90% of the incoming customer enquiries about fuel cells. If there is a specific question, my recommendation would be: submit an enquiry. We will check it because a fuel cell does not make sense for every vehicle. One should be above 1000 operating hours, so that the vehicle is permanently in use. We would not recommend equipping hand-guided vehicles with a fuel cell as of today. The recommendation would be to make an enquiry and we will check this individually for your purpose and application.

What is the situation with fuel cells in terms of safety?

The fuel cell is a safe energy source, otherwise it would not be approved in Europe. There are safety regulations and rules that a battery replacement module must fulfil. It does. And the communication between the vehicle and the module is also safe, as is the refuelling process. It's a closed system, so no hydrogen escapes. Although you have to be aware when dealing with hydrogen that it is a highly flammable gas. That's why there are so-called explosion protection zones in the refuelling area, and when installing a hydrogen infrastructure on the factory premises, there are local rules and regulations that have to be observed.

One more question on the subject of fuel cells: Does STILL also install hydrogen infrastructures?

I can clearly say no to that. STILL does not offer the installation of hydrogen infrastructures. STILL's DNA is to design, optimise, supply and service intralogistics processes. Of course, we also look left and right in the context of our trucks as far as the energy source is concerned. With lead-acid and lithium-ion, we have rather closed systems that are relatively easy to handle. With hydrogen technology, we have a volatile and flammable gas that requires special handling. There are market players who have a perfect command of gas handling, and whenever it comes to a customer project, we get the right partner on board so that the infrastructure can then be implemented in line with our vehicle fleet.

Where can you buy the right dispensers?

There are numerous suppliers on the market who offer hydrogen infrastructure solutions. For example: Linde Gas, Air Liquide, Air Products, Westfalen Gas, Rhein Gas, Plug Power, etc.

Is it not possible to operate a conventional industrial truck with a fuel cell instead of a lead or Li-ion battery?

At STILL, a truck or series is always separately qualified to be fitted with a fuel cell. This involves making minor mechanical and electrical adjustments so that the BRM can be accommodated. This makes the vehicle "fuel cell ready". Now the customer can decide whether a lead-acid battery or a fuel cell is to be integrated into the vehicle. Changing systems on a daily basis is not recommended. A BRM only needs the supply of hydrogen and does not have to be removed from the vehicle.

How much hydrogen per tank? And at what pressure?

The tank capacity is between 0.78kg and 1.8kg of hydrogen, depending on the fuel cell model. The pressure is 350 bar.

How can the risk of an explosion be reduced?

There are a wide variety of safety requirements that can be achieved by technical or organisational measures, e.g.
- Avoidance of the formation of explosive or suffocating atmospheres, through tightness monitoring (gas sensors) and ventilation,
- Avoidance of ignition sources, safety distances, mechanical protective measures (fire walls, access restrictions, collision protection), avoidance of fire loads, noise protection, personal protective equipment.

These are examined in a safety assessment/HAZOP (hazard and operability study) and appropriate measures are taken.

Technical safety measures on the H2 infrastructure:
Gas warning system
Fire alarm
Connection to fire alarm centre
Emergency stop switch
Potential equalisation
Lightning protection
Hall ventilation
Breakaway coupling

Furthermore, rules of conduct should be introduced, such as no naked flames, no smoking near the H2 infrastructure and the industrial truck.

But surely you can keep a spare fuel cell box on hand for the downtimes, which you then slide into the vehicle.

Yes, if a fuel cell has to be taken out of service for maintenance, you can alternatively use a spare fuel cell to minimise the vehicle's downtime.

Was gas ultimately better in all criteria? Is hydrogen as effective as gas?

The advantage of hydrogen over gas (e.g. propane mixture) is that no harmful emissions are produced during use/combustion. Therefore, the comparison in terms of effectiveness is not correct, as the objective is to avoid CO2 and other harmful emissions.

Further questions

I have heard about CSM batteries - Copper Stretch Metal. Is this technology being investigated by Still? Can you share more information on this topic?

New battery technology is in strong development focus today and therefore many new developments and individual products are available. In the context of established and widely available Li-ion cells, NMC, LFP and NCA are worth mentioning. These are in use today in the series production process. We are constantly looking at tomorrow's technology for use in intralogistics.

You have not talked about life cycle analysis of batteries, environmental impact of extraction of metals and resources in these metals. Finally, you have not addressed the issue of recycling.

There are numerous studies and reports on this. The framework of the analysis must always be considered here: Where do the value-adding characteristics begin and end? What assumptions are made, e.g. to assess economic efficiency. In general, it is apparent that there are a large number of assumptions in the studies and thus also divergent results.

Are the Still batteries and fuel cell freely interchangeable between ALL vehicles in the Still range? Is there a standardised socket and connector?

No, each vehicle has a vehicle-specific battery installation space. A battery is always characterised by a certain weight and defined dimensions.
The plug connections can correspond to standard market solutions.

Does STILL offer complete systems for generating energy in the warehouse and managing this energy (in addition to the trucks)?

As of today, our product portfolio includes trucks, battery and chargers. Beyond that, there are no products available from STILL.

What about the recycling of raw materials?

Today we have a new technology and there are also raw materials in it that simply have to be considered critically. But we are still at a very early stage in this technological development. And we can also see from the last few years that not only the prices are changing, but also the composition of the cell. This means that critical raw materials are being reduced and at the same time performance parameters are improving. This refers to the raw materials, which means that we don't yet know what the battery technology or chemicals of tomorrow will look like. It could be completely different, very good in terms of raw materials, with great properties. The issue of recycling is also something that exists in parallel to the implementation of technology and is being worked on. So you have to see that the number of units on the market, especially in the automotive sector, is only just beginning. A topic like recycling is growing in parallel, where there are market players who have always done this and where there are new market players. These are things that are critical today, but they will be solved through technological development.

Could you give us a hint about gel batteries?

Gel batteries are gassing and maintenance-free. Consequently, they already reduce operating costs compared to lead-acid use. Nevertheless, the use and charging time (+10h) is usually very extensive and challenging.

On the diagram, all drives/storage devices look like boxes. So can you switch between FuelCell, Li-ion & Lead Acid in the same vehicle to suit the application (time of day).

Each vehicle has a specific installation space to accommodate energy sources. Lead-acid and Li-ion batteries in the appropriate troughs are available for every vehicle and installation space. In addition, many vehicles have the option of using a fuel cell instead of a battery. While lead-acid batteries are changed frequently, Li-ion batteries and fuel cell systems usually remain permanently in the vehicle and are charged or refuelled there.

What is the life span of the three battery types?

The lifetime of lead-acid batteries is usually 1200-1500 charging cycles. Li-ion batteries last on average at least twice as many charging cycles. In the case of Li-ion batteries, the capacity in particular must be taken into account, as this often differs from that of lead-acid batteries.

I did not understand the cost of kW (Li-ion) vs. hydrogen (fuel cell) ratio. Could you please repeat that?

A kilowatt hour generated from hydrogen is on average 5 times more expensive than a kilowatt hour from electricity.