THE DRIVE TO NET ZERO: LITHIUM-ION AS A POWERFUL TOOL FOR SUSTAINABILITY AND SAVINGS



The ice arena business has many challenges. Arena owners need a tool chest full of efficient equipment and technologies that can deliver every possible advantage to save time, money and valuable resources.



LITHIUM-ION IS A GAME-CHANGER FOR ICE RESURFACING EQUIPMENT

Maybe your facility is considering switching from fuel to electric. Lead acid battery powered electric equipment is a solid choice and you may be confident that it is right for your arena. There is a lot of interest in lithium-ion, but it's new so is it right for your next ice resurfacer?

With zero battery maintenance, faster + more efficient charging and increased performance, lithium-ion batteries are the future of the industry.

The efficient use of electricity from lithium-ion batteries supports environmental sustainability and the drive to Net Zero.

The challenges faced by facility owners and operators are numerous. With the introduction of lithium-ion batteries, taking your machine out of service for an overnight charge is no longer one of them. Resurface, recharge and repeat.

Lightning-Fast Chargers and Battery Management Systems Assist Busy Facilities

In an ice arena, time is money. The profitability of your business counts on maximizing available ice time. Since the introduction of the first electric production Zamboni machine in 1990, battery and charger technologies have made dramatic advances.

Today's smart chargers utilize battery management systems to protect the batteries from operating outside of their safe range, monitoring the state of charge and controlling the charging process while properly balancing the battery cells. Lithium-ion batteries have a higher charge efficiency than that of their lead-acid counterparts.

Like a modern cell phone, a quick charge between uses can top off the battery, maintaining sufficient resurfacing power for around-theclock power.

Lithium-ion batteries are ideally suited for the application of ice resurfacing. While the power of lead acid batteries degrades



Comparison of State of Battery for Lithium-ion and Lead Acid Batteries

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during the work day under normal use, the performance power of lithium-ion batteries is maintained at optimal voltage throughout the work day. a reduction in performance. This is one reason you'll see owners of lead acid equipment make the move to Li-ion."

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A lithium-ion battery has a flatter discharge curve and maintains higher voltage significantly longer than a lead acid battery throughout the discharge cycle. This means the machine always has the **??** same power level and the driver never experiences a reduction in performance.

Emil Westerlind, (Technical Manager), ETP Kraftelektronik AB

Formed in 1978, ETP Powering Solutions specializes in electric powertrains. As their Technical Manager, Emil Westerlind has seen the dramatic transformation of the battery industry in recent years. The company is sharing their thoughts regarding the benefits of lithium-ion battery technology.

Westerlind shares: "Of course, there are a number of benefits that come from a Li-ion battery, but one that finds favor with ice resurfacer operators is the constant power and performance of Li-ion.

A lithium-ion battery has a flatter discharge curve and maintains higher voltage significantly longer than a lead acid battery throughout the discharge cycle. This means the machine always has the same power level and the driver never experiences A quick recharge between resurfacings brings the state of the battery charge back to 100% for optimal performance.

Zero Battery Maintenance

Lithium-ion batteries are sealed and require no maintenance. The labor savings over lead acid batteries are one consideration. The extended



Battery watering gun for lead acid batteries

life of lithium-ion versus lead acid batteries is another.

The sealed battery case provides a number of benefits. There is no need to water the batteries. requiring you to count on your operators to not overwater or underwater or to forget the practice altogether. No need to measure and document open circuit voltage (OCV). The lithium-ion batteries are selfcontained inside of the sealed case and you no longer have to handle electrolyte which contains sulfuric acid. The routine specific gravity test is a thing of the past. No battery corrosion and no cleaning of the batteries. No concern of broken water water caps,



Lithium-ion battery in the Zamboni Model 552AC

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connectors or split cables. The sealed case means that there will be no off-gassing of the batteries during charging.

Lower Total Cost of Ownership

"While the longer life of lithium-ion will require time to prove the performance in the resurfacing application, other industries including forklift, automotive and mining the lower cost of ownership of lithium-ion equipment."

The chart represents factors which should be considered relating to the total cost of ownership for a lithium-ion battery versus a lead acid battery include: energy cost (battery energy and charge efficiency), battery maintenance costs, battery replacement frequency and battery cost. While the initial lower cost of lead acid batteries might make the technology

...it appears that the efficiencies of the technology and potential for a much longer battery life will contribute to the lower cost of ownership of lithium-ion equipment.

Kelly McMillen, Staff Engineer Zamboni Company

attractive, over time, these associated costs are driving customers in the direction of the lithium-ion product.

Lithium-ion batteries and their chargers have exceptional charge efficiency. This means it takes less electricity and significantly less time to recharge the batteries. Users of other industrial equipment like forklifts have seen valuable savings in electric utility costs on an annual basis by switching from lead acid to lithium-ion power, which may be attributable to these new efficiencies.

The labor and materials required to maintain lead acid batteries should be factored in to the total cost of ownership. A query of the forklift industry shows estimated annual costs for lead acid battery maintenance of at least \$1,000.00 and



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equipment have demonstrated significant extended life over lead acid batteries." says Kelly McMillen, Staff Engineer for the Zamboni Company.

It's well-known that lithium-ion batteries have a larger price tag than that of lead acid batteries. However, some of the initial cost is offset by a number of factors.

McMillen continues: "The initial cost of the battery purchase may be higher than that of lead acid product, but it appears that the efficiencies of the technology and potential for a much longer battery life will contribute to

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that number of course varies and could be higher or lower, based on your labor cost and other arena-specific factors.

The number of cycles afforded by lithium-ion batteries shows evidence of being double that of lead acid batteries. By keeping the batteries on the charger between resurfacings, the degradation of the battery power is lessened, extending the life of the batteries.

Not having to purchase new batteries as frequently as one would with lead acid product not only saves money, it saves resources by keeping the batteries in use longer before replacement might be necessary.

Truly Emission-Free

With no tailpipe emissions and no off-gassing during charging, another compelling reason to consider lithiumion batteries is a resurfacer which does not release emissions in your building.

Chris Fish is the Account Manager for Industrial Machine Inc. (IMI) of Alberta, Canada. As a distributor of heavy equipment including Zamboni ice resurfacers, IMI has begun to see a shift. "For decades, fossil fuel powered equipment was the industry standard. People were confident with the product and may have been inclined to feel that electric equipment suffered from lower performance than the fuel powered machines." says Chris. "The reality is that in the past few years, the technology of the electric equipment has advanced dramatically. With lithium-ion batteries providing a constant level of power, there is no reduction in performance. When speaking with the customer, all I do is let them know they will no longer have battery maintenance and no need for a full overnight charge and the machines pretty much sell themselves." One of IMI's customers in Medicine Hat. AB recently made an investment in support of their decision to target GHG emissions.

As Alberta, Canada is an oil and gas production capital, you may not think that the province has a focus on green power. Actually, the Municipal Climate Change Action Centre (MCCAC)

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Justin Brunelle, the Manager of Fleet Services for Medicine Hat, Alberta Canada provided funding, technical assistance and education for the municipalities, schools and community organizations with a goal of helping them lower energy costs, reduce greenhouse gas emissions and improve climate resilience. There are a number of programs throughout North America with similar support and funding in pursuit of net zero.

Justin Brunelle, the Manager of Fleet Services for Medicine Hat, AB worked with the MCCAC to make the switch from fossil fuel powered equipment to electric. His decision to go with the lithium-ion powered product would require some explanation to the decisionmakers who were familiar with the combustion engine resurfacers. He compiled data which helped to clear the air. The math for their anticipated reduction in greenhouse gasses is impressive. The elimination of 9.35 tons of CO₂e/year. His report found additional savings.

"We are expecting to see significant cost savings by switching to the electric Zambonis," said Justin. "In fuel costs alone, we have estimated that we'll see savings of up to 80 percent compared to the gasoline units these are replacing."

"These machines will be the city's first electric vehicles," says Justin, "so putting one in Medicine Hat's flagship arena makes sense on

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two levels: the emissions-free power will ensure cleaner air for the thousands of people in the rink, and it also gives the city a prominent platform to show local citizens its "trailblazing" efforts to convert municipal vehicles to cleaner fuel sources."

Brunelle points out that "Indoor emissions from conventional internal combustion engines used in most ice resurfacers today are an issue that municipalities and arena managers wrestle with right across Canada." This gives the ice arenas with the new electric equipment GHG reduction and peace of mind that comes with no longer having equipment in an enclosed space which has tailpipe emissions and off-gassing during charging sessions.

"It's something we deal with regularly," says Brunelle. "We have a lot of expertise within our recreation department to make sure [our conventional resurfacers] run properly, that ventilation systems are in place. But one of the big selling features [of the electric machines] is this eliminates the issue. We're no longer worried about it from a health and safety perspective."

IMI has another tool to assist the Medicine Hat fleet: the Zamboni Connect System. IMI works closely with customers whose machines have the Zamboni Connect System. They have the ability to partner with Brunelle to monitor trends in the consumption of resources. inconsistency between operators and the performance and maintenance needs of their machines. Chris spends time compiling quarterly reports using data from the machines' individual and collective resurfacings. "It's a great way to work with customers and highlight where they have opportunities not only to

save on their overall cost of ownership, but where they have opportunities to coach their machine operators as well."

The Path to Net Zero for London, Ontario, Canada

In September of 2019, the Zamboni Company brought a Model 450 electric resurfacer, powered by lithium-ion batteries to the Bostwick Community Centre in London, ON. The operators were trained on its operation and used it daily during a trial period.

The operators delivered a positive report card. The machine was easy to use and handle; demonstrated quiet handling; charged quickly and the power was equivalent to that of London's natural gas powered units. After the successful trial, London began doing the math.



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Air quality incidents that could be tied to poorly maintained fuel powered equipment can be eliminated with the choice of lithium-ion battery power.

With an ambitious goal of being net zero or near net zero emissions by 2023 for ice resurfacers, the City would be one of the first in North America to do so. Each resurfacer converted from fuel to electric would result in a savings of 19 tons (metric system) of GHG on an annual basis. Their planned replacement of 14 CNG powered units would contribute to nearly 25% of the Corporation's overall GHG curtailment target of 900 tons annually, 85% of their green fleet's GHG curtailment target of 250 tons annually and avoiding 579 tons of cumulative GHG emissions by 2023. Their team analyzed operational savings including fuel/maintenance costs versus the electric equipment and identified a 35% savings with the new machines.

Anyone with CNG equipment can relate to the need to properly maintain the filling stations and replace when necessary. These and other cost savings provided additional advantages to a switch to electric charging. Further, the move to electric equipment allows the City to shift to renewable energy resources including solar/ PV. If London ultimately pairs the sustainable energy project with the electrification of its resurfacer fleet, their 2023 net zero goal will come sooner, rather than later.

"Freezing" Climate Change

Net Zero? Net Negative? Carbon Neutral? The conversations surrounding reduction/elimination of GHG, conservation of resources and developing sustainable products and practices are evolving. With so much information, it can be overwhelming. How do you know which new technologies or future practices deserve immediate attention?

Fortunately, ice arena industry groups are actively engaging with their members, giving guidance on how to begin making positive changes that support sustainability and can help facilities move in the direction of Net Zero. The NHL has been working in this space for more than a decade. Around the world, government agencies and entities including municipalities and federal governments are setting goals and implementing policy for their respective regions. Fossil fuels are a target and some local and federal governments have already determined that

elimination of fuel-powered products will take place in the next decade or so.

Many non-profits have taken on the task of gathering, evaluating and sharing information to help arena owners and operators make cost-effective decisions that have a valuable benefit and even a return on their investment. Fortunately, many of the tools available for arena owners bundle sustainability and return on the initial investment.

Lithium-ion powered resurfacers provide cost savings and meet the green goals that will help to ensure ice sports are sustainable for future generations.

Top 10 Reasons To Move To Lithium-ion!

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- 1. Ideally Suited for Rink Industry Use: the quick charge time of Lithium-ion affords operators a fast return to the ice with maximum capacity, supporting busy arena schedules and with no overnight downtime
- 2. Zero Battery Maintenance: the sealed battery package has no need for watering, equalization, acid/electrolyte handling nor cleaning
- **3. BMS Smart Charge:** no worry of over-charging or monitoring charger performance as the battery management system monitors and optimizes health and longevity of the system
- 4. BMS Safe Charge: the battery management system and smart charger features ensure the operator won't accidentally start the machine while still plugged in
- **5. Extended Battery Life:** lead acid battery life is typically five years or so, depending on usage and proper maintenance, whereas Li-ion applications can expect longer usable life, up to double that of equivalent lead acid batteries

- 6. **Reduced Cost of Ownership:** maintenance costs for electric products are significantly less than those of fuel powered products
- 7. **The Green Choice:** Lithium-ion batteries provide a true Net Zero alternative to other equipment, creating a safe and healthy environment for staff and guests
- 8. Fuel Savings: the cost of electric power per resurfacing is a fraction of that versus use of fossil fuels
- **9. Zero Emissions:** reduced load on HVAC and no need for consideration with building codes related to off-gassing of lead acid batteries/fossil fuel product
- **10. Model 450:** the first hydrostatic + electric delivers the same operating experience familiar to fuel powered machine owners, but with quieter and more efficient performance