Safe Ice Resurfacer Room Battery Charging Unit Installation and Use Guidelines

July 2014

Introduction

The Ontario Recreation Facilities Association Inc. (ORFA) reminds members that any change in equipment or operational practice requires careful consideration. The interest in battery technology in the ice rink industry to power ice resurfacing and edging equipment continues to increase. Other battery powered equipment found in recreation facilities include, forklifts, floor maintenance equipment and aerial lifts. The safe use of batteries requires a clear understanding of the potential risks and hazards. Often, the primary shift toward battery powered equipment is based on indoor air quality issues caused by fossil fuels. Shifting to battery technology may in fact significantly reduce the potential for poor indoor air, however, it is important to understand that hazardous gases can be generated during the charging process, and as such, must be properly controlled. This guideline is offered as general awareness information only and should not be considered a sole source of information specific to any facility considering battery technology.

Types of Batteries

A worker must first determine what type of battery has been installed. This information along with general safety information will be contained in the manufacturer's owner manual. The two (2) common types of rechargeable batteries are lead/acid and alkaline. **Lead/acid batteries** are the most often used to power vehicles. **Alkaline batteries** are most often found in smaller items, such as, lap top computers. There are two (2) different types of lead/acid and alkaline rechargeable batteries – valve regulated (maintenance free) and vented. Valve regulated batteries do not allow any gases that are produced during the recharging process to escape. It is important to dispose of these batteries as required by law. Vented batteries allow hydrogen and oxygen gases that are produced during the recharging process to escape. These gases must not be permitted to accumulate and as such must be safely ventilated.

General Risks and Hazards

Batteries are designed to hold an electrical charge and must be given the same level of respect as a standard electrical device. A common misconception is that there must be high electrical voltage to injure or kill a person. The fact is that lower voltage contact can cause fibrillation in the heart that can result in death.

Batteries are often filled with corrosive chemical solutions (electrolytes that use sulphuric acid or potassium hydroxide) that will cause permanent damage to eyes and skin.

Electrical arc defined: A luminous discharge of current that is formed when a strong current jumps a gap in a circuit or between two electrodes. This is often caused by a metal object that comes in contact with both terminals at the same time. A high risk condition usually occurs during connection and disconnection of a battery. To assist in reducing the chance of electrical arc equipment will have a manual electrical switch or button that is to be activated during the battery connection and disconnection process

Rings can be of significant risk when working near batteries. Incidents involving workers who have accidentally touched the positive terminal with a wrench, which caused a short circuit welding the ring and finger to the battery hold down clamp and to the wrench have been documented. When removing any battery, always remove the negative terminal first before touching the clamp on the positive terminal.

Battery Material Safety Data Sheet (MSDS)

All batteries will have safe use instructions and or an MSDS. This information should be reviewed with Standard Operating Practices and/or Job Hazard Analysis being created specific to each workplace for the safe use, storage, transportation and disposal of batteries. MSDS information will provide workers with the following (sample) battery contact or emergency safety information:

Eye Contact: Flush eyes with large amounts of water for at least 15 minutes. Seek immediate medical attention if eyes have been exposed directly to acid.

Skin Contact: Flush affected area(s) with large amounts of water using deluge emergency shower, if available, shower for at least 15 minutes. Remove contaminated clothing. If symptoms persist, seek medical attention.

Ingestion: If swallowed, give large amounts of water. Do NOT induce vomiting or aspiration into the lungs may occur and can cause permanent injury or death.
Inhalation: If breathing difficulties develop, remove person to fresh air. If symptoms persist, seek medical attention.

Special Fire Fighting Procedures and Protective Equipment:
Use appropriate media for surrounding fire. Do not use carbon dioxide directly on cells. Avoid breathing vapors. Use full protective equipment (bunker gear) and self-contained breathing apparatus.

Unusual Fire and Explosion Hazards:
Batteries evolve flammable hydrogen gas during charging and may increase fire risk in poorly ventilated areas near sparks, excessive heat or open flames.

Specific Hazards in Case of Fire:
Thermal shock may cause battery case to crack open. Containers may explode when heated.

Consider that projectiles may be created from a battery explosion which may also place workers at risk of injury. It is important to always read the MSDS, SOP and/or JHA and to wear all recommended Personal Protective Equipment (PPE) when handling or recharging any battery.

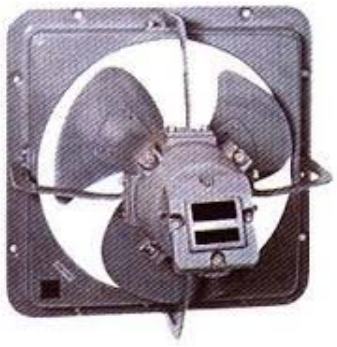
Legislation that Guides Indoor Battery Charging Use

There is no one legislative obligation that clearly guides indoor battery use. It is left with each owner to ensure compliance specific to their battery type and equipment design. Key partners in determining correct installation would include, local building officials, the equipment manufacturer and the battery supplier. Local fire officials may also be considered a resource.

Ventilation Requirements

As indicated, vented batteries produce hydrogen and oxygen gases during the recharging process. These gases must be vented. Fans should be of explosion proof design. Standards that are often used to

determine proper ventilation calculations include, but are not limited to:



National Fire Protection Association (NFPA) 76 – which suggests that any battery room exhaust fan capacity in Cubic Feet Minute (CFM) should be in the room area (in sq. ft.).
http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=76

ASHRAE 62 – which recommends 1 CFM per charging ampere to be provided, but not less than 6 air changes per hour.
http://www.automatedbuildings.com/news/jan03/articles/ebtron/ebt.htm

IS: 12332 Code of Practice for Ventilation – which recommends 12 air changes per hour for a battery room using a forced air supply and positive exhaust system that uses flameproof electrical fittings with air inlets located near the floor and outlet openings at the high point of the room.
https://archive.org/details/gov.in.is.12332.1988

BS EN 50272-2:2001 – Safety requirements for secondary batteries and battery installations: provides the following calculation formula to calculate the hourly exchange of air volume for battery rooms:

Q in Cubic Meters/hour for battery rooms

Q = 0.05 x n x I (cubic meter/hour)

Where n = number of cells
I = value for the current from table of EN 50272-2

With natural ventilation the minimum inlet and outlet area is calculated as: **A** should be greater than or equal to 28 x Q (sq. cm.)
http://shop.bsigroup.com/ProductDetail/?pid=000000000019984534

The following calculation is used by the Resurfice Corporation specific to their battery ice resurfacer design:

Determining hydrogen production:
H = .00027 x F x C
F = finish rate
C = number of cells

Determining ventilation requirement:
V = R X P / H X 60
V = Ventilation required
R = Room in cu. feet
P = Maximum % of hydrogen allowed = .01
H = Total hydrogen produced per hour

Determining fan requirement:
Fan size = R / V
R = Room in cu. feet
V = Ventilation required

It is important to note that these calculations are for example purposes only. What calculation is to be used is based on facility design and battery type.

Gas Detection

A hydrogen mixture above 4% significantly increases the chance of explosion. It is recommended that levels be kept below 1% at all times. Local by-laws, fire codes and/or building codes may require that hydrogen detectors be installed. This installation may require that the detector be linked to fan actuation based on hydrogen vapour levels. If not linked, the fan may then be required to run continuously. As with any equipment it must be regularly inspected and maintained for proper function.

Fire Protection

A Carbon Dioxide portable fire extinguisher is required to be on site. Housekeeping of a battery charging room is a legal obligation. Storage of combustible materials in a battery charging room is unacceptable. Fossil fuelled

power equipment should never be stored in a battery charging area. Work that may result in "spark" creation must not take place in this area. Keeping items or work 1.2m (4ft) from the charger at all times is strongly recommended.

Facility Upgrades vs. New Construction

Facilities that are considering switching from fossil fuels to battery powered equipment must consider a variety of construction and operational issues beyond equipment selection. It is reasonable to assume that new construction that identifies battery rooms would meet all legislative obligations. For both new and retrofit construction it is recommended that ceilings in battery charging rooms be flat as to not allow pockets of gas to accumulate. It is further recommended that lighting be fixed to the wall or suspended at more than 50cm (20in) from the ceiling, but not above the charging unit. All fixtures should be closed so that gas cannot accumulate. It is important to evaluate all current equipment found in the room, to determine if in fact it is acceptable for battery charging equipment to be in close proximity.

Battery Disposal

There are very toxic/corrosive materials in some batteries that should be prevented from being released into a landfill or water system. Lead, sulfuric acid and toxic elements like cadmium and mercury can be generated of held in old batteries. Disposal of batteries may be controlled under Regulation 347. Speaking with the supplier of the equipment to determine best methods and options for battery disposal is strongly recommended.

Worker Safety

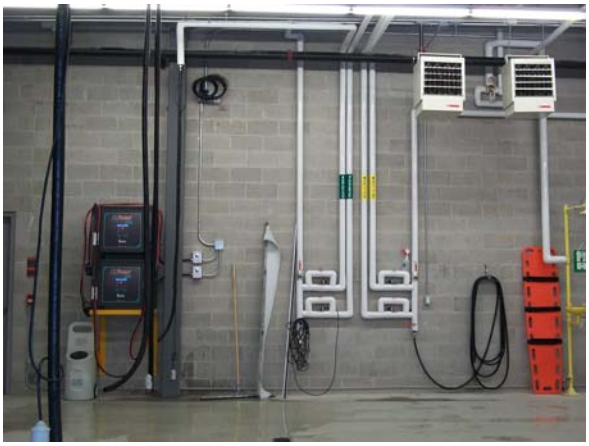
The following information is provided as awareness and industry best practice when working with batteries:

- ✓ Only work with batteries if properly trained to do so
- ✓ Remove watches, rings, chains, bracelets or any other metal item when working with batteries
- ✓ Always wear PPE when handling, disconnecting or connecting a battery
- ✓ Always wash your hands after handling or working with batteries
- ✓ Keep plastic terminal covers in place to help reduce accidental contact
- ✓ Items such as aluminum ladders or scaffolding should not be used in a battery room
- ✓ Only charge and maintain batteries as recommended by the manufacturer
- ✓ Only use the manufactures battery charging unit
- ✓ Depending on the size of battery installation eye wash stations may be required
- ✓ Appropriate warning signage should be posted at all entrances to the battery room
- ✓ Only add acids and/or water to batteries if trained to do so
- ✓ Always switch off battery charger before connecting or disconnecting a battery – negative first – positive second
- ✓ Always dispose of used batteries in an environmentally friendly manner

Battery Ice Resurfacer Safety Details

- ✓ To avoid water contact chargers should be mounted off of the floor 1.2m (4ft)
- ✓ All equipment and other matter should be kept 1.2m (4ft) from charger

- ✓ Charging cables should always be properly stored in the cable harness or cable storage rack when not in use
- ✓ Charger and charging unit electrical breaker must be in close proximity
- ✓ Always lift the snow dump tank when charging batteries
- ✓ Check water levels weekly
    - o Add water only after charging the batteries
- ✓ Chargers are 600v and as such should only be adjusted or repaired by a qualified technician



Workplace Specific Training Checklist

As required under the Occupational Health and Safety Act Supervisors must provide workplace specific training to all employees. The following is a DRAFT list of items that may be included in such a training plan for worker safe battery use:

- ✓ Review owner's manual
- ✓ Risks and hazards associated with battery use, storage, handling, transportation and disposal
- ✓ MSDS (if available)
- ✓ PPE use training
- ✓ Fire extinguisher training
- ✓ Connection and disconnection training
- ✓ Battery testing training
- ✓ Battery maintenance training
- ✓ Ventilation use awareness
- ✓ How to deal with emergency situations involving batteries

Conclusion

Battery technology in the provision of recreational services is expected to continue to expand as facility operators strive toward safe indoor air requirements while reducing fossil fuel use. Today's recreational professional must include battery safety use awareness as part of ongoing staff awareness and training.