Ontario Recreation Facilities Association

Building Community Since 1947

Safely Draining Oil From A Flooded Ammonia Evaporative Chiller: Risk and Hazard Reduction Guideline

VERSION 1.0

ISSUE DATE: JUNE 2018

orfa.com

Ontario Recreation Facilities Association

Building Community Since 1947

ONTARIO RECREATION FACILITIES ASSOCIATION INC.
1 Concorde Gate, Suite 102, Toronto, Ontario M3C 3N6, Canada
Tel: 416-426-7062 Fax: 416.426.7385
info@orfa.com www.orfa.com

Introduction

The risks and hazards associated with ammonia have been magnified prompting many ammonia-based refrigeration plant owners to re-evaluate the level of staff preparedness during plant maintenance. The following document will explore information that might be considered industry best practices when designing Standard Operating Procedures (SOP) for draining an ammonia chiller.

Natural Loss of Oil During the Cycle of Refrigeration

Reciprocating compressors require oil to lubricate and cool the mechanical operation of the equipment. During this process, a small amount of oil naturally escapes from the compressor and is collected in the "oil pot" located on the bottom of the chiller. To ensure maximum function of this unit, the oil must be regularly, manually, removed by a "competent" operator. The chiller owner's manual will provide specific direction as to when and how this task should be performed. Typically, the task is undertaken once the "oil pot" is no longer covered with ice.

Risk and Hazard Reduction

The amount of ammonia airborne concentration is directly related to the operator training and the technique being used during the draining of the chiller. As the primary service release valve is opened and oil is removed, the oil will act as a natural barrier between the ammonia gas in the chiller and the plant room.

Risk: If the primary service drain valve (which is a wheel type valve design) is not closed quick enough, a high concentration of ammonia gas can be released into the room when the oil is no longer holding back the gas.

Hazard Reduction Through Engineering

The risk of a significant gas release can be significantly reduced by the installation of a "secondary" manual spring return valve (dead man valve) below the "primary" oil release service valve. This safety valve must be manually pushed down by the operator to release the oil. Should ammonia gas be released, the operator will take their hand off the handle closing the valve. The spring release return valve was not always an original installation safety device, but is now considered "industry best practice". These safety devices have a projected life-cycle and should be replaced as recommended by the manufacturer.

Operators must be trained on the importance of using the primary service valve to open and close the system. The main service valve should never be left in the open position after draining oil. It is recommended best practice that the main service valve always be closed tightly (hand tighten only) with the bottom of the secondary manual spring return valve having a "plug" threaded in and tightened using a wrench as a final safety feature.

Hazard Reduction Through Ventilation

As set out in the CSA B-52 Mechanical Refrigeration Code, entry procedures require that the ventilation system in the plant room is running prior to and during all plant room entries. Having ventilation

operating will assist in clearing the room should a gas release occur.

Hazard Reduction Through Performance

A common practice, that should be reassessed in all operations, is an operators desire to want to drain as much oil as possible in order to reduce the number of tasks required to complete the job function. There is no direct benefit of removing 100% of the oil from the chiller pot in one attempt. By designing the SOP that allows for operators to leave a small amount of oil in the system, and performing the task more often, will result in the risk reduction of an ammonia release.

Managing Used Oils

Plant operators are reminded of the obligation to safely store and dispose of used compressor oil. Oil that has been drained from a chiller that uses ammonia as a primary refrigerant will have trace amounts of ammonia remaining. Historical practice has been to return used oil to the original container for storage. A reminder that these containers need to be identified as part of the internal SDS labelling program. Often these containers are warehoused in the plant room until they are collected for disposal. This is considered an unsafe practice over the long-term. Other practices include the collection of used oils in an outside drum. Used oils should not be mixed together. If this system is in place, the drum should be properly marked and stored away from any egress, fossil fuels or other hazard. Facility oils are governed under Regulation 347 and must be tracked from cradle to grave. It is the plant operator's responsibility to ensure that the facility is registered as a waste generator and that disposal is being conducted in an environmentally friendly manner.

Refer to: ORFA Recreation Facility Environmental Compliance Guideline

Hazard Reduction Through Training

The relationship between the refrigeration plant service contractor and plant owner should include workplace specific training for all operators with duties inside the plant room. Service contractors are highly trained professionals that clearly understand the risk and hazards associated with the plant room. This expertise must be considered as an affordable, on site, workplace specific training opportunity.

The Changing Face of Refrigeration Plant Safety

Town of Caledon Respirator Fit Testing and Arena Plant Room Training Photo – Note: Different masks are being used as part of the educational process

Respirator protection has no one specific regulatory obligation to be met, however, under the CSA B52 Mechanical Refrigeration Code, *"the owner of a refrigeration system shall supply and maintain for its employees the personal protective equipment required by the jurisdiction where the system is located"*. A further application of the OHSA *"Duties of employers 25. (1) An employer shall ensure that, (a) the equipment, materials and protective devices as prescribed are provided"* would be applied.

In addition, plant owners must consider R.R.O. 1990, Reg. 833: Control of Exposure to Biological or Chemical Agents that states: (1) Every employer shall take all measures reasonably necessary in the circumstances to protect workers from exposure to a hazardous biological or chemical agent because of the storage, handling, processing or use of such agent in the workplace.

An occupational exposure limit (OEL) is the maximum allowable concentration of a hazardous substance in a workplace. It is defined as the upper limit of concentration in the air. These general safety obligations require plant owners to assess the need for respiratory protection requirements. Given the potential risk to exposure having respirator protection in a refrigeration plant setting appears reasonable. What type of protection requires investigation based on intended use. The employer must consider the risks associated with untrained operators who have not been fit tested with the specific respirator or air purifying options. The first source of information is always the Safety Data Sheet

(SDS) from the supplier. The respirator is important equipment to reduce risk of exposure to escaping gas that gives operators an opportunity to remove themselves from an unsafe environment. Meeting fit testing as required under CSA Z94,4-11 may be a challenge when all operators are to use the same equipment. The reason to perform respirator fit testing is to verify that the user can obtain an effective seal and level of comfort with their chosen respirator. The user also wants to make sure that the respiratory protection being worn provides the best possible protection when required. The fit test is also an opportunity for the user to demonstrate their level of competence with donning, doffing, and user seal check training. CSA Z94.4 stipulates that no facial hair be in contact with the seal area of the respirator. CSA requires that the test subject needs to wear the PPE they normally wear on the job when receiving a fit test. If the operator must wear a hard hat, safety glasses and hearing protection, they should not interfere with the mask. When you really need the mask, it is a bad time to find out that safety glasses don't fit with the respirator. Annex M in the Standard provides guidance on what is acceptable. Basically, if facial hair is – or could be – in the mask sealing area, the operator cannot conduct a fit test. CSA Z94.4 requires that workers repeat the test every other year or when there is a change to the respirator, physical condition of the user, or PPE being worn. Having communal respirators available typically results in neglect of the equipment. When multiple workers will be using the equipment, the masks will require cleaning and sanitization. The potential transmission of germs and bacteria via hands is a risk.

Consider when the potential transmission of germs and bacteria via hands is a risk:

- Wearing disposable non-latex gloves when handling a respirator.
- If a shared "test" respirator needs to be wiped out between uses, have the person being tested do the wiping. This promotes good respirator hygiene.

Operators should also be trained in the location and use of the required deluge shower and eye wash station. These safety devices are identified on a standard ammonia SDS as well as required under the CSA B52 Mechanical Refrigeration Code in all new or retrofitted plant rooms.

Self-Contained Breathing Apparatus (SCBA)

Are not legally required to be available near a refrigeration plant room. These devices should only be attempted to be worn by trained personnel.

Refer to: ORFA SCBA Refrigeration Mechanical Room

Guidelines for Changing Oil in a Flooded Ammonia Refrigeration Systems

The relationship between the refrigeration plant service contractor and plant owner is regulated by the Operating Engineers Regulation, Boiler, Pressure Vessel Act, and the Occupational Health and Safety Act. The standard for the design, construction, installation, inspection and maintenance of refrigeration systems is the CSA B52, "Mechanical Refrigeration Code". The Code contains specific requirements for machinery rooms, ventilation systems and refrigerant vapour detectors. Owners must ensure that facilities meet these requirements. The Occupational Health and Safety Act (OHSA) and Regulations establish minimum standards to protect the health and safety of workers who work on or around refrigeration systems. Owners must ensure that these standards are followed by employees or contractors who work on their refrigeration systems. The draining of oil from, and the addition of oil to ammonia refrigeration systems are routine maintenance procedures. The potential for the release of ammonia during these procedures is cause for concern and the following guidelines have been developed to reduce the risk associated with these procedures, and to ensure compliance with the OH&S Act and Regulations.

1. Prepare written procedures for the draining and addition of oil and post them in the plant room.
2. Personnel responsible for the maintenance of the plant must be trained in these procedures. Check lists should be developed to guide personnel and provide a record of the work.
3. Proper personal protective equipment for the protection of respiratory system, skin and eyes must be worn while carrying out these procedures.
4. Turn on the plant room ventilation system.
5. Have a second person nearby observing the procedure and prepared to give assistance. Appropriate safety equipment must be readily accessible.
6. Ensure that workers have received education and training in the Workplace Hazardous Materials Information System (WHMIS) requirements, Safety Data Sheet (SDS) and exposure limits for anhydrous ammonia.
7. Schedule these procedures for times when the facility is normally not in use or occupied by patrons. Keep a log of the quantity of oil drained and added to the system.
8. Oil should not be drained while the refrigeration system is running. The refrigeration system should be shut down to allow the oil to settle.
9. Do not attempt to remove 100% of the oil in the chiller.
10. Install and correctly use a "secondary" manual spring safety return valve.
11. Close the chiller drain service valve tightly and install a "plug" in the secondary manual spring safety return valve stem when not in use.
12. Develop and practice an emergency response plan that includes instructions, contact names, addresses and phone numbers being posted in a conspicuous location.

Maintenance Service Contractor Support

Some plant owners have shifted away from facility staff performing this type of maintenance by scheduling service contractors to conduct this task. As required under the Operating Engineers Regulation and the Occupational Health and Safety Act, the health and safety relationship between any contractor and the "employer" must be clearly defined. In addition, CSA B52 13 9.1.2 states: *Installation and service personnel working on a refrigeration system shall be equipped, on arrival at the premises, with the personal protective equipment required by the jurisdiction where the system is located.* Ensuring this obligation is included in the service contractor relationship agreement is strongly recommended.

Conclusion

Oil has been removed from ice arena chillers since the very first installation more than 100-years ago. The industry has a legacy of "close calls" relating to unplanned plant room gas releases that all could have been avoided through proper planning, engineering and administrative controls, personal protective equipment and training.

Attitudes surrounding the risks and hazards of ammonia exposure continues to improve. Operator safety is easily within reach if basic risk and hazard reduction principles are applied.