Eco-friendly refrigeration systems for ice rinks

The ice rink system of the future
complICE

Over 10 years of development of cooling systems using CO₂ as a refrigerant, as well as practical operating experience with over 600 systems installed, clearly demonstrates that Advansor is the world’s largest manufacturer of transcritical cooling systems. The systems combine a number of features that ensure reliability, good temperature control, and low operational costs.

Ice skating rinks have a reputation for being very energy-intensive on account of the huge pump energy required to circulate brine through the rink floor circuits. Advansor offers a revolutionary concept for refrigerating ice rinks – a concept that involves circulating CO₂ through the rink floor circuits and using direct, no-loss evaporation to refrigerate the rink. This technology results in savings of around 80–90% of the pump energy usage.

Choosing a complICE product means choosing the most operationally reliable and energy-efficient CO₂ refrigeration system on the market.

- Advansor is the leading manufacturer of transcritical CO₂ systems in the world
- Eco-friendly refrigeration systems for ice rinks
- Based on more than 10 years of experience with CO₂ systems
- Reliability and operational security
- Compact and small footprint
- Full heat recovery for heating utility water, space heating and melting snow from ice resurfacing.
- 80–90% reduction in pump energy usage
- Improved ice quality

Why CO₂?

complICE systems from Advansor use only one refrigerant – CO₂. CO₂ is neither flammable nor toxic, making it an attractive refrigerant, both in terms of production, installation and operation of the unit. CO₂ meets all international requirements on refrigerants – both now and in the future. By selecting a complICE system from Advansor means that neither the contractor nor the end user needs to be concerned about future legislation or new taxes. Instead they can be comfortable with a solution that utilises an eco-friendly refrigerant.

Why choose a complICE product?

There are many reasons to choose a complICE product. All systems from Advansor are made with careful attention to details, in order to achieve optimal, safe and service-friendly operation.

- complICE has proven reliability secured by a fully developed digital oil management, optimised pump vessel design and internal suction gas heat exchanger.
- To prevent vibrations and noise in the system, the compressors are fitted with vibration dampers on an installation plate that is welded to a solid, rigid base frame built of profile tubing. Prior to production, every single system is designed using a 3D engineering and construction program to provide documentation for all the components used in each system. This method also ensures that all service points are positioned to allow easy access for service procedures. All the relevant components are stock parts in Advansor’s warehouse.
- If a power failure should occur, the UPS (uninterruptible power supply), which is installed on the control panel, ensures that the high-pressure valve and the gas bypass valves are closed. The high pressure and the low pressure side of the system are separated from each other. This ensures that the pressure levels are maintained and that the refrigerant in the system does not leak during a longer power outage. When the power returns, the system will restart automatically.
- complICE systems are designed with standardized components, which is making it easy for customers to procure spare parts, in order to avoid long shut down periods. If the local procurement of spare parts is a problem, the components can be supplied directly from the Advansor warehouse. This also applies to older systems.

Advantages of complICE

- Environmentally friendly system
- Non-toxic, non-flammable refrigerant
- Only one refrigerant
- No greenhouse effect
- No ozone-depleting potential
- No zone classification needed
- Compact construction
- Low noise level
- Low installation requirements
- Easy to maintain
- Low energy consumption
- Low installation costs
- Low maintenance costs
- Future-proof solution
- Improved ice quality
- No corrosive brine

complICE

complICE systems are designed as single stage compression systems. The high-pressure gas is led into a heat recovery exchanger and then through a condenser located outdoor where the remaining heat in the gas is rejected to the outdoor air (optional heat recovery is available). The cooled gas is then passed to an expansion valve (high-pressure valve), which maintains optimal operating pressure in the heat recovery exchanger and condenser in relation to the outdoor air temperature.

The system is fitted with a pump separator. From the pump separator, the liquid CO₂ is pumped to the ice rink floor circuits, where it evaporates and cools the rink floor to the desired temperature.

All control components for capacity regulation, oil handling and pressure management are based on a controller platform where all parameters are handled in a single control system. This means that communication with and monitoring of the equipment can be carried out in a coherent network. complICE is available with most controller platforms that are commonly used on the market today.

As standard, the capacity control of the compressors is handled by frequency converters. This ensures optimal capacity, which translates into improved temperature control and ice quality.

Refrigeration capacities of complICE: 150–450 kW
Evaporation temperature range: -15 -> -5°C (normally -8°C)

Installation-related advantages

Solutions from the Advansor complICE range feature a single refrigerant. As a result, there is no need for secondary circuits with inherent large pump energies. The fully direct system avoids corrosive brines and coolant glycol solutions. This contributes to a lower maintenance cost for many years to come. The installation can be executed in small tube dimensions, where both steel and copper can be used. Condensing the CO₂ directly in the air cooled condenser makes it possible to achieve major energy savings as there is no additional heat exchange with the dry cooler. These advantages will soon become evident – both on electricity bills and on the installation costs.
The heat recovery system

Instead of rejecting all the heat from the refrigeration system to the ambient via the gas cooler, Advansor systems are supplied as option with heat recovery. The heat recovered can be used for utility water, ventilation or, for example, melting snow from ice resurfacing. The unique heat recovery system design allows heating water to temperatures of 70–80°C. The heat recovery process comprises up to four steps, depending on the heat and temperature level needed.

**Step 1:** The 3-way valve is set so the discharge gas flows through the heat exchanger, and the water pump is started. The heat recovery has started.

**Step 2:** By gradually increasing the gas cooler pressure, the temperature of the discharge gas is increased. This is useful if a higher temperature and capacity on the water side is required.

**Step 3:** The gas cooler fans are stopped. A minimal amount of heat is lost to the environment.

**Step 4:** The 3-way valve is set so the gas cooler is bypassed. The heat recovery reaches 100%.

**Standard configuration, compICE models:**
- Semi-hermetic reciprocating compressors – Bitzer or Dorin
- Electrical panel and electronic control with controller – mounted on the rack
- Frequency control used for capacity regulation of the compressors
- Standard design pressure of the system: LP/HP: 45/130 bar

**Optional extras:**
- Heat recovery with associated control
- Subcooler
- Cover for outdoor installation
- Extra receiver volume
- High design pressure of the system: LP/HP: 60/120 bar
- System manager for monitoring the system on an external network
- Energy meters
- Performance analyser
- Multiple ice sheet control