

## Industrial Visit Report

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Subject: Heat Ventilation Air Conditioning and Refrigeration (HVACR)

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Place Visited: Renuka Ice Factory, Baramati



### Objective of the Visit

The main objective of this industrial visit was to gain practical knowledge about the production, storage, and handling of ice in an industrial setup. Students were expected to understand the principles of refrigeration, the ice-making cycle, the types of refrigeration systems used, and the temperature control mechanisms necessary for ice preservation. This visit also aimed to connect theoretical knowledge of vapor compression refrigeration, heat transfer, and phase change processes with their real-life industrial applications.

## About the Company

Renuka Ice Factory, located in Baramati MIDC, is a medium-scale industrial plant engaged in the production of block ice and crushed ice. The factory mainly caters to dairy industries, fish preservation units, cold storage chains, and beverage distributors in the surrounding region. The plant is equipped with ammonia-based refrigeration systems, brine tanks, and insulated cold rooms for efficient ice manufacturing and storage. The factory operates year-round and follows strict safety and hygiene standards to ensure product quality and energy efficiency.

## Activities and Observations

### 1. Introduction to the Ice Manufacturing Process

The visit began with an introduction to how ice is manufactured in large quantities using the vapor compression refrigeration cycle. The plant engineers explained that ammonia ( $\text{NH}_3$ ) is used as the primary refrigerant because of its high latent heat of vaporization and cost-effectiveness for large-scale systems. The refrigeration cycle consists of a compressor, condenser, expansion valve, and evaporator, operating in a continuous loop.

### 2. Process of Ice Formation

The factory uses the brine freezing method to produce ice blocks. The process involves the following steps:

Step 1: Metal cans (usually galvanized steel) are filled with pure water and placed in large brine tanks.

Step 2: A brine solution (mixture of water and salt) is cooled to around  $-10^\circ\text{C}$  to  $-12^\circ\text{C}$  using the ammonia refrigeration system.

Step 3: The brine absorbs heat from the water in the cans, gradually freezing it from outside to inside.

Step 4: After complete freezing (usually 8–10 hours), the cans are removed and dipped in warm water for a few seconds to release the ice blocks easily.

Step 5: The formed ice blocks are then moved to storage rooms or crushing machines, depending on customer requirements.

This process is highly energy-efficient and allows the plant to produce uniform ice blocks of desired sizes.

### 3. Refrigeration System and Components

The engineers showed the major components of the ammonia-based refrigeration system:

Compressor: Compresses low-pressure ammonia vapor to high pressure.

Condenser: Rejects heat to the atmosphere, condensing ammonia vapor to liquid.

Expansion Valve: Reduces pressure and temperature of liquid ammonia.

Evaporator (Brine Cooler): Ammonia evaporates in coils, absorbing heat from the brine solution and cooling it.

The system is equipped with pressure gauges, temperature sensors, and safety valves to ensure safe operation.

#### 4. Ice Storage and Handling

Once formed, the ice blocks are stored in insulated cold rooms maintained at around  $-5^{\circ}\text{C}$  to  $-8^{\circ}\text{C}$ . The insulation prevents melting losses and helps maintain ice quality during storage. In some sections, crushed ice is also prepared using mechanical crushers and stored separately in insulated bins for quick delivery to customers. The cold rooms use fan-coil evaporators to circulate cool air uniformly, and digital thermostats are installed to monitor temperature precisely.

#### 5. Safety and Maintenance Practices

Ammonia is a toxic refrigerant, so the plant follows strict safety protocols:

- Leak detection sensors are installed near compressors and valves.
- Technicians wear PPE kits and follow proper ventilation practices.
- Regular maintenance of compressors, expansion valves, and brine pumps ensures reliable operation and energy efficiency.
- Emergency exits and first-aid facilities are well-marked within the plant premises.

#### 6. Energy Efficiency and Environmental Aspects

Renuka Ice Factory minimizes energy consumption by:

- Using recirculated brine to maintain consistent cooling.
- Employing insulated pipelines and tanks to prevent thermal losses.
- Scheduling defrost cycles and compressor operation during off-peak hours to save electricity.

The use of ammonia, a natural refrigerant with zero ozone depletion potential (ODP), also contributes to environmental sustainability.

#### Learning Outcomes

- Understood the working principle of industrial ice manufacturing systems.
- Learned the brine-based ice formation process and its thermodynamic basis.
- Observed the practical use of ammonia as a refrigerant and related safety measures.

- Gained knowledge of ice storage techniques, insulation, and temperature control.
- Recognized the importance of energy management and maintenance in refrigeration industries.
- Linked theoretical knowledge of refrigeration cycles with real-world applications.

### **Conclusion**

The visit to Renuka Ice Factory, Baramati, provided valuable insight into the industrial production and preservation of ice using advanced refrigeration systems. The practical exposure helped students understand how vapor compression and brine systems are applied to achieve continuous ice formation on a large scale. The experience bridged the gap between classroom theory and real-world operation, enhancing understanding of refrigeration principles, system design, and industrial safety in HVACR applications.