#### **Ice Manufacturing Process**





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## Technology and Manufacturing Process



- Due to cost effectiveness, ammonia based ice manufacturing is suggested for ice plant.
- Main components of ammonia based refrigeration system
- 1. Ammonia compressor
- 2. Condensors/Heat Exchangers
- 3. Ammonia receivers
- 4. Cooling coils/Evaporators
- 5. Chilling tanks for ice plant



# **3 Phase Transformer**

 Required Electricity Connection Depend upon the ICE PLANT CAPACITY SELECTED.





## **Reciprocating Compressor**

# QUALITY COMPRESSORS



# Agitator





#### **Ammonia Gas Cylinder**





## **Ammonia Reciever**





### **Ice Canes**









#### **Salt For Brine Tank**





- The main cycle used for ice plant is vapor compression cycle with ammonia as the refrigerant in primary circuit and brine solution in secondary circuit.
- Brine solution takes heat from water in secondary circuit and delivers the heat to ammonia in primary circuit.
- Thus, the indirect method of cooling is used in ice plant.
- In secondary circuit brine is cooled in evaporator and then it is circulated around the can which contains water.
- The heat is extracted from the water in the can and is given to the brine.
- The brine is contentiously circulated around the can with the help of brine pump till entire water in the can is converted into ice at -6 0 C.







- Ammonia vapor coming out of evaporator is compressed to high pressure and then these vapors are condensed in the condenser.
- High pressure liquid ammonia is collected in the receiver and it is passed through the expansion valve to reduce its pressure as per requirement.
- The throttle liquid ammonia at low temperature & low pressure enters in evaporator, whose coils dipped in brine tank.
- The liquid ammonia absorbs heat from brine and gets converted into vapors, which are drawn by suction line of compressor.

#### Flow diagram of ice production







#### Finally ice is obtained



#### Ice quality



- The properties of ice vary substantially with temperature, purity and other factors.
- Ice is water frozen into a solid state. Thats why the quality of water should be within the standard limit.
- Depending on the presence of impurities such as particles of soil or bubbles of air, it can appear transparent or a more or less opaque bluish-white color.

#### **Water Quality**



- The quality of the water affects energy consumption and ice quality.
- A pH level below 7.0 is strongly recommended for a quality ice surface
- Water contaminants, such as minerals, organic matter, and dissolved air, can affect both the freezing temperature and the ice thickness necessary to provide satisfactory ice conditions.
- Variety of treatments are available. When these treatments are properly applied, they reduce or eliminate the effects of contaminants and improve ice conditions.



#### **Microbial quality of ice**

- The ice used in the food industry has to be safe and the water used in ice production should have the quality of drinking water.
- The consumption of contaminated ice directly or indirectly may be a vehicle for transmission of pathogenic bacteria to humans producing outbreaks of gastrointestinal diseases.
- The objective of this study was to monitor the microbiological quality of ice, the water used in producing ice and the hygienic conditions of ice making machines in various food enterprises.
- In an study, Escherichia coli was detected in seven (6.7%) ice and 23 (21.9%) ice chest samples whereas *E. coli* was negative in all examined water samples.
- Psychrophilic bacteria were detected in 83 (79.0%) of 105 ice chest and in 68 (64.7%) of 105 ice samples, whereas Enterococci were detected only in 13 (12.4%) ice samples.
- Coliforms were detected in 13 (12.4%) water, 71 (67.6%) ice chest and 54 (51.4%) ice samples.
- In order to improve the microbiological quality of ice, the maintenance, cleaning and disinfecting of ice machines should be carried out effectively and periodically. Also, high quality water should be used for ice production.

# Pre-requisites for quality ice production



- 1. in order to improve the microbiological quality of ice, pre-requisites should be performed.
- 2. For this purpose, the maintenance, cleaning and disinfecting of ice machines should be carried out effectively and periodically.
- 3. High quality water should be used for ice production; additionally the water should be sanitized by using sufficient amounts of chlorine or other proper methods such as UV and ozone treatments.
- 4. Routine training should be given to relevant staff regarding hygiene matters and maintenance of ice machines.
- 5. Furthermore, periodic surveys should be performed regarding the microbiological quality of ice, the hygienic conditions of ice machines and the hygiene of employees as a necessity of HACCP and ISO 22000 food safety management systems.



- Nowadays, quality assurance standards and guidelines are widely applied in the food industry in many countries.
- For this reason the HACCP plan should be developed and applied for ice production processes.
- In addition to this, microbiological standards for ice should be determined and regular inspection by proper authorities should be established for consumer's health in order to prevent the risk of exposure to pathogenic bacteria.