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MEAT AND FRESH FISH

Carcass Chilling and Holding: Cooler, Systems Used; Beef Carcass: Chilling, Holding, Cooler Layout, Drying, Design Conditions, Refrigeration Load; Hog Carcass: Chilling, Tempering, Cooler Design, Refrigeration Equipment, Spray Deck Coolers; Lamb and Calf: Chilling, Processing Variety Meats, Refrigeration Load; Hog Cutting; Pork Trimings; Smoked Meat; Fresh Pork; Sausage Dry Rooms; Lard Chilling; Hide Curing; Refrigerating Machinery; Fresh Fish: Care Aboard Vessels, Icing Fish, Shore Plant Procedure

THIS chapter deals with the processing of meat and fish particularly with care, cleanliness, and refrigeration requirements for maintenance of quality. Chilling, holding, storage, and handling methods are described and load calculations are explained in detail.

REFRIGERATION SYSTEMS FOR CARCASS CHILLING AND HOLDING COOLERS

Refrigeration systems in common use in carcass chilling and holding rooms are operated with ammonia, at a system pressure of 20 to 25 psig, as the primary refrigerant, and are of three general types: chilled brine spray, sprayed coil, and dry coils.

In *chilled brine spray systems* sodium chloride brine—normally 70 Salometer (about 20 percent) solutions—is used as the secondary refrigerant. It is chilled by the primary refrigerant to 15 to 20 F in shell-and-tube coolers or in large central tanks equipped with pipe coils. From these it is pumped to banks of brine sprays placed in overhead spray decks or in vertical floor-mounted bunkers in the chill rooms, and returned by gravity to the central tanks. The air is chilled directly by the sprays, in which the brine temperature usually rises 3 to 4 F deg in the process. The brine is constantly diluted by moisture condensed out of the spaces being refrigerated, and must therefore be *strengthened* (i.e. concentrated) regularly.

Chilled brine spray systems are generally being abandoned in favor of other systems described due to large building space required, inherent low capacity, brine carry-over tendencies, and difficulty of control. Nevertheless, many such systems are still in use.

Sprayed coil systems comprise the majority of chilling and holding room installations in use today. These employ unit coolers equipped with coils, brine spray banks, eliminators to prevent brine carry-over, and fans for air-vapor circulation. The units usually are mounted (without ductwork) either on the floor, or overhead on converted brine spray decks. Refrigeration is supplied by the primary refrigerant in the coils. Chilled or non-chilled recirculated brine is continually sprayed over the coils, thus eliminating ice formation and need for periodic defrosting.

The brine predominantly used is sodium chloride, with caustic soda or other additive for control of pH. Because the sodium chloride brine is very corrosive, bare-pipe coils (without fins) are usually used. The brine is also highly corrosive to the rail system and other cooler equipment.

Another coil spray solution, recently finding some use in competition with sodium chloride, is propylene glycol with added inhibitor complexes, available commercially under various trade names. As with sodium chloride brine, it is constantly diluted by moisture condensed out of the spaces being refrigerated, and must be *concentrated* by the evaporation of water from it. The reconcentration process requires special

equipment designed to minimize glycol losses. Sludging in the concentrator may become a difficult operating problem; to avoid it, additives must be used and pH closely controlled. Fanned coils are usually used with propylene glycol.

Because of its non-corrosiveness in comparison with sodium chloride, the use of propylene glycol greatly reduces the cost of unit cooler construction as well as maintenance of space equipment. However, propylene glycol is expensive, and the cost of equipment required to reconcentrate the spray solution is high.

Dry coil systems have been used very little in chilling and holding rooms until recently, although they are widely used in other applications. Early attempts at dry coil chilling were unsuccessful, largely because the coil capacity provided was inadequate for dry coil operation. Dry coil systems usually include unit coolers equipped with coils, defrosting means, and fans for air-vapor circulation. Because the coils are operated without continuous brine spray, eliminators are not required. Coils are usually of the finned type with fins limited to 3 or 4 per in. to avoid icing difficulties. The units may be mounted on the floor, overhead on the rail beams, or overhead on converted brine spray decks.

A feature of all dry coil systems operated at surface temperatures below 32 F is that moisture condensing on the coil surfaces results in the gradual build-up of a coating of frost or ice. Beyond a point, this causes substantial reduction in air flow and consequent capacity loss. The coils must therefore be defrosted periodically to maintain capacity, normally every 4 to 24 hours for coils having 3 or 4 fins per inch. The rate of build-up, and hence the defrosting frequency, decreases with large coil capacity and high evaporating pressure. Successful dry coil operation at frosting temperatures therefore requires far more coil surface than does sprayed coil operation.

Defrosting may be done manually or automatically as follows:

1. *Hot gas defrost* is accomplished, with fans either on or off, by introducing hot gas direct from the system compressors into the evaporator coils. The evaporator suction is throttled to maintain a coil pressure of about 60 to 75 psig (approximately 40 to 50 F). The coils then act as condensers and supply the heat for melting the ice coating. Other evaporators in the system must supply the load for the compressors during this period. Hot gas defrost is rapid, normally requiring 5 to 15 minutes for completion.

2. *Coil spray defrost* is accomplished (with the fans turned off) by spraying the coil surfaces with water, which supplies the heat required to melt the ice coating. Suction and feed lines are closed off, with pressure relief from the coil to the suction line, to minimize refrigeration effect. Enough water at 50 to 75 F must be used to avoid freezing on the coils, and care must be taken that freeze-up does not occur in the drain lines. The sprayed water tends to produce some fog in the refrigerated space. Coil spray defrost is fully as rapid as hot gas defrost.

3. *Room air defrost* is accomplished with the fans kept running while the suction and feed lines are closed off, with pressure