



Unit 3– Topic 1&2

ESTIMATION OF SERVICE REQUIREMENTS INCLUDING PEAK LOAD CONSIDERATION

14.1 Introduction

Estimation of service requirements is important to determine the capacity of equipments used for providing different services in the dairy plants. The major utilities of dairy plants are steam, refrigeration, electricity and air supply. It is necessary to know rate input services required for various equipments. The peak load can be estimated by for various services based on the operating schedule of the equipments. The peak load estimation is also important to make contract for connected electrical load of the dairy. The peak load requirement for steam, refrigeration, electricity and effluent treatment plant is very much necessary. Peak load is calculated based on capacity utilization of equipment and load conditions of cold store, ice bank tank and effluent treatment plant.

Dairy processing plants are traditionally divided into two separate categories for the purpose of production and energy statistical data presentation: fluid milk; and industrial milk. These two categories are described as follows:

- Fluid milk processing involves the pasteurization and processing of liquid milk for direct consumption, as well as creams, chocolate and other flavoured milks, and buttermilk.
- Industrial milk processing involves the processing of milk into value-added products. These include cheese, butter, ice cream and other frozen products, condensed and evaporated milk, dried milk powder, yogurt and other cultured milk products. The milk used in the manufacture of industrial milk products is also pasteurized before processing.

For the purpose of this guide, six major generic process sequences (one fluid and five industrial) have been considered. These processes are

- Fluid milk;
- Cultured products;
- Cheese;
- Butter;
- Ice cream and other frozen products;
- Evaporated/dried products



- Traditional Indian dairy product.

These generic process/product combinations were selected because they:

- Cover the wide range of product manufacturing activities undertaken;
- Represent the natural groupings of similar generic processes; and
- Coincide with the general process categories separately modelled in support of Hazard Analysis Critical Control Points (HACCP).

14.2 Steam Requirement

Steam requirement is calculated for processing and other purposes separately, while boiler for condensing and drying plant is selected separately, based on the calculation of steam requirement in the condensing and drying plants. After estimation of steam requirement of each equipment on hourly bases, time schedule diagram including each processing equipment is prepared to know the peak requirement of steam in the peak hours. Depending on the peak load requirements, steam pressure is maintained and boiler is started in advance to get required steam pressure and quantity of steam. The main steam line pressure is maintained higher than actually required during peak load hours, considering losses in the lines and number of bends in the line. The fluid milk plant requires approx. 0.25 to 0.4 kg of steam per liter of milk, while that of powder plant requires approx. 5 kg of steam per kg powder.

14.3 Refrigeration Requirement

Refrigeration requirement of dairy plant is mainly divided into two major categories (i) Chilling load and (ii) Cold storage load. Chilling load is referred to the chilled water requirement of different equipments during processing of different products. It is calculated based on the chilling requirement of different processes. The chilled water requirement of different processes can be met by Ice Bank Tank (IBT) or Ice Silo. IBT can be designed based on the total requirement of chilled water in the different processes in a day. The refrigeration plant for IBT can be operated during night hours (16 to 18 hours a day). The cold storages are required for different dairy products like ice cream, butter, cheese, milk etc. They are maintained at different temperatures and at different relative humidity depending on type of product to be stored. The cold storage refrigeration plant capacity is calculated based on consideration of different types of loads like product load, wall gain load, air change load, lighting load and miscellaneous load.

Time schedule for different processes which, requires chilled water is prepared to know peak load requirement of chilled water. Similarly time schedule for loading and unloading of the cold



storages are also prepared to know peak load requirement of cold storages and accordingly refrigeration plant is operated to conserve energy.

14.4 Electricity Requirement

Electricity requirement for different equipments, pumps, motors, refrigeration plants, lighting and general purpose is calculated based on actual operating load. Depending on the requirement of single phase and three phase connections load distribution is made using necessary controls. All the equipments are provided with safety devices to protect from over load condition or voltage fluctuations. Motors are provided with variable frequency drives and soft starters to conserve energy. Refrigeration plant of dairy contributes approx. 40 to 50% of total electricity load.

14.5 Water Requirement

Water supply for dairy plant is important and must be considered at the planning stage. An adequate supply of pure water for washing of equipment and cooling purpose is essential. An ideal water supply is one that is soft cold and free from all impurities. The water is treated to meet plant requirement by using suitable process. The hardness of the water used in the dairy plant should be maintained below 35 ppm. Generally the ratio of milk:water of fluid milk plant is 1:1, while that of multi product plant is 1:1.5 or 1:2. It depends on type of products made and size of the plant. There are different types of water soft water, well water, chilled water, hot water etc. they are used in the different processes, for cleaning of equipment and floors. The distribution of water can be done by gravity, centrifugal pumps or by hydro flow systems. Hydro flow system is used to have uniform pressure in the water pipe lines, which facilitates operation of automatic control systems. Control of use water is required to conserve water and to reduce load on effluent treatment plant.