

## Lesson 18

### Service accommodation

#### **18.1 Introduction**

Siting of auxiliary services mean proper placing of service sections providing auxiliary services such as steam, refrigeration and electricity to the dairy plant. In small and medium capacity plant, it is practicable to provide these rooms within the main building. But in large plants, it is better to group these rooms in a separate building. The arrangement of rooms where secondary equipment such as boiler, compressor, evaporators, condensers and workshop equipments are installed should be such, so as to allow easy supervision. Equipment, such as brine pumps, chilled water pumps, hot water circulating units and control should be located in a separate or beneath the floor away from processing section.

#### **18.2 Boiler room**

The boiler house, if placed in the main building, it should then be placed near the main areas utilizing steam, such as mil drying and condensing. Usually boiler is installed on the ground floor with access from one side for the removal and replacement of the plant when required. The room for boiler accessories should be close to the boiler house. The discharge of solid fuel and removal of ash are dusty operations. Therefore, it is desirable to place the boiler section in such a way that the process room is not affected by it. This point has to be considered carefully if solid fuel is used.

#### **18.3 Refrigeration machinery room**

Refrigeration is a costly affair. Economy should be considered in minimizing the length of service lines by locating it centrally, and near the place where cooling is required. In small and medium capacity plants, the condensing unit for the cold store may be placed adjacent to it; but in large plants or where the products include ice-cream, the equipment involved will require a special room. This should be placed as close to the load areas as possible because in these and other applications of direct refrigeration, the longer the service lines, the greater the cost of refrigerant required to charge the system and greater the running cost.

Indirect refrigeration using chilled water is mainly concerned with precooling of raw milk and final cooling of pasteurized milk. In small and medium sized dairy plants, it is possible to place the compressor and chilled water tank with those for direct refrigeration. In large plant, it is better to site compressor near the section concerned.

An energy exist must be provided in the compressor room. Care for installation or replacement of equipment should be taken in view and this would decide to site the compressor room on ground floor with easy approach to room 8in case of emergency.

#### **18.4 Electricity**

If the electricity is purchased from outside, i.e., State Electricity Board or Municipal Undertaking, then high or low voltage intake will present no unusual siting problems. In case the electricity is to be generated, the power house should then be located close to the boiler house for supervisory reasons. The switch rooms should be centrally located to economise in wiring. A large plant may have moré than one switch room.

The siting of switch room may be more difficult to decide especially in a multistory building. If all or most of the motor starters are housed there, power cables must be taken to the equipment concerned and control circuits must be brought in from all the operating stations. Thus, the switch rooms must be located as central as possible to economies in wiring.

### 18.5 Workshops and garages

Workshops include three main sections which will carry out routine repair and maintenance work of dairy in respect of Civil Engineering, Mechanical Engineering and Electrical Engineering. A small dairy will have one large workshop having three sections under one roof. For medium and large dairies, there will be separate workshops for electrical, mechanical and civil works, respectively. All workshops can be grouped and placed in a separate building near the plant.

Garages are generally of two types, one meant for parking cars tankers or other vehicles, the second one is for repairs. Parking garages are located near offices or place of work. If the plant has its own fleet of vehicles, then garages have to be erected at a suitable place on the site. The garages may be placed close to workshop with facilities for washing the vehicles and for lubrication services.

Residential accommodation for key workers or essential service personnel may be constructed near the plant side but quite separate from plant building.



## Lesson 19

### Arrangement of different sections

#### 19.1 Introduction:

Arrangement of different sections of dairy means siting of various sections in relation to each other in dairy building. Arrangement of different sections in dairy must be done in such a manner that main rooms are planned and sited in relation to each other first. The product sections can then be grouped around them. Utility sections are placed near the areas where services are needed. Garages with facilities for washing and lubrication will be placed adjacent to workshop. Offices will have separate apartments. Overall layout of the dairy plant should be of functional design and should give hygienic outlook. Arrangement of different sections in the dairy plant has effect on energy conservation and product losses. Arrangement of different sections should be based on the future expansion required in the dairy plant.

#### 19.2 Arrangement of primary and secondary rooms

Primary rooms mean milk reception and milk treatment (milk processing) rooms. Reception and milk treatment rooms should be connected with each other. The laboratory is mainly meant for testing incoming milk and should, therefore, be located adjacent to milk reception dock. Cold store should be placed adjacent to bottle/pouch filling room. Secondary rooms mean rooms not directly connected with milk, e.g., dry stores accessory room etc. Secondary rooms are attached to their main requirement sections. For instance, boiler accessories room will be sited adjacent to boiler room.

#### 19.3 Arrangement concept of various sections of dairy in general

An arrangement concept of various sections of dairying in general Fig. 19.1. It will be noticed that product sections are placed around milk storage and treatment room (main rooms). Product storage is next to product sections from where they are sent to dispatch dock. Laboratory has been placed near milk reception and refrigeration machinery room near the product storage. Utility sections near the area where services are needed. This is only a concept diagram.

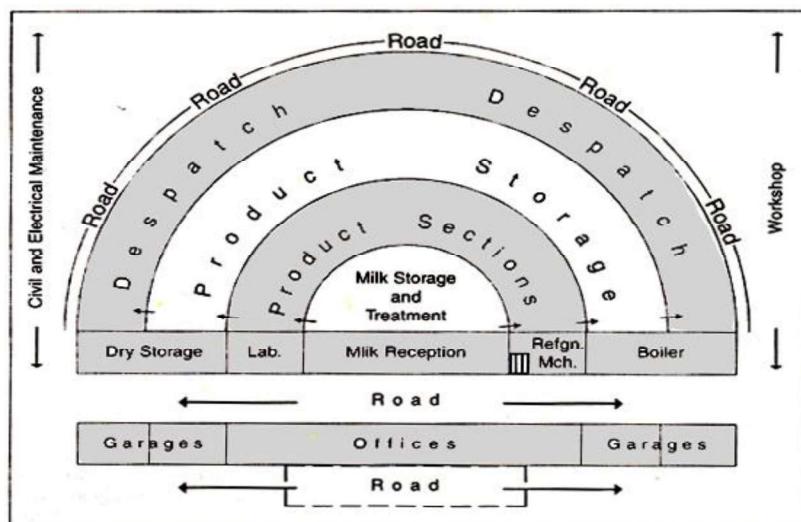
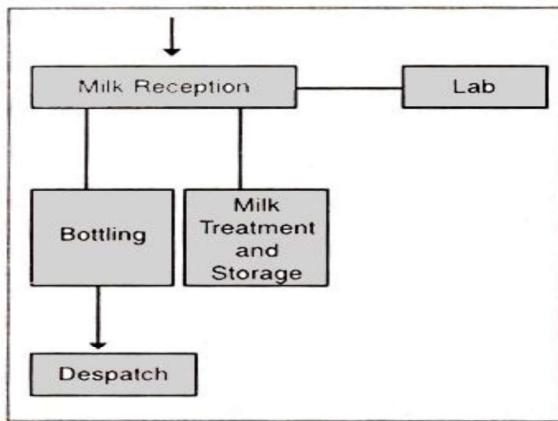


Fig. 19.1 Arrangement concept of various sections of dairy in general

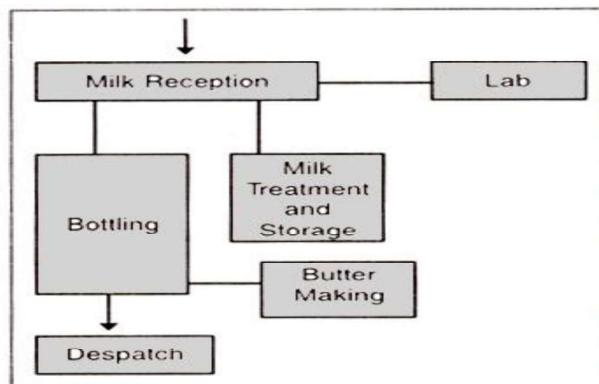
#### 19.4 Planning and arrangement of small milk plant

Small plants are usually on ground floor, i.e., one level and arrangement should be like Fig.19.2. for a small plant for market milk. The milk storage tanks can conveniently be placed in milk processing room because hardly one or two items are manufactured in small capacity units. Laboratory is connected with milk reception room. Next to storage is placed dispatch dock. Service sections and office areas have not been shown in this block diagram.



**Fig. 19.2 Room arrangement of small milk plant**

Where the market milk is to be standardized, the plant may incorporate a butter section to utilize cream. This butter section can be arranged as shown in Fig. 19.3 in such a way that the cold rooms for butter and bottled milk are next to each other. By doing this, there is saving in respect of thermal insulation and cooling capacity. Also the products loading are then done through the same bay. In this room arrangement for market milk and butter making plant cold stores can be placed just before dispatch dock. This is the arrangement of processing sections only. Other sections can be linked suitably to complete the dairy unit.

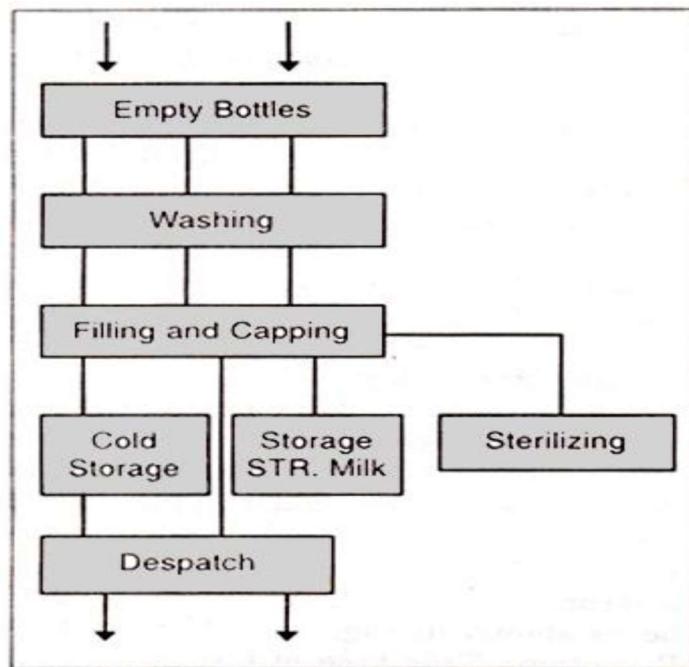


**Fig. 19.3 Room arrangement of small milk plant for market milk and butter**

In all cases while arranging the rooms, flow of the product should be kept in view, and all pipe lines should be as short as possible so that economy is achieved. Flow should be in order and accordingly the placement of the rooms. Future extension cannot be neglected. So while siting the rooms, at least one wall should be made in such a manner so as to allow for future extension in one or the other direction.

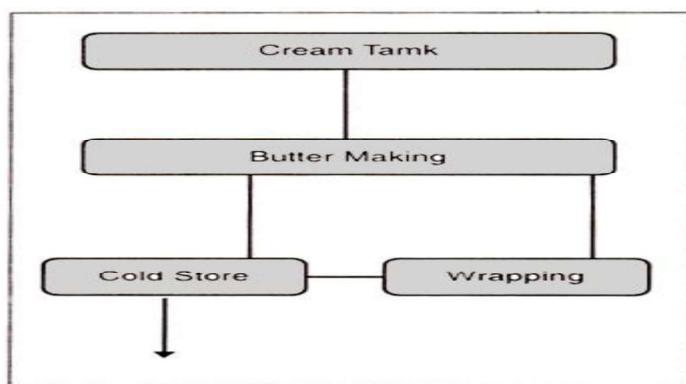
#### 19.5 Medium-sized dairy plant

Medium-sized dairy plant ranging capacity from 20,000 liters to 80,000 litres of milk handling per day will require that each room should be planned separately and then all rooms be arranged as per requirement with forward flow of product in view. The market milk section may include milk in glass bottles, in 20 or 40 litre cans, polyethylene or tetra packs or paper cartons and other non-returnable containers. A bottling section should be planned as shown in Fig. 19.4. From this type of set up it will be noticed that empty bottle side and dispatch side are free so that trucks can drive up to dirty bottle reception dock (empty bottle side) and dispatch dock easily and thus there will be no rush of vehicles. This separation of dairy bottle reception dock and despatch dock is essential in medium and large size dairy plants. Left side has been kept free for future extension. If non-returnable containers are used, this will completely dispense the bottling line. This means, there will be saving in floor space. Basement if available can be used for storage purposes.



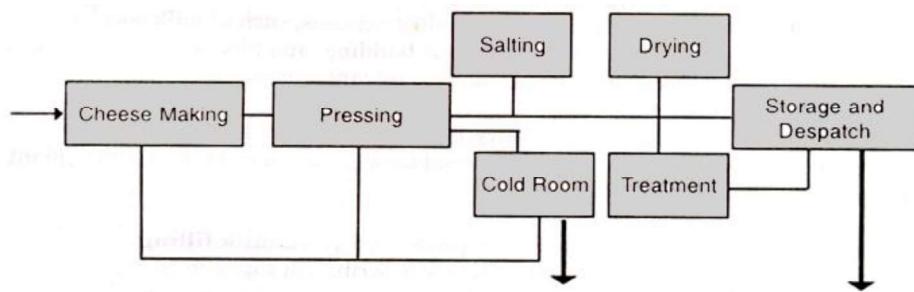
**Fig. 19.4 Basic Plan for milk bottling section**

Medium size butter sections are often simple to plan and place. The various space required within the section for production of butter are laid out as shown in Fig. 19.5. This is only a concept. Other sections are suitably linked and placed within main building. Tanks for the storage and treatment of cream are often placed in butter making room when one person is there to supervise the section. Where butter is discharged from the churn or other butter making equipment directly to the packaging machine by a chute, the rooms must be on two levels. Cold store for butter should be placed near dispatch dock, if possible.



**Fig. 19.5 Space layout within room for butter making**

Layout of cheese section which includes cottage cheese will require cold store and daily distribution. For this, cold store would be placed close to milk store as shown in Fig. 19.6.

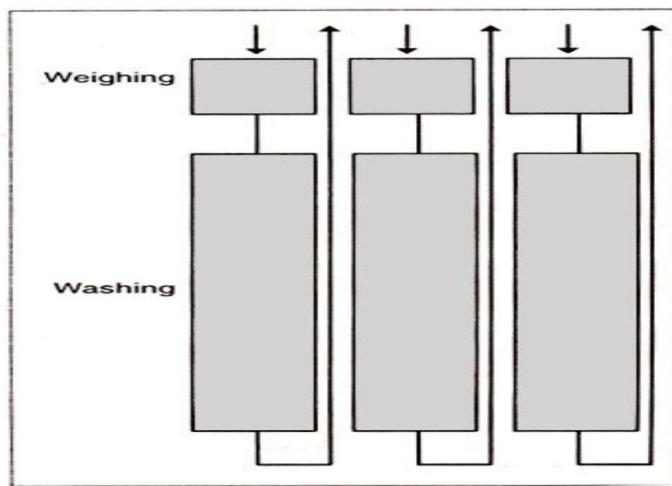


**Fig. 19.6 Cheese section for several varieties**

The processing of cheese will involve cheese making, pressing, treatment and storage. Cheese rooms vary in number, size temperature, humidity etc. For different types of cheese placing of one after the other on one level would naturally make the area of the building very large, particularly in those cases where the cheese has to be stored for a considerable length of time, thus requiring very large storage rooms. In large cheese making plants, it is advisable to have a vertical arrangement if possible from production and technical standpoints. For certain types of cheese, curd can be produced on an upper floor, an then conveyed to the room below, where pressing and other processing take place. From here, the cheese can be conveyed horizontally or down to the basement where it can be stored or further treated. Where space is available, curding, pressing and other processing are carried out on one level with storage rooms underneath. When very large storage rooms are needed, these must be sited on a suitable number of floors by the side of cheese making premises.

### 19.6 Large-sized dairy

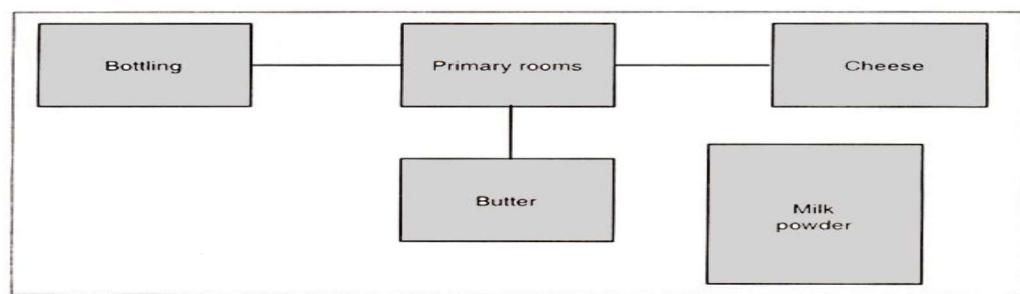
For large-sized dairy plants, the best solution is to have both milk treatment and tank storage on the first floor. The actual design depends very much on planning of reception room. If there are more than two weighing-in units with necessary conveyors and can washers, the layout suggested may be as shown in Fig. 19.7 (Multiple Line Reception). This type of layout makes a rectangular form of the milk reception room, thus making it easier to place within the structure of the building.



**Fig. 19.7 Multiple line reception layout**

In a multiproduct plant, the suggested layout of rooms may be as shown in Fig. 19.8. In this case when product sections are grouped around primary rooms, there will be difficulty in future extension of primary rooms. In

such situation, it is advisable to have primary rooms sufficiently large enough in the beginning, so that, when question of future extension is there, it is only in respect of capacity of the equipment. If any of the product sections, such as milk powder section is very large, this can be housed in a separate building, and pipelines connection can then be taken overhead. Such arrangement is advantageous if extensive changes in operation are expected in the future.

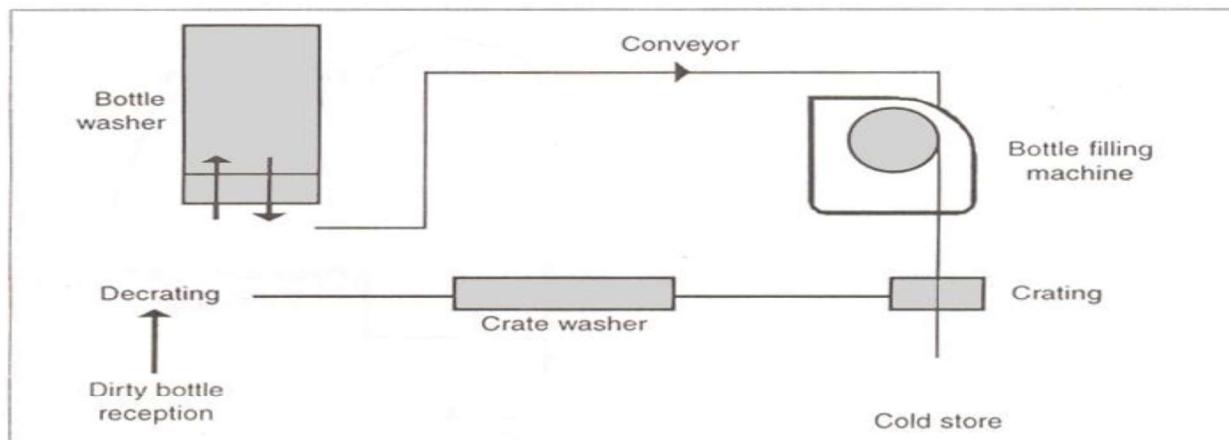


**Fig. 19.8 Multiple product plant layout**

In a nutshell, the principles of dairy layout should be following, various working sections be placed around milk treatment and tank room, no matters whether plant is built on one, two or more levels.

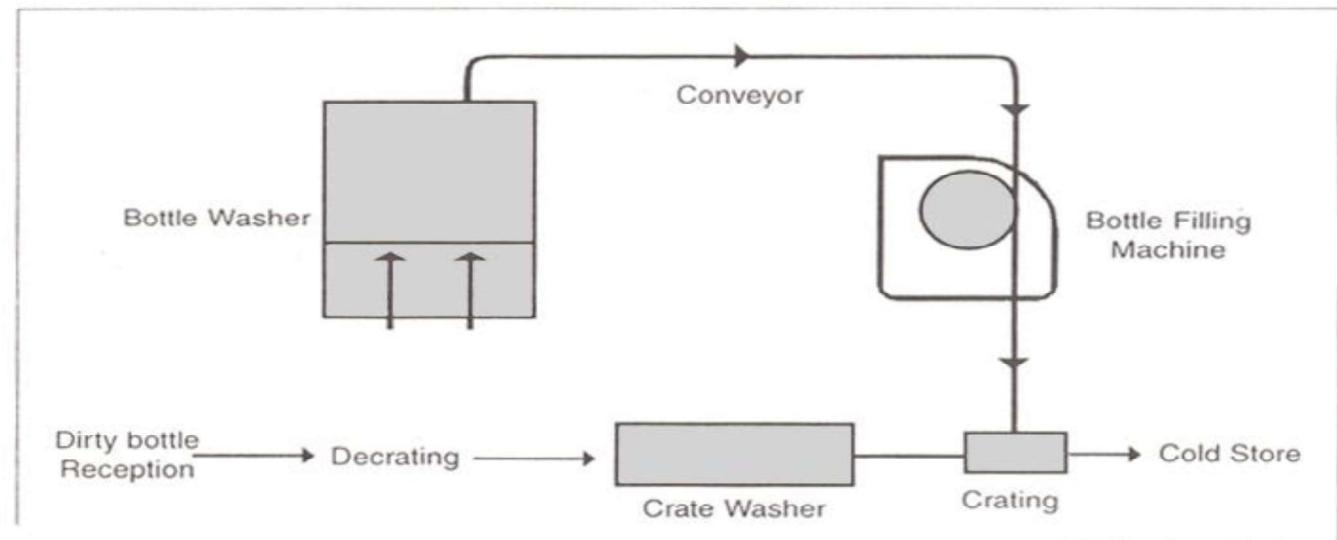
### 19.7 Arrangement of bottling section, pre-pack/tetra pack milk filling

Arrangement of bottling section is clearly described in Fig. 19.9. In this case, dirty bottle reception and dispatch of milk is on the same side. In this arrangement, comeback type bottle washer has been used. Bottles after filling find straight route for dispatch through cold store as dispatch dock ((not shown) is next to cold store. This arrangement is available for small dairies. Bottle washer and crate washer can be placed in a separate room while milk filling machine in the processing room near cold store.



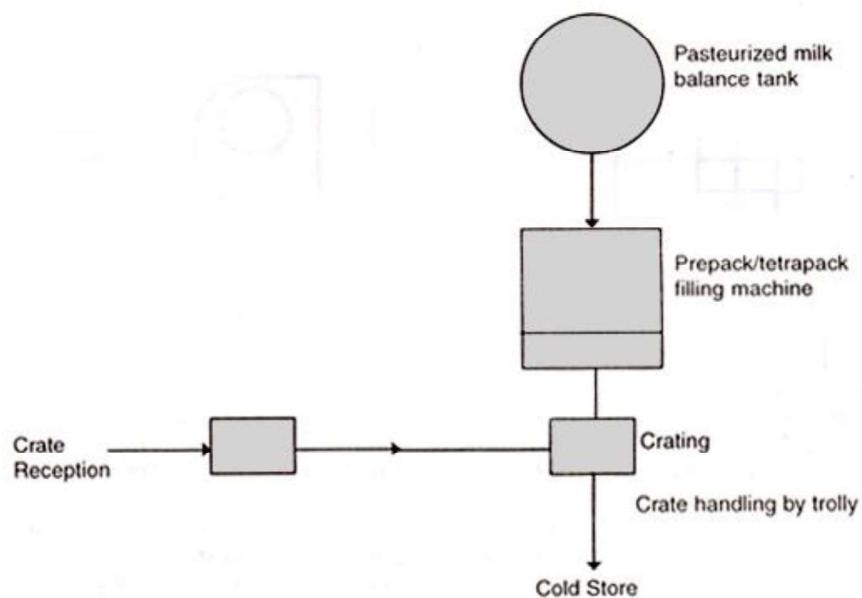
**Fig 19.9 Arrangement of bottling section using come back type washer**

An alternate arrangement (Fig.19.10) where crates travel straight and position of dirty bottle reception dock and dispatch dock are just opposite to each other (docks are not shown in the diagram). This arrangement utilizes straight through bottle washer.



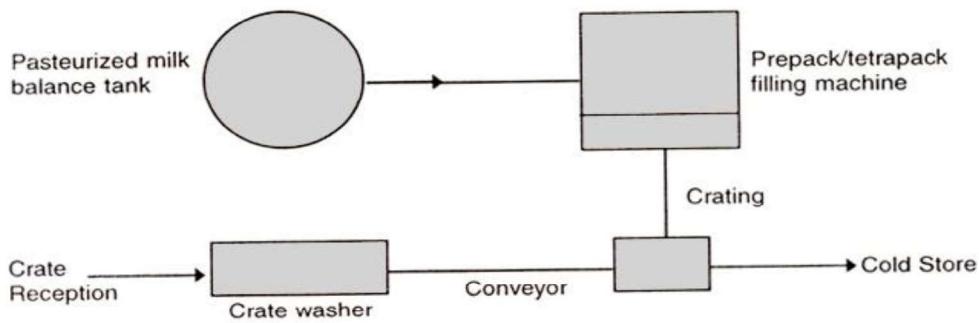
**Fig. 19.10 Arrangement of bottling section using straight through bottle washer**

The arrangement of Pre-pack/Tetra pack filling machine (Fig.19.11) where crate handling is done by hand trolleys. Here passage is not blocked by conveyors. Coled store is on the right side of the crate reception.



**Fig.19.11 Arrangement of Pre-pack/Tetra pack filling machine**

The crates carrying milk pouches (Fig.19.12) travel straight to cold store. This arrangement using conveyor saves labor and is efficient and economical though initial expenses are more. This has to be planned in relation to other sections, in such a way that passage is not blocked for carrying out other operations.



**Fig. 19.12 Arrangement of prepack / tetrapack filling machine crate handling by conveyor**

## 19.8 Layout and arrangement of milk treatment, processing and product rooms

In large dairy planning for milk treatment, processing and products rooms has to be done carefully. For large dairy, primary rooms, i.e., milk reception, milk storage (tank room), treatment room (processing room) have to be centrally located. These rooms are planned and sited first in relation to Reception Dock and Milk Testing Laboratory. Product sections when grouped around them will have easy approach. These sections may be interconnected, but they must have direct approach to milk processing room. Butter section may be connected with ghee making section. It is advantageous to interconnect similar nature product which may have same bay for dispatch. If stores and cold stores are planned on one and the same side of the dairy building, the loading of end product can be done easily. This will save unnecessary travel of men and material. Plant will be efficient if material handling is minimized. The route should be as short as possible.

## 19.9 Service sections

Siting of auxiliary services mean proper placing of service sections providing auxiliary services such as steam, refrigeration and electricity to the dairy plant. In small and medium capacity plant, it is practicable to provide these rooms within the main building. But in large plants, it is better to group these rooms in a separate building. The arrangement of rooms where secondary equipment such as boiler, compressor, evaporators, condensers and workshop equipments are installed should be such, so as to allow easy supervision. Equipment, such as brine pumps, chilled water pumps, hot water circulating units and control should be located in a separate or beneath the floor away from processing section.

## 19.10 Office layouts and their linking with dairy plants

A dairy factory will not have only technical, dairy professionals, operators, skilled and unskilled workers, but will also have staff personnel not directly concerned with plant, but very much associated with dairy. This staff looks after all activities of dairy such as administration, milk procurement, processing, dispatch, distribution, sales and marketing of products, establishment, finance and accounts, H.R.D., security (watch and ward) and management in general.

This staff requires office accommodation comprising number of rooms properly linked. For employee comforts and convenience, staff canteen, toilets, reception lounge have also to be provided. Size of office varies with the capacity of the plant. A small dairy may have small office as number of activities will be less. Medium size dairy plant will have bigger office as compared with small dairy. In this number of activities will be more and plant may be manufacturing more products. Accordingly, staff will increase. A large dairy will still have large

office with large number of staff employed. Before deciding number of rooms in office and space requirement, it is essential to know the activities, number of departments and persons who can handle the work, as number of persons employed will determine the area and room needed by them.

A small dairy may have sections or departments viz milk procurement, milk processing, milk dispatch and distribution, sales and marketing, advertising, sanitary control and hygiene, security (watch and ward), establishment, finance and accounts, dairy technology and dairy engineering.

Medium dairy will have all above departments, but there may be addition of two or more sections, such as labor welfare department (office), human resource development (H.R.D. section), personnel department etc. Large number of employee and labor justifies the existence and importance of additional sections mentioned above.

In small dairy office, there will be one Manager who will be assisted by various Sectional Heads with suitable designations. Each Sectional In charge will have 2 or 3 Assistants/Clerks and one Peon or Attendant. All staff will be housed in a separate building or block which will be suitably linked with dairy, except for security office which will be located near the entrance or gate of the factory. Officer Incharge of a particular section will have his room next to his working section for easy approach and supervisory reasons. For instance, Accounts Officers' room will be immediately next to Accounts Department or Section.

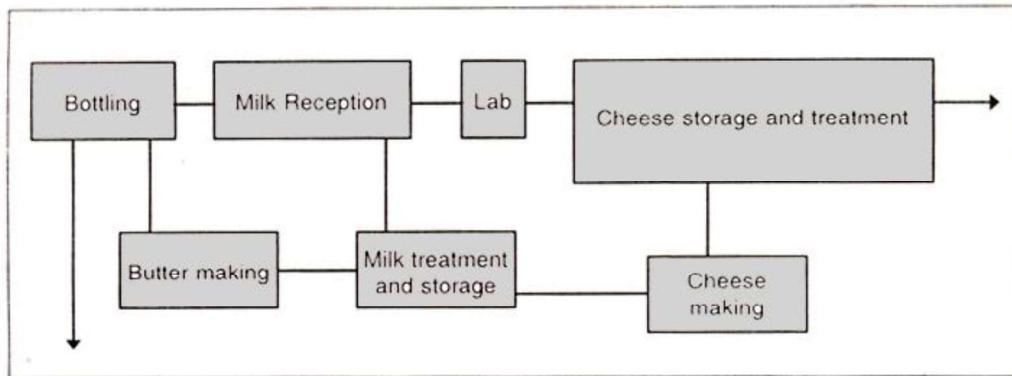
Medium-sized dairy plant may have one General Manager, one Deputy General Manager, one Manager, three Deputy Managers, six Assistant Managers, twelve Sectional Heads with suitable designations and three Assistants or Clerks with two Peons or Attendants in each section.

Accommodation for all these staff members has to be provided and carefully planned keeping logic in mind. Sufficient space has to be provided for walk ways, passages, corridors and reception lounge with visitor's waiting room.

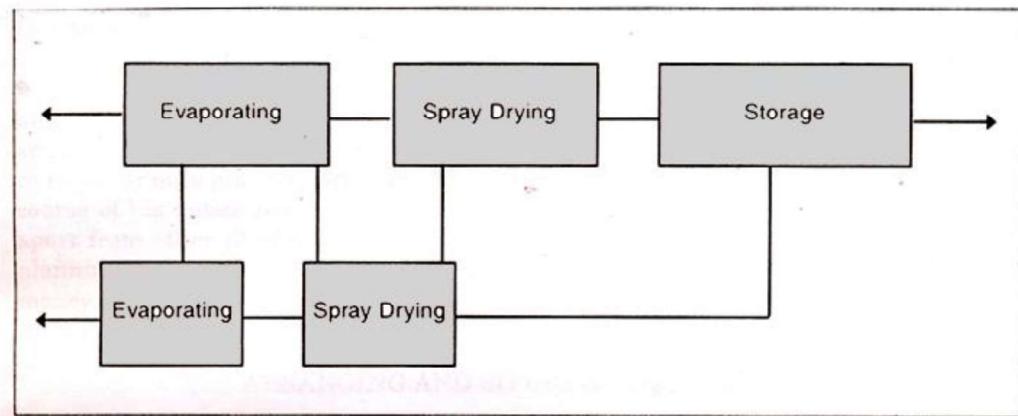
Large dairy plant will have big office layout with large number of employees at different levels to manage various department. Staff pattern in large dairy organizations is somewhat different from other two small and medium size dairy plants. Here above General Manager, there is Managing Director, Board of Directors presided over by Chairman of the company. While deciding accommodation and room layout for office of this magnitude, it is essential to make provision for Chairman's office, Board Room (Conference Room), Guest Room / Guest House etc. It is a good practice to work out detail staff required at all levels in the factory including office and plant works. The organization chart may be drawn, which will give clear picture of staff position. Accordingly, office layout can be prepared. Refer Part B of the book chapter titled 'Office Layouts'.

### **19.11 Missing-view problems**

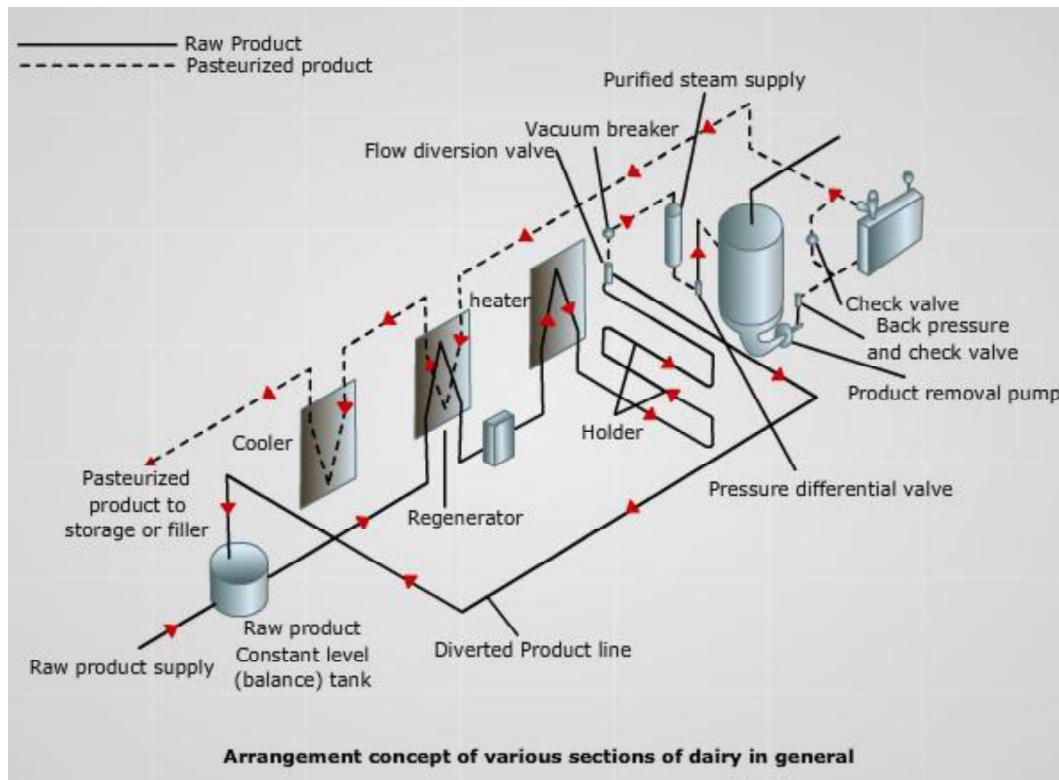
Missing view problems on room arrangement for different sections of dairy building are given in Figs. 19.13 and 19.14. It is required to study the layouts carefully and then add missing sections linking them logically, keeping in view planning and principles of dairy layout. Utility sections, offices, workshops and garages etc. are not shown in these diagrams. These missing sections are to be linked suitably in such a manner that a complete room arrangement layout of dairy is presented. Reception and dispatch docks can also be shown in the layout alongwith approaching roads around the plant. Fig. 4.13 shows small dairy plant manufacturing three products, namely Milk (in bottles), Butter and Cheese. Fig. 19.14 shows layout of condensing and drying section of medium size dairy plant. Fig. 19.15 shows arrangement concept of various sections in dairy in general, while Fig. 19.16 shows arrangement of various sections of dairy in general



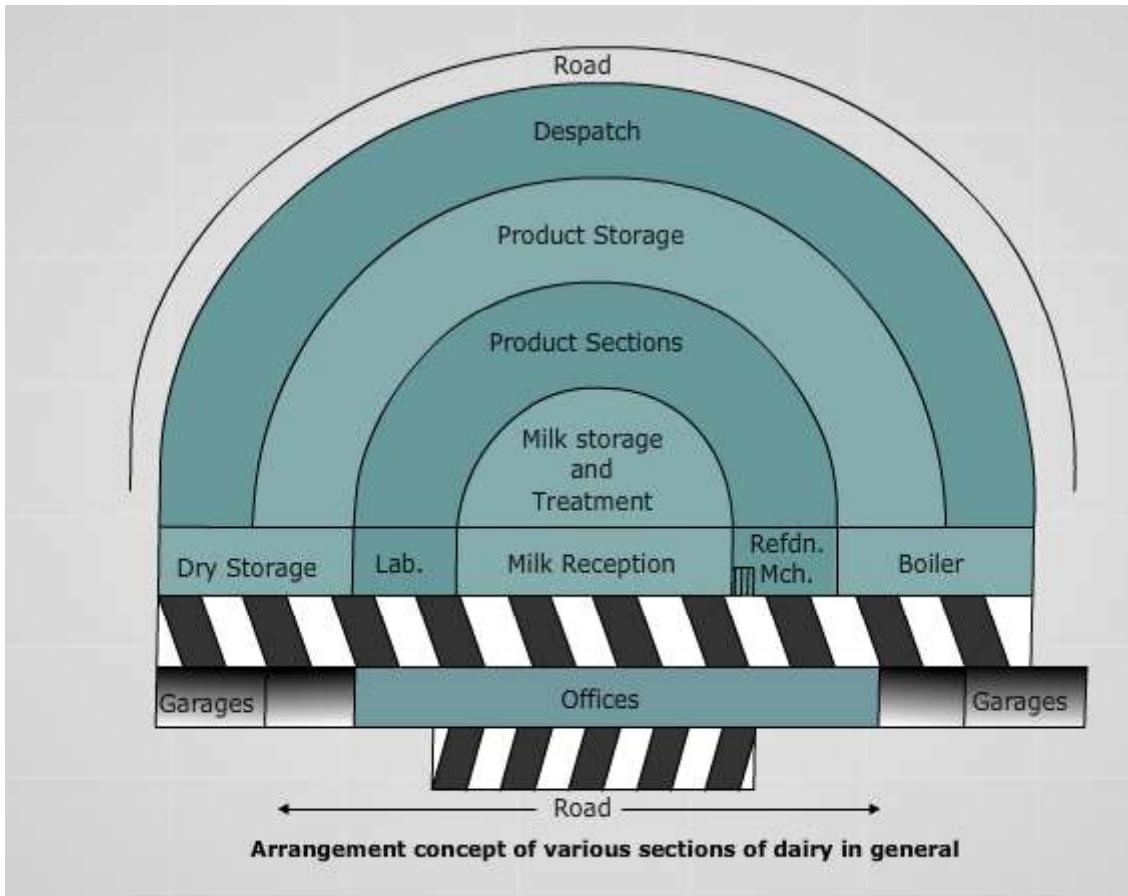
**Fig. 19.13 Small plant for three products**



**Fig. 19.14 Condensing & drying section**



**Fig. 19.15 Arrangement concept of various sections of dairy in general**



**Fig. 19.16 Arrangement of various sections of dairy in general**



## Lesson 20

### Service pipe-line layout

#### **20.1 Introduction :**

Service pipe line layout for different services required in the dairy plant like steam, well water, chilled water, hot water, fresh water, refrigeration, air etc. is prepared for minimizing material requirement, estimating cost of installation, to facilitate selection of different fittings, and to smoothen the operation. Service pipeline layout is prepared considering safety aspects of the plant and personnel working. It also helps in deciding the material requirement, mountings and accessories required in each pipelines. There are different color codes used for different piping systems. The steam pipe is painted with yellow color, chilled water pipe line is painted with blue color, well water pipeline is painted with green color and pipelines carrying hot fluid are painted with red color. The pipe lines carrying hot and cold fluids are insulated with suitable insulating material.

#### **20.2 Color coding for identification of pipe-lines**

When a number of pipe lines are running in dairy factory, it becomes necessary to know what material is being piped through particular pipe. To avoid any sort of accident, it is important to identify the pipe lines. The American Society of Mechanical Engineers has suggested color code for identification of all piping arrangement and systems.

Colour codes which have been accepted universally by dairy industry are as follows:

1	Safe products (air, water, etc)	Green
2	Dangerous material (ammonia, fuel oils, high pressure steam etc.)	Yellow
3	Protective material piped through the plant to minimize hazards of dangerous material	Blue
4	Fire control equipment	Red

In a milk plant, green color for safe material, yellow for dangerous material and red for fire control equipment are used. However, an organization can use shades of these colors for further identification of more pipe lines. For instance, cold water light green, hot water dark green, chilled light blue etc. A factory using color code for identification of piping must display at the entrance or at a suitable place a color identification of pipes running in the plant. This can be done by cutting small length of pipes say 4 inches and painting them; write the material being piped through against the color painted pipe ends. These may be mounted on a board and hanged on wall so that this can be noticed by all.

#### **20.3 Milk piping**

The layout of interconnecting milk piping system should be decided keeping in view the method of cleaning. There are two methods which are commonly adopted for cleaning milk piping. These are: (1) manual cleaning method and (2) cleaning-in-place (C.I.P.) method.

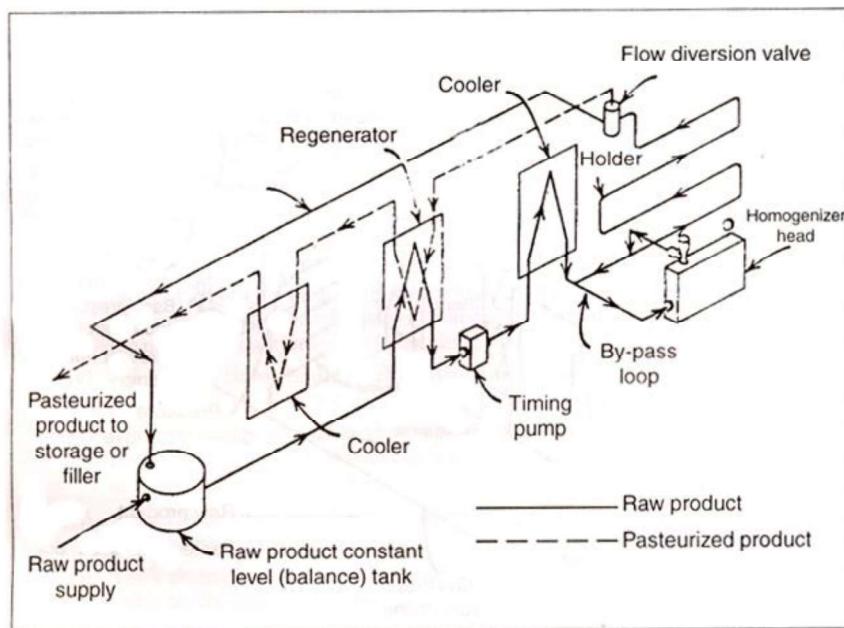
If manual cleaning method is adopted, it must be clear that the pipes have to be dismantled frequently for cleaning operations and for this purpose, it is essential that approach to pipe lines is made very easy, i.e., piping system is easily accessible. For this piping supports from ground (floor) is preferred for supporting overhead pipe lines which are 7 to 8 ft above the ground level. Piping supports should be placed at a distance of about 3 meters or about 10 ft. All pipes carrying milk are of stainless steel as they are easy to clean. Sanitary piping is recommended for dairy industry.

For cleaning-in-place method, approach to pipe line is less important as piping will be dismantled relatively infrequently. Layout of piping in C.I.P. system has to be planned carefully because the purpose is not only conveying or carrying milk but also cleaning. Contamination has to be avoided in all cases. In large installations, it will be necessary to arrange for part of the pipe system to be cleaned while another part is conveying milk, and precautions and safeguards must be incorporated to prevent accidental contamination of milk by cleaning solutions or detergents. A milk piping must be so arranged to minimize loss of product at the end of process run to ensure that all cleaning solutions are removed from plant before use. For C.I.P. cleaning of pipe lines, milk piping may be supported from ceiling. In this metal suspension rods are fixed to ceiling. This gives a clear floor area with no obstruction and operations are carried out smoothly.

Typical layouts for service pipe lines are shown in the Fig. 20.1 (a), 20.1 (b), 20.2, 20.3, 20.4, 20.5, 20.6, and

20.7.

figures



**Fig. 20.1(a) Milk piping**

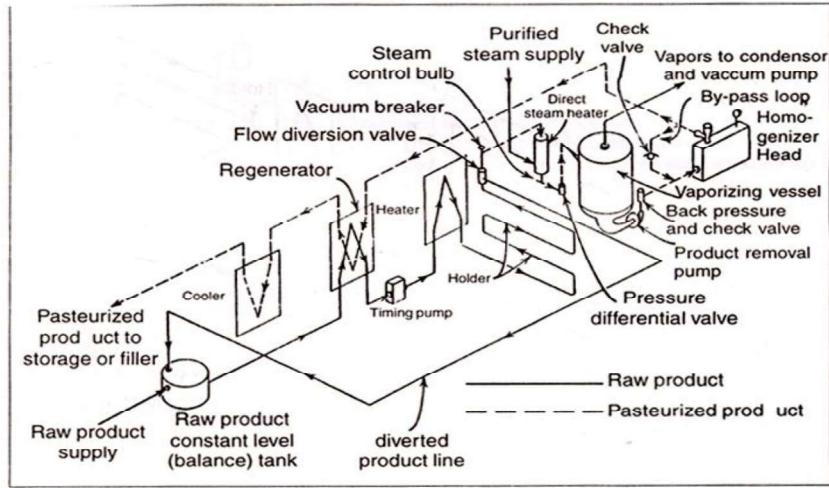


Fig. 20.1(b) Milk piping

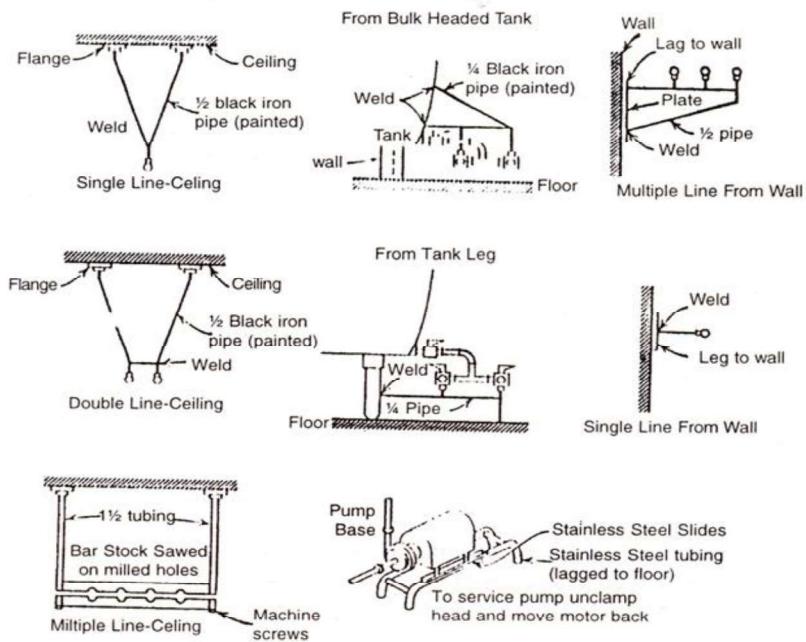
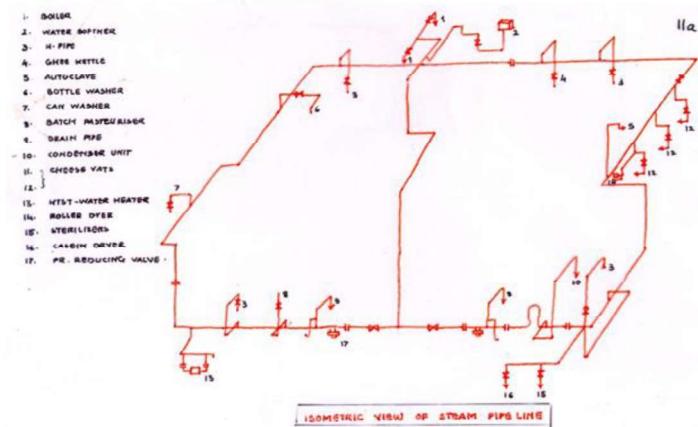
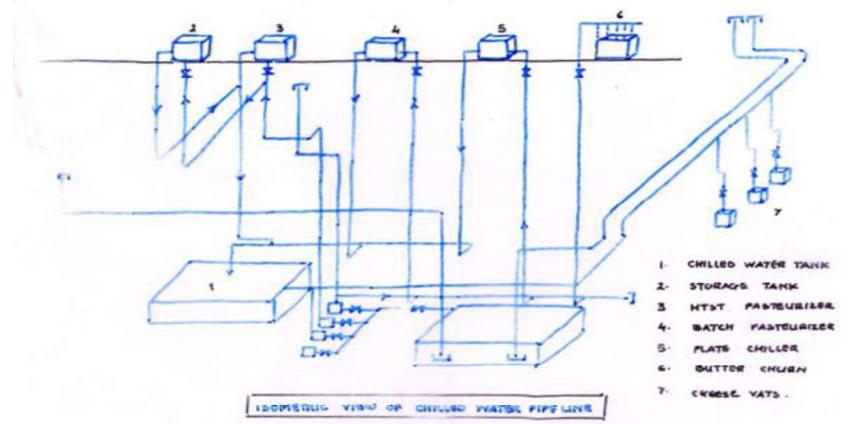


Fig. 20.2 Typical sanitary pipe supports





**Fig. 20.4 Isometric view of chilled water pipe line in dairy**

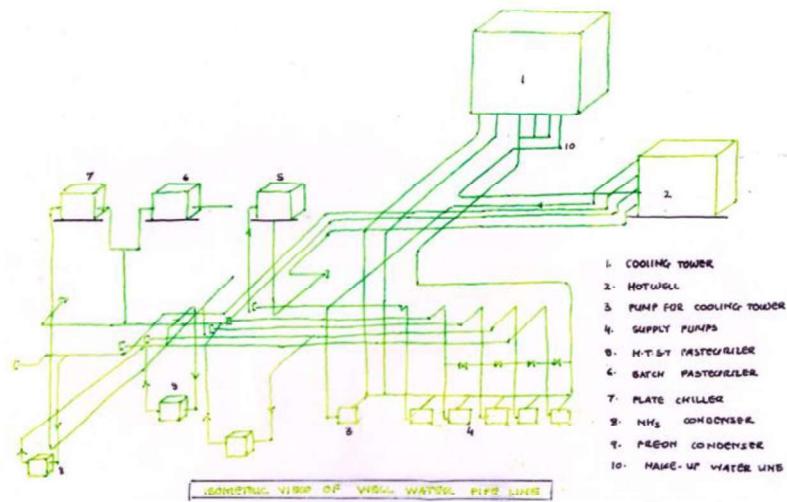
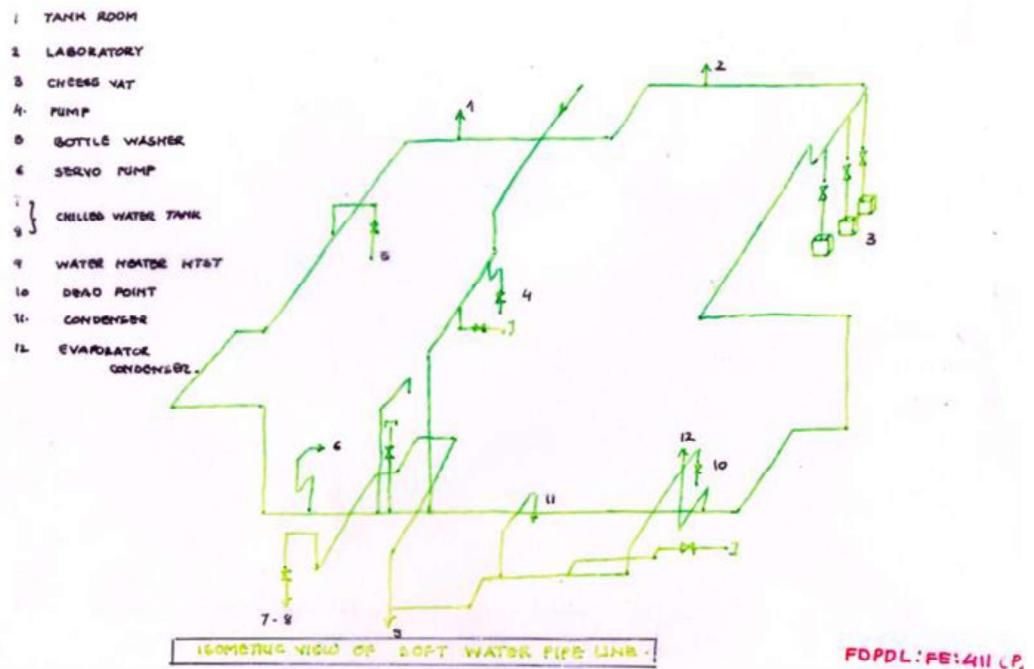
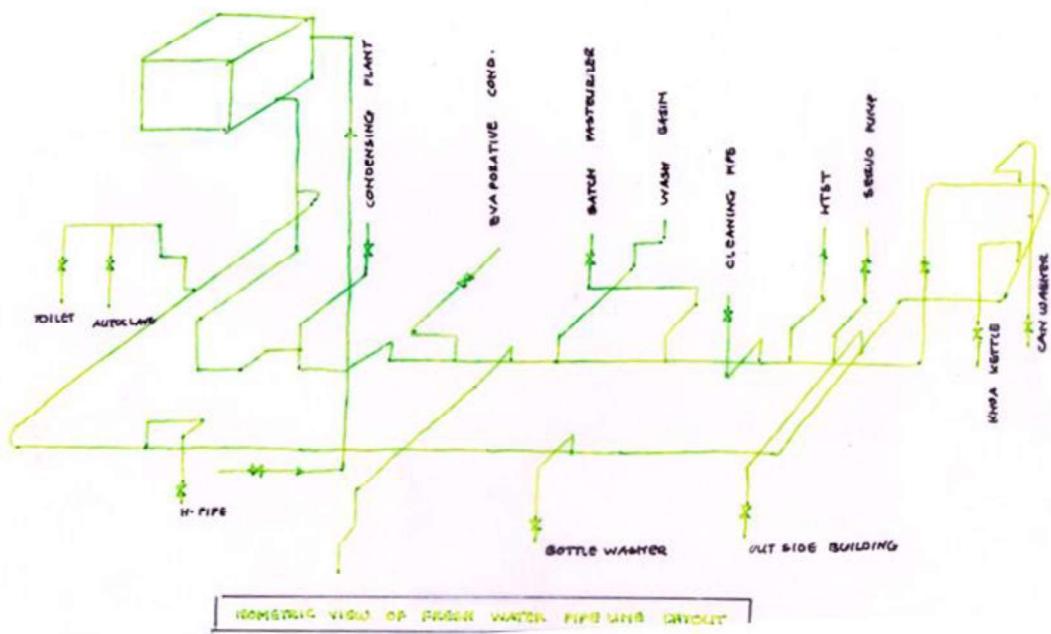


Fig. 20.5 Isometric view of well water pipe line in dairy



**Fig. 20.6 Isometric view of soft water pipe line in dairy**



**Fig. 20.7 Isometric view of fresh water pipe line in dairy**

## Lesson 21

### Equipment layout

#### **21.1 Introduction**

A plant will be efficient only if equipment installation is in proper order. Proper order means laying of equipment according to flow pattern of manufacturing process. The equipment must be laid as per sequence of the operations, i.e., ‘what comes next’. Horse has to be put before the cart and not a cart before the horse. For instance, milk after its reception at Milk Reception Dock, has to be weighed, dumped into dump tank, chilled through surface cooler or plat chiller before it is stored into storage tank for further processing. Here a chiller will have to be placed in between dump tank or milk receiving vat and storage tank. Milk route has to be made as short as possible. Unnecessary travel of men and material should be avoided as it amounts to waste of time. Failure to provide adequate working space may hamper cleaning operations or may cause one operator to obstruct to another, thus causing delay. The positioning of a milk cock or other control just out of normal reach may involve an extra journey or additional effort in getting the means to perform the operation involved. Placing a conveyor or milk pipe across the route which an operator will have to take in the normal course of his duties may cause obvious difficulties and may lead to accidents which, apart from other ill effects, reduce operating efficiency. It is often seen that wrong planning and faulty installation of equipment leads to inefficiency, delays and loss of money as plant becomes uneconomical. Therefore, proper arrangement of equipment is essential for any successful plant.

#### **21.2 Secondary equipment**

Secondary equipment are those equipment which are not directly related to milk such as boilers, compressors, condensers and workshop equipment. This equipment should be in a separate room from the main part of the dairy plant. Equipment, such as brine pumps, chilled water pumps and hot-water circulating units and controls should be located in a separate room or beneath the floor away from processing section.

#### **21.3 Bulk milk receiving**

A minimum clearance of 5 ft (152 cm) above the highest milk tanker should be allowed for cleaning spray head and balancer. An 8 ft (244 cm) working space should be provided behind each tanker for ease in handling the hose and making connections. The floor at rear of the truck should slope  $\frac{3}{4}$ " per ft (1.9cm/30cm) for fast drainage.

#### **21.4 Arrangement of processing equipment**

The main idea for proper arranging the equipment is to achieve maximum efficiency and economy in respect of installation of the equipment and to provide facilities to staff looking after the equipment for smooth running of the plant. For planning a layout of the equipment, use of layout planning table and model planning is highly recommended. Consideration must be given to the cleaning-in-place system (C.I.P.) when placing the equipment. Storage tanks should be in a battery such as in a row, so that, a common supply and cleaning solution return line can be in a buttry such as in a row, so that, a common supply and cleaning solution return line can be used for all tanks. The same idea holds true for the arrangement of pasteurizing vats or similar pieces of equipment. Regular order of the equipment installation is essential and must be in accordance with flow pattern of the product.

A pasteurizer would probably comprise the heat exchanger, hot water set, milk pump, float tank and possibly an instrument panel together with the inter connecting milk piping.

A bottling line would consist of a bottle washer, filler, capper, and associated conveyors. These equipment should be installed in regular order without any obstruction in the way.

## **21.5 Milk piping**

The layout of interconnecting milk piping system should be decided keeping in view the method of cleaning. There are two methods which are commonly adopted for cleaning milk piping. These are: (1) manual cleaning method and (2) cleaning-in-place (C.I.P.) method.

If manual cleaning method is adopted, it must be clear that the pipes have to be dismantled frequently for cleaning operations and for this purpose, it is essential that approach to pipe lines is made very easy, i.e., piping system is easily accessible. For this piping supports from ground (floor) is preferred for supporting overhead pipe lines which are 7 to 8 ft above the ground level. Piping supports should be placed at a distance of about 3 meters or about 10 ft. All pipes carrying milk are of stainless steel as they are easy to clean. Sanitary piping is recommended for dairy industry.

For cleaning-in-place method, approach to pipe line is less important as piping will be dismantled relatively infrequently. Layout of piping in C.I.P. system has to be planned carefully because the purpose is not only conveying or carrying milk but also cleaning. Contamination has to be avoided in all cases. In large installations, it will be necessary to arrange for part of the pipe system to be cleaned while another part is conveying milk, and precautions and safeguards must be incorporated to prevent accidental contamination of milk by cleaning solutions or detergents. A milk piping must be so arranged to minimize loss of product at the end of process run to ensure that all cleaning solutions are removed from plant before use. For C.I.P. cleaning of pipe lines, milk piping may be supported from ceiling. In this metal suspension rods are fixed to ceiling. This gives a clear floor area with no obstruction and operations are carried out smoothly.

## **21.6 Can washing**

Conditions and environments under which milk and milk products are processed are of great importance to customers. Pollution free environment and cleanliness become the prime factor for dairy industry. Cans in which milk is brought are often washed and cleaned well at dairy. Installation position and arrangement of can washing machine in relation to other respective equipment must be done in such a way so as to avoid contamination. The can washer must be installed in milk receiving room or at Milk Reception Dock covered from sides. It has to be placed adjacent to weigh tank (milk dump tank) in between dump tank and can washer, there will be drip saver so that any droplet left again goes back to weight tank. Milk may be transported upto tipping point on can trolleys or by means of conveyors. A stand by washing trough with cold and hot water facilities can be helpful in case of emergency. It will be clearly noticed that 'can cycle' ends at milk reception / milk receiving room only as after cans are washed, these are loaded on the same vehicle in most of cases and returned back to milk producers for next day bringing milk. Some space equal to one hour load capacity has to be kept on floor for washed empty cans as precautionary measure. Ultimately these have to be picked up within an hour's time. A minimum of 3 ft. distance is desirable between drump tank and can washer may be rotary or straightway can washer.

## **21.7 Pasteurizer, homogenizer and ice-cream freezer**

As mentioned earlier under arrangement of processing equipment, pasteurizer and other relative equipment along with it have to be installed in order. But there are some other accessory equipment which are integrated into HTST and UHT pasteurizers. These are clarifiers, separators and homogenizers. Clarifiers and separators

when installed so as to operate on the heated product must be connected in such a way that they will not reduce the holding time below the legal minimum.

As all fluid milk and all ice-cream mix are homogenized, homogenizers are integrated into continuous pasteurizing systems. Homogenizing temperature must be at least 120 °F. The homogenizer must be located either between the regenerator and heater section or after the heater. Homogenizers work better when the product is delivered to the suction manifold under positive pressure than when they must draw the product into the suction manifold. The timing pump and downstream resistances supply the necessary pressure in most installations, but when there is a lack of pressure on the suction manifold, a centrifugal pump immediately upstream is recommended. It should be electrically connected, so that it can run only when homogenizer motor is running.

**Ice-cream freezers and hardening room:** Hardening cabinets (for small units) must be placed close to homogenizer. If a plant is incorporating a separate section for ice-cream making, then all relative equipment for ice-cream manufacture have to be installed in regular order sequence-wise.

## **21.8 Consideration of cleaning-in-place system**

Cleaning in place C.I.P. means in place cleaning of equipment, i.e., cleaning solutions are brought to equipment and cleaned there only instead of equipment being dismantled and taken to separate place for cleaning. For proper performance of any C.I.P. system, all pipe lines must be properly fitted, properly pitched and rigidly supported. Special attention must be given to the supporting arrangement since proper support alone can assure maintenance of proper fit and pitch. Gaskets and joints which are protected from stress will be long lived and trouble-free. Conversely, joints subjected to strain because of vibration, lack of support or poor fit will invariably cut, deform and eventually fail completely. Ingenuity is essential in solving mounting problems at hand when installing C.I.P. system.

General recommendations regarding installation of C/A systems and C/A cleaned equipment are given below:

- (i) Tank trucks which are to be spray cleaned should be pitched at  $\frac{1}{4}$  inch per foot from front to rear to provide for efficient high speed unloading and cleaning operations.
- (ii) Storage tanks that are to be spray cleaned should be pitched at  $\frac{1}{4}$  inch per ft from rear to front to provide rapid drainage and continued positive recirculation of cleaning solution.
- (iii) Where tanks are associated fill-discharge header systems are to be mechanically cleaned, these tanks should be installed with the outlets 18 to 24 inches(45cm to 60 cm) above the floor, or higher, if necessary to accommodate the required number of lines. This height provides good return solution flow from tank washing operations and places all valves at a height convenient to the operator for product-flow control and cleaning.
- (iv) All product lines should pitch continuously to pumps being supplied by these lines.
- (v) All product transfer lines should pitch from a point above the transfer pump involved continuously if possible toward the constant level tank, storage tank, or filler bowl being supplied.
- (vi) All C.I.P. cleaned product lines should pitch continuously towards one or more drain ports.
- (vii) Tank cleaning return lines should pitch continuously from the tanker outlet valve to the cleaning return pump involved.

(viii) All connections should fit precisely, so that nipples and elbows can be easily installed and removed for making product piping and C.I.P. connections.

## **21.9 Arrangement of boiler house and refrigeration machinery**

The boiler house is constructed on ground floor with approach from large bay for the removal and replacement of plant. The boiler accessories room is attached to it. Its ideal location is near most steam consuming areas especially milk drying and condensing. It should be on one side of the building away from prevailing winds, if solid fuel is used for obvious reasons of dust and ash. Fuel storage must be adjacent to the boiler house and must have good approach for transport. In any case boiler section must be away from main processing sections.

Refrigeration machinery should be planned so as to locate it centrally. The compressor room and chilled water tank may be placed in a basement and this may have some advantage in warm climates. A ready emergency exit must be provided in the room. It is preferable to have refrigeration room on the ground floor as it will be easy for installation and replacement of equipment. In large plant compressor room may be near the boiler in a separate building

## **21.10 Conveyors**

Whenever question of material handling comes, thought must be given to available material handling devices, such as, cart, trolleys, fork lift truck, conveyors, etc. All these devices save labor and time. Not only efficiency is achieved but delays are also curtailed. Out of all these for constant and organized movement of the product from one point to another conveyors are the best. Other devices are good for small operations. Conveyors should be properly laid out, timed and provided with convenient shut off switches. They should be so located that they do not block passages. Automatic controls for speed control and stopping in the event of a pile-up are desirable. The length of conveyor between two pieces of equipment is important and serves as a storage to aid in synchronizing the speed of the two machines. This storage function gives the operator a brief period in which to correct minor difficulties with a machine without stopping the entire line. Conveyor sections can be mounted on wheels which can be rolled into position to extend the fixed conveyors to load trucks, if necessary.

### **Types of conveyors**

Conveyors move cases and cans faster and more efficiently than men and this increases the proportion of time workers who can spend more time on actual production work. The most common types of conveyors used in dairy industry are:

1. Chain conveyor
2. Belt conveyor
3. Gravity conveyor (roller conveyor)
4. Wheel conveyor

Chain conveyors are the type most widely used in the dairy plant to convey crates, cans and other packages. Chain conveyors are of three types: (1) above floor type, (2) in floor type, and (3) on floor type. Regardless of the type, every chain conveyor system consists of 4 basic parts, namely (1) power unit, (2) conveyor frame, (iii) chain, and (iv) take up unit.

All complete chain conveyor systems may consist of one or more power units depending upon the size of the plant and the complexity of the package handling flow in plant.

Above floor chain conveyors have an open type steel welded or bolted frame. The chain is pulled along in the hardened steel chain tracks mounted in this frame – usually foot above the floor. The return chains run in channels mounted in the frame below the carrying chains. The standard chain height for an above-floor conveyor in most plants is between 18 and 22 inches. This is because the top of the case is generally 30 to 36

inches off the floor, which is the most convenient working height for most washer and filler operators. This type of conveyor is used to convey single cases and cans. The conveyor frame has side rails that extend up above the top of the chain to keep the case and can on the conveyor.

The in-floor type conveyor is a double chain conveyor imbedded in the floor. The in-floor type conveyors cost same as above floor type conveyors except that installation cost is slightly higher because of the necessity of supplying in-floor pits for drives and take-up units. Also cost of additional work required to embed the conveyor in the floor flush with floor level. The frame consists of a steel plate 1/8 to 3/16 inch thick, formed with channels for the carrying and return chains, so that the overall width of frame is about 16 inches. The conveyor frame is embedded in the floor. The two carrying chains are usually 1/2 inch above the floor level. The return chain travel is between and below the carrying chains.

In-floor conveyors must be planned in the initial stages, because a floor channel has to be provided to accommodate them and to house driving motor. The pits for driving motors are made large enough for cleaning and maintenance and are covered by removable steel plates or grids. With in-floor conveyors, the entire area where the conveyor is located is free from those conveyors which must be climbed over to get around the plant.

### **Belt conveyors**

Belt conveyors are used in dairy plants for carrying cases between floors in multistory plants. These are also used in the dry storage warehouses for unloading warehouse items from delivery trucks. Belt conveyors are not suited for handling milk cans.

### **Gravity-roller conveyors and wheel conveyors**

Gravity-roller conveyors and wheel conveyors are used today to a limited extent. These conveyors find their use in warehouse and for short sections or lift sections at the end of power conveyor systems. Wheel conveyors are ideal for warehouse operations because they are light in weight, portable and are easily moved around in the warehouse.

### **Bottle conveyors**

Bottle conveyors are of two types, namely (1) Flat link, and (2) the lateral curve. Both have a smooth level surface and can be used for either glass or paper bottles. It will be noted that bottles require slat conveyors to give the necessary area of flat surface for stability. Bottle conveyor is a type of chain conveyor using chains which may have from a 1 to a 4 inch pitch. The drive unit is usually of the gear-motor variety located at one end of the conveyor and pulling the chain through the system to an idler sprocket at the other end. The chain runs on a frame between the rails. Conveyors are installed as per requirement of a particular section.

### **21.11 Typical equipment layouts:**

Typical equipment layouts are shown in the Fig. 21.1, 21.2, and 21.3. For preparing equipment layout typical symbols are used for different equipments to prepare its layout, Fig. 21.4 shows symbols for different equipments.

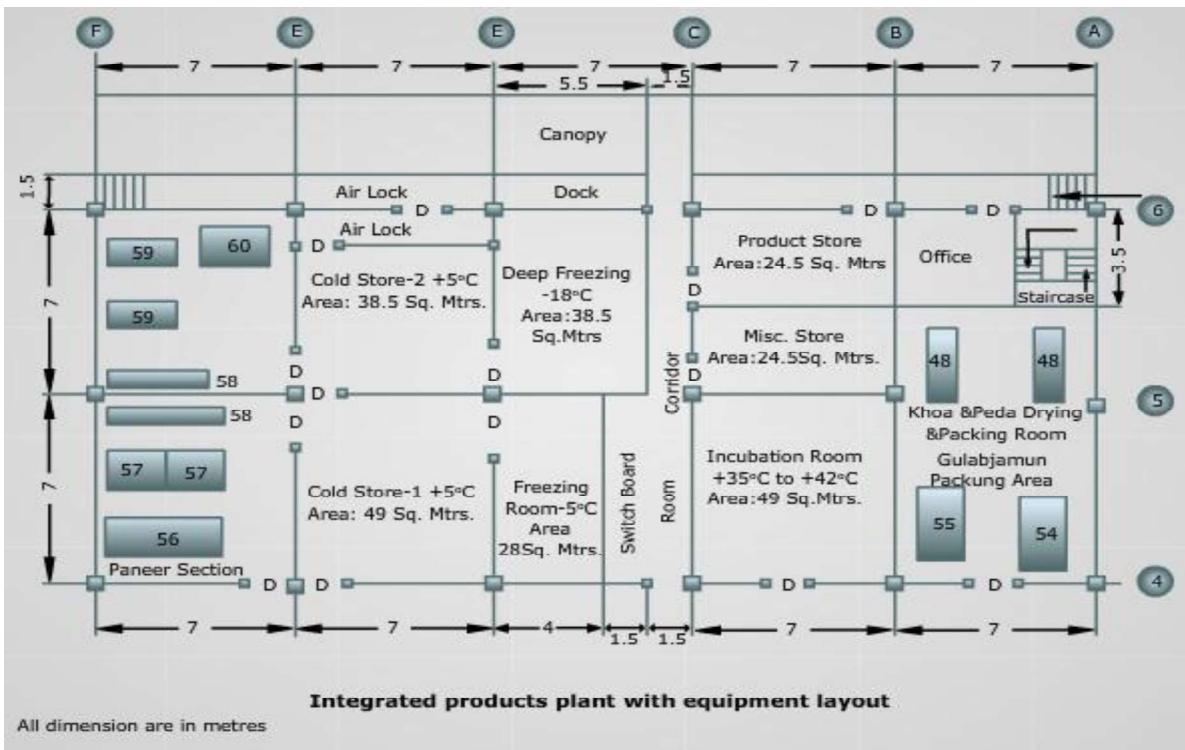


Fig. 21.1 Integrated product plant with equipment layout

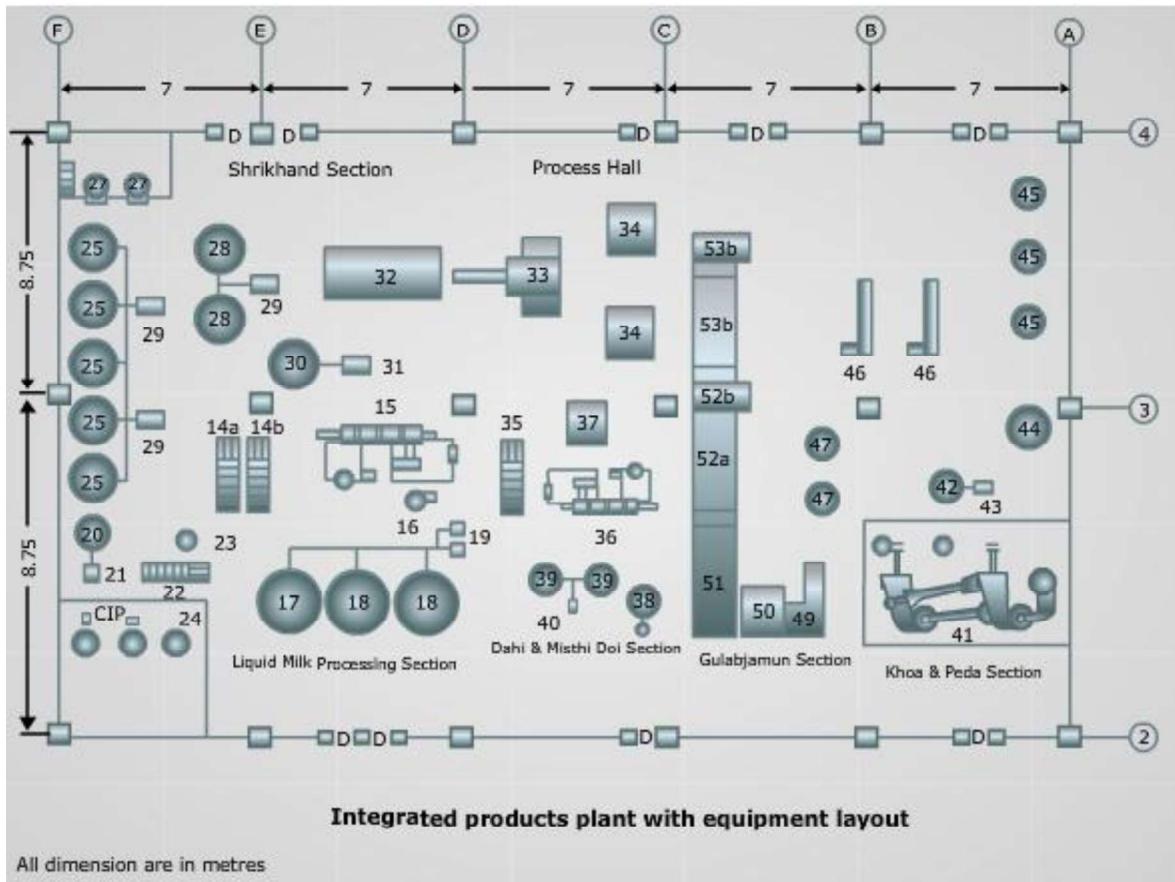
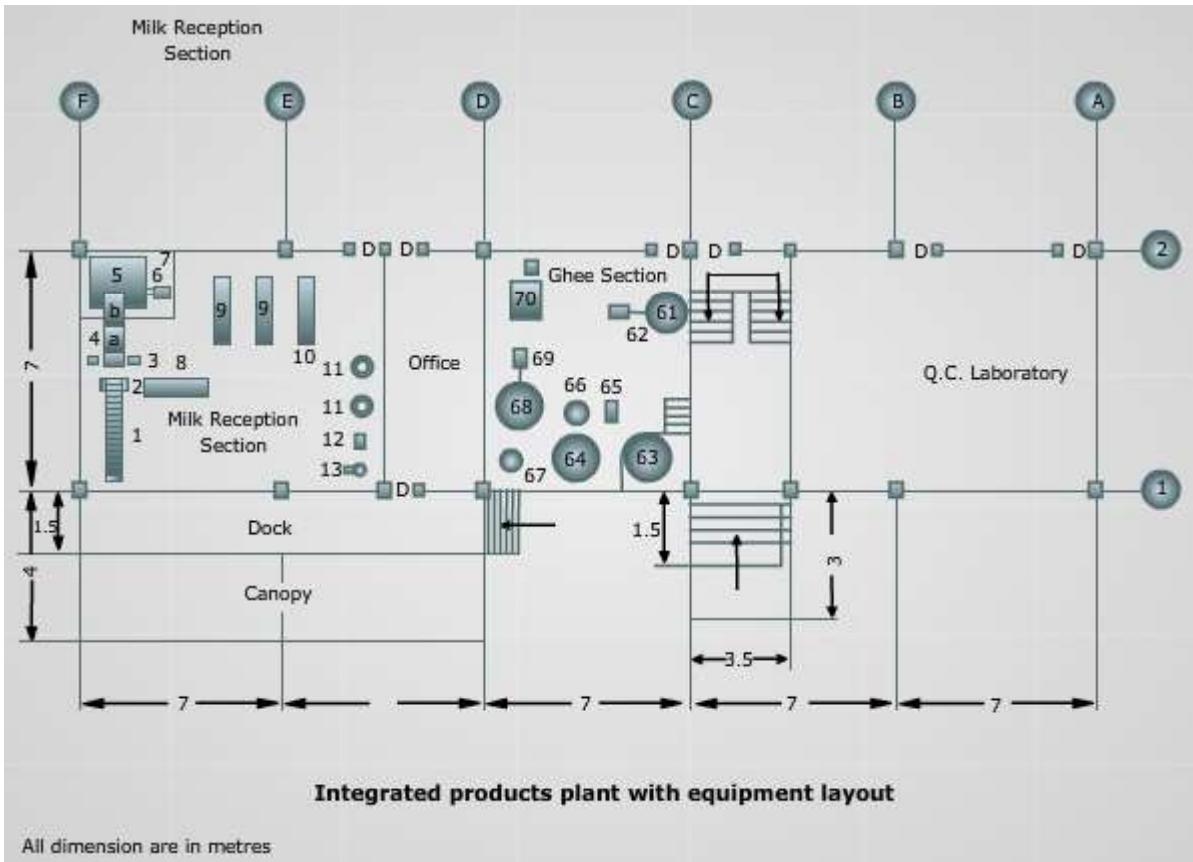
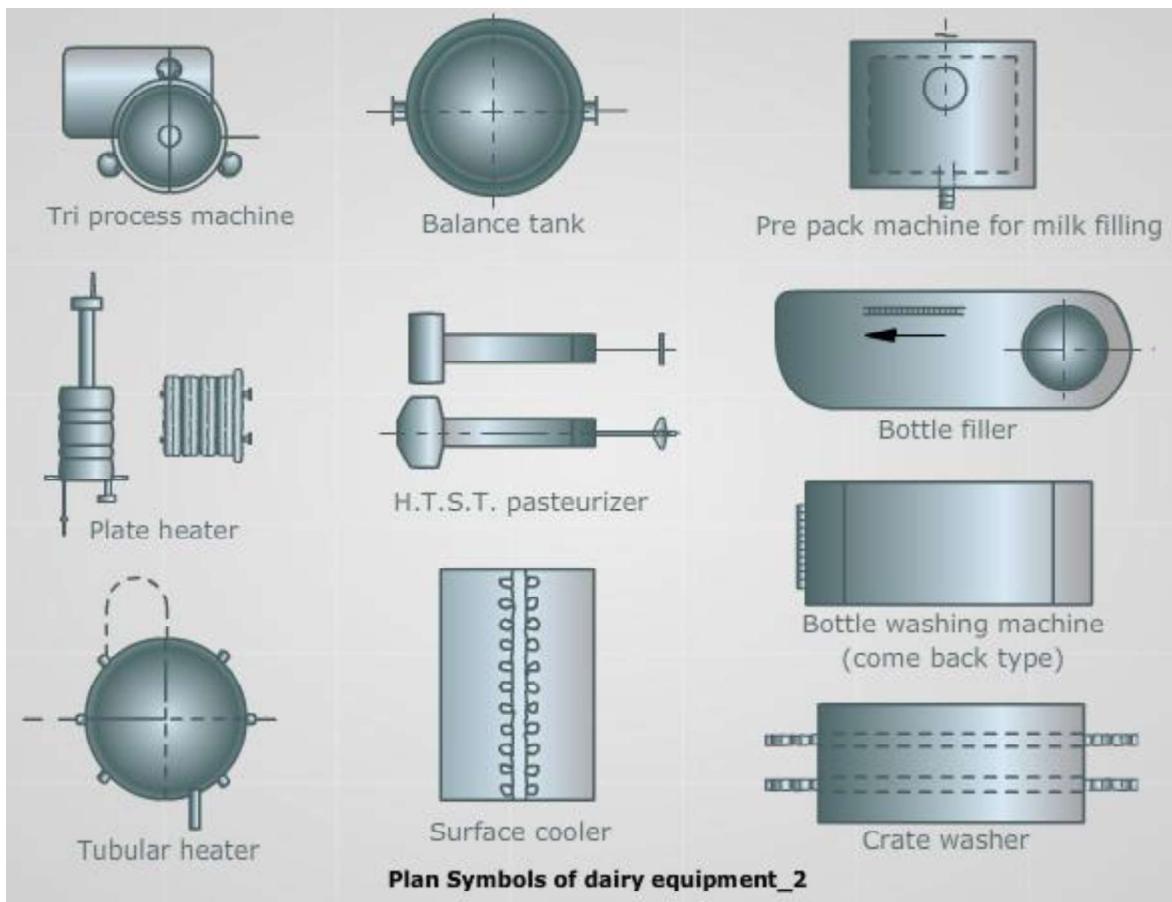
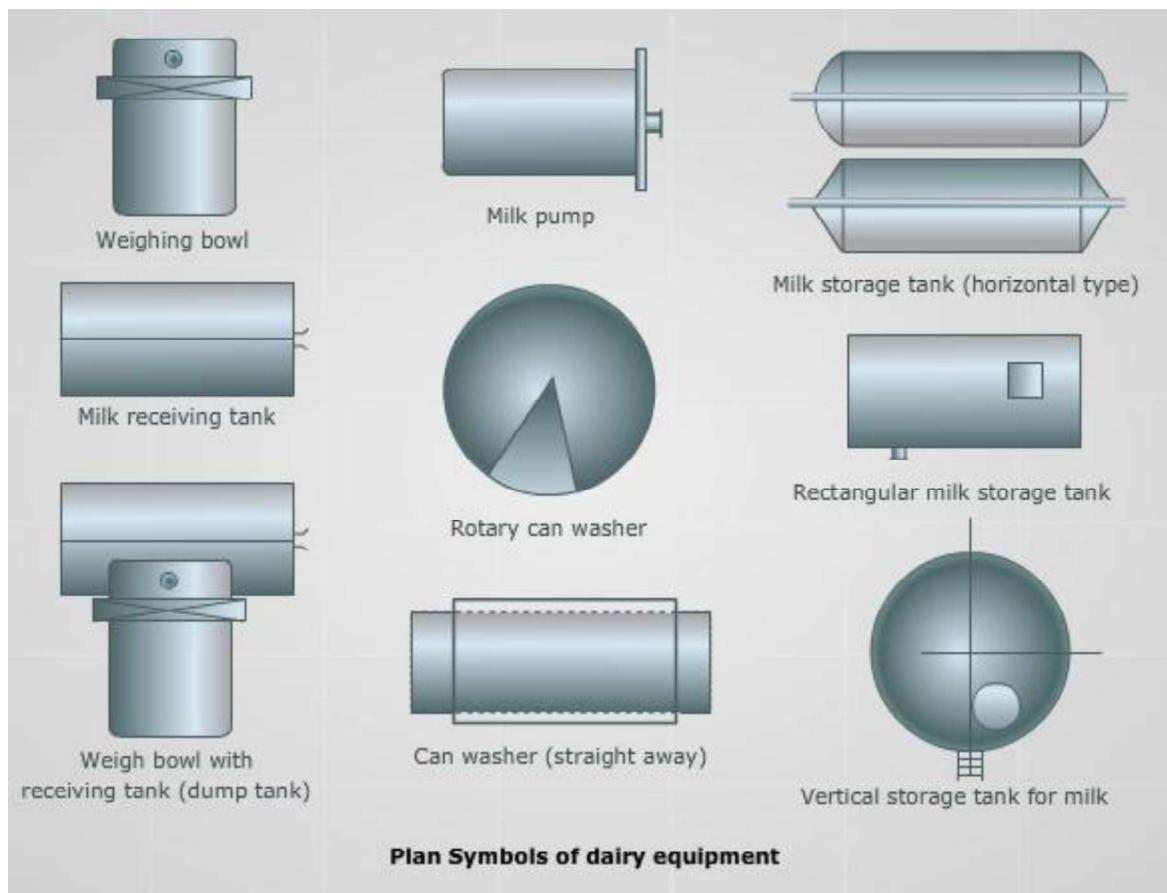


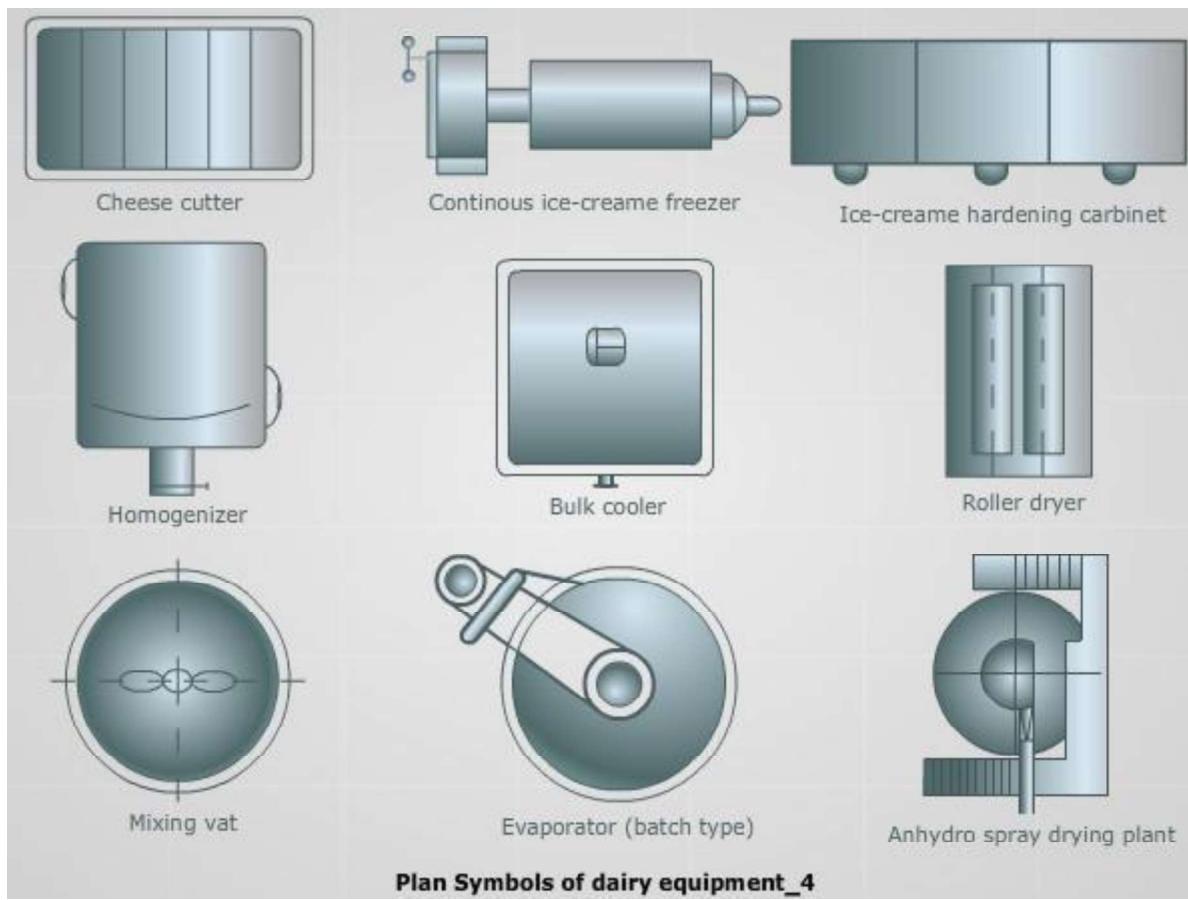
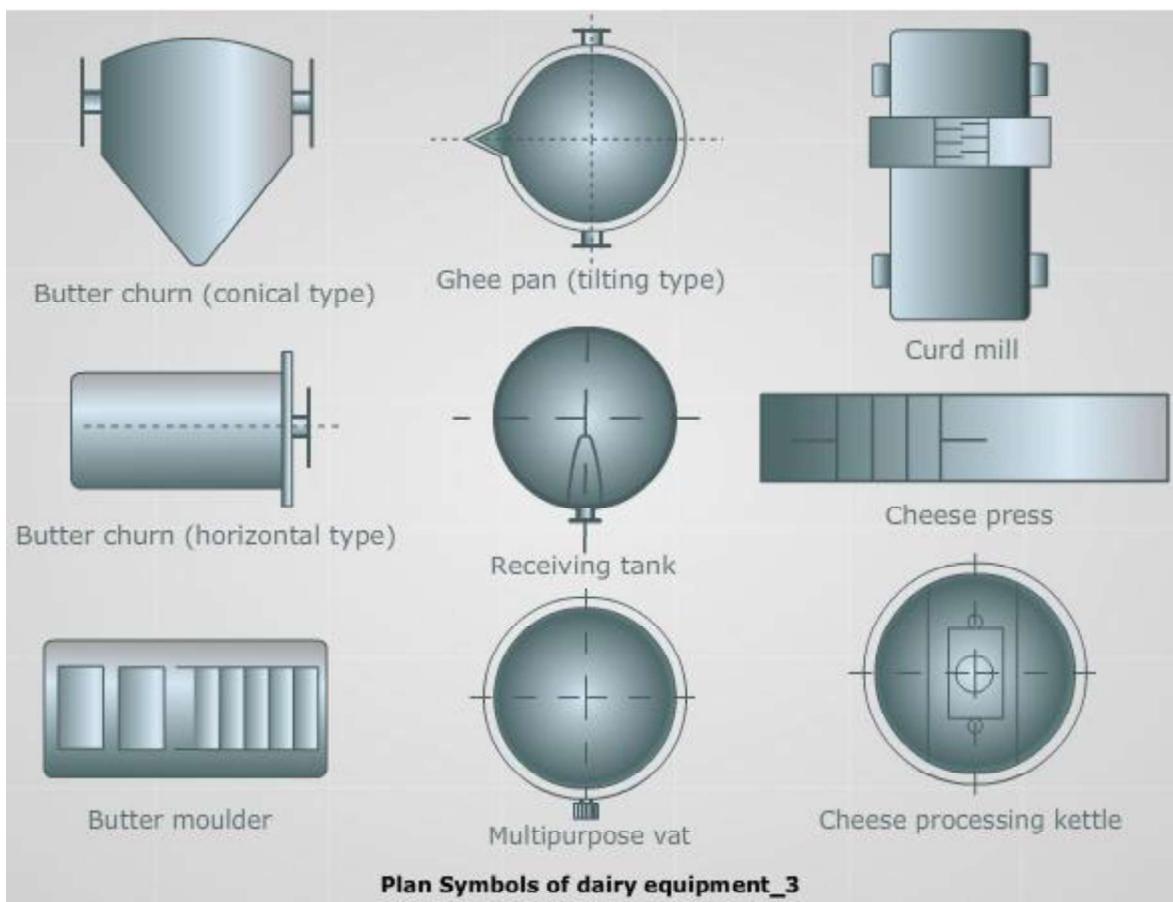
Fig. 21.2 Integrated product plant with equipment layout

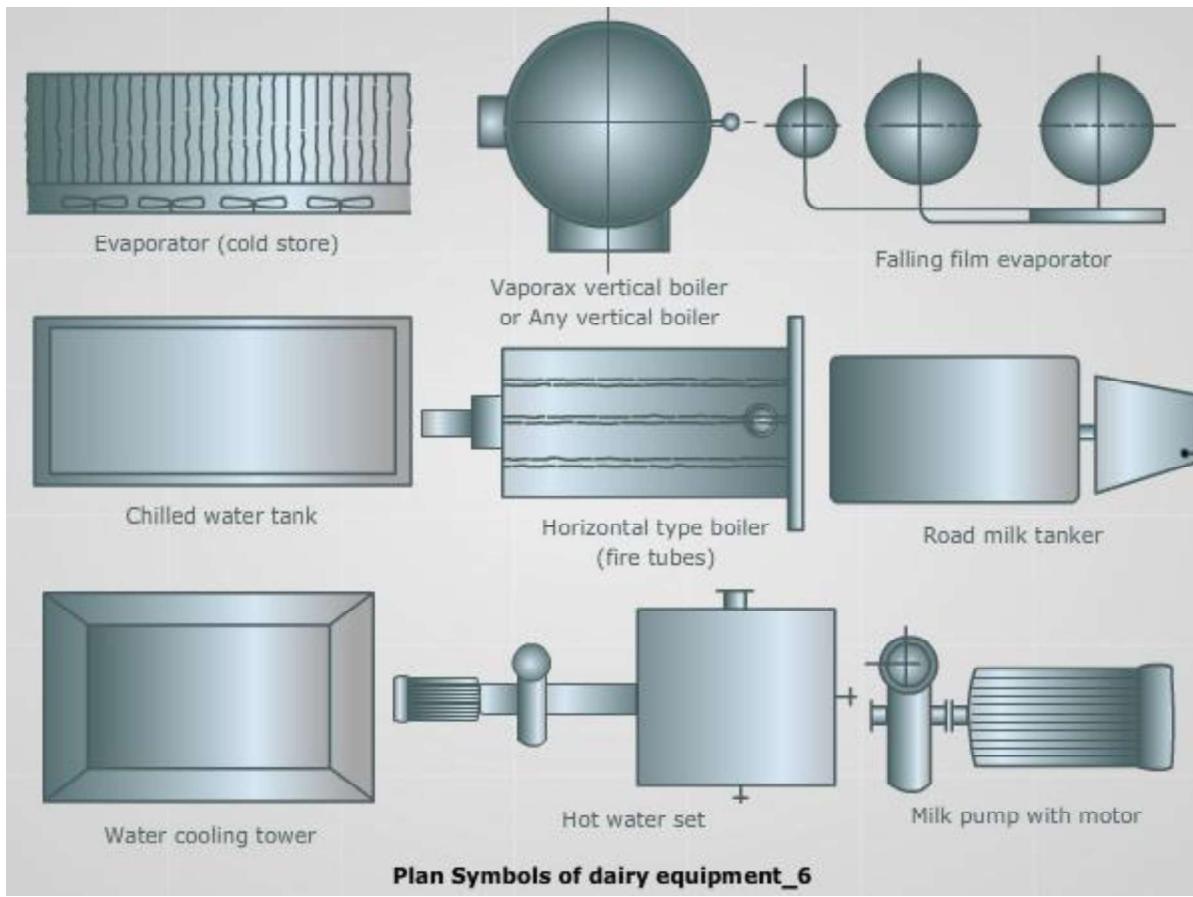
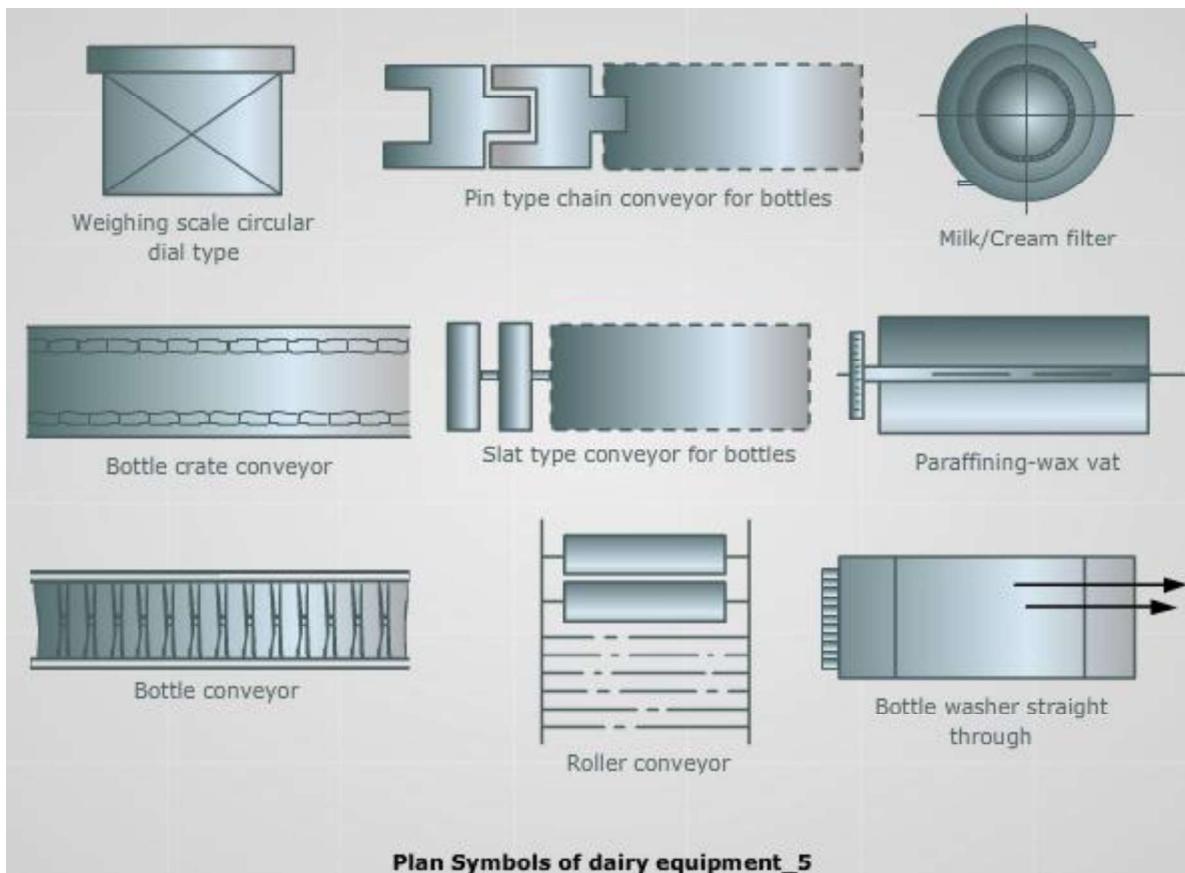


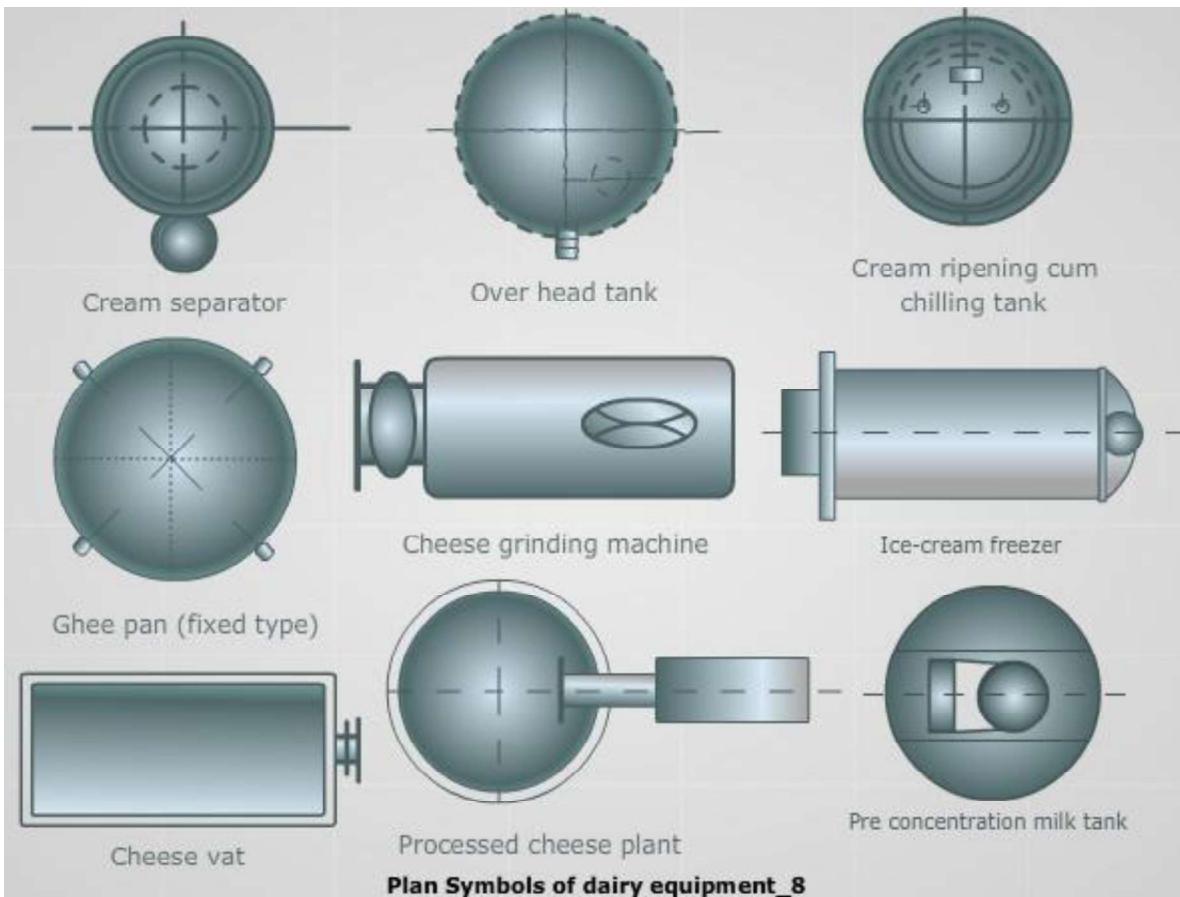
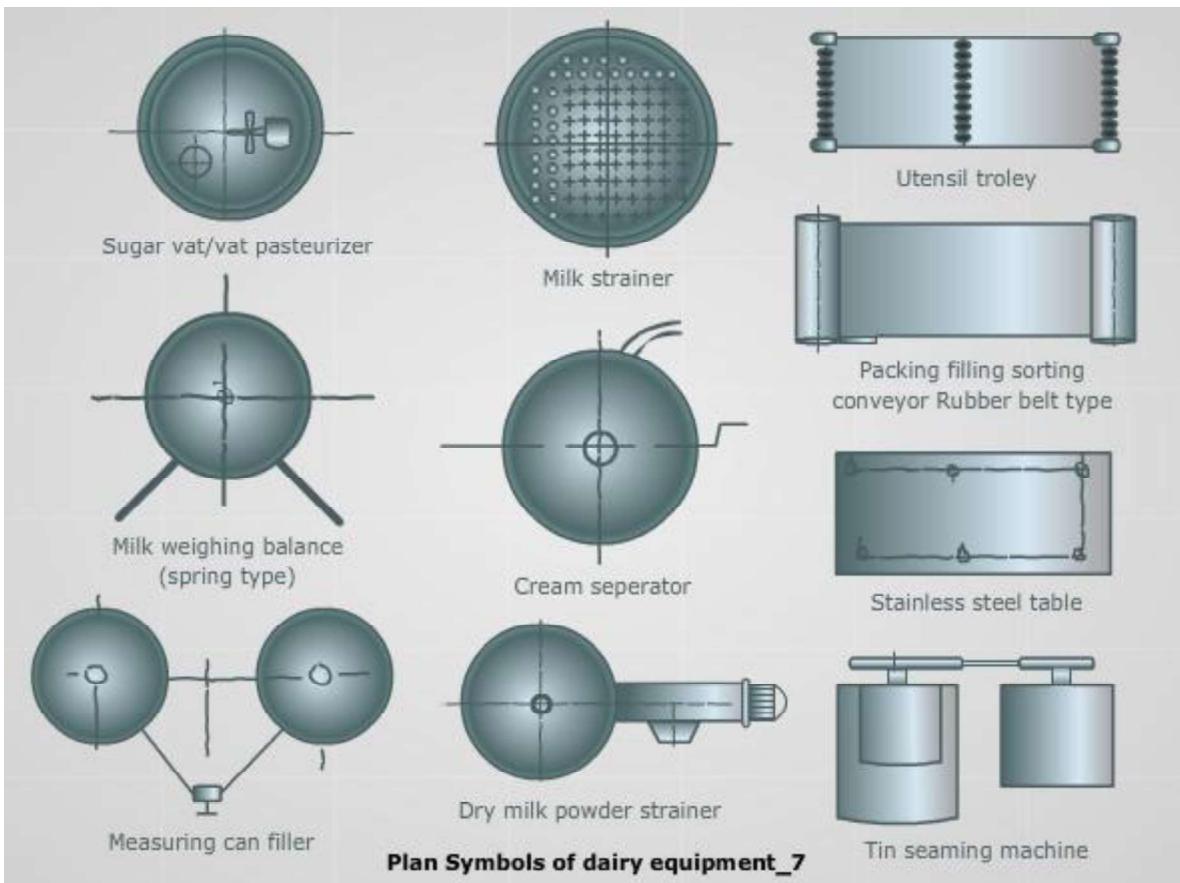
**Fig. 21.3 Integrated product plant with equipment layout**

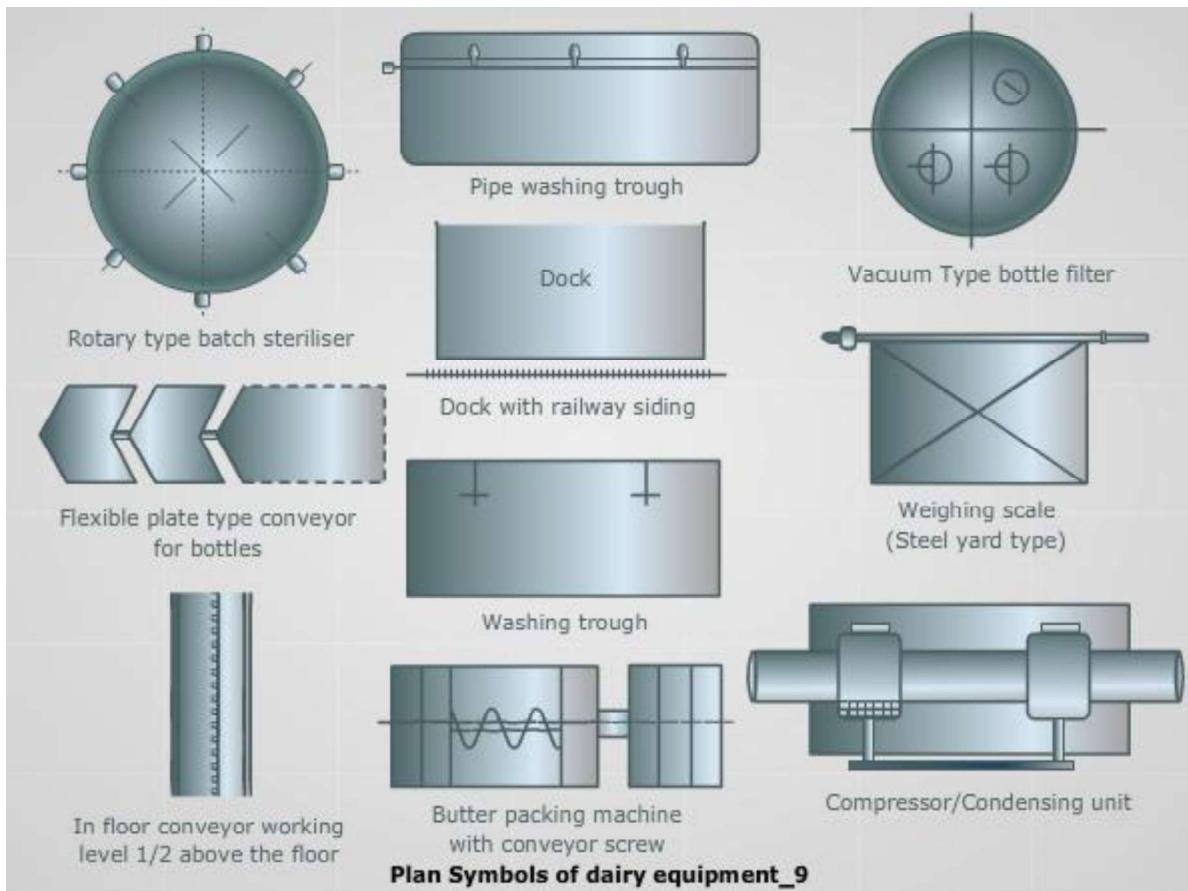
The Following figures (21.4) shows symbols for dairy equipments.











**Plan Symbols of dairy equipment\_9**

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