DAIRY PLANT MANAGEMENT & POLLUTION CONTROL

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Dairy Plant Management and Pollution Control

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Lesson :1
Production Management, Definition, Function And Structure of Production Management

1.1 INTRODUCTION:

Management is a multipurpose organ that manages business i.e managers, workers and work. It is the act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively.

1.2 FUNCTIONS OF MANAGEMENT:

In every organisation, the managers perform certain basic management functions depends on the position. These are broadly divided into six categories viz., planning, organizing, staffing, directing, coordinating and controlling.

1.2.1 Planning: Planning is deciding in advance what is to be done, when it is to be done, how it is to be done. It is basically concerned with the selection of goals to be achieved and determining the effective course of action from among the various alternatives. This involves forecasting, establishing targets, developing the policies and programming and scheduling the action, procedure, etc., Thus, planning requires decisions to be made on what should be done, how it should be done, who will do it, where it will be done, and why it is to be done. The essential part of planning consists of setting goals and programmes of activities.

1.2.2 Organizing: After the plans have been drawn, management has to organize the activities, and physical resources of the firm to carry out the selected programmes successfully. It also involves determining the authority and responsibility relationships among functions, departments and personnel at various levels to ensure smooth and effective function together in accomplishing the objective. Thus, the organising function of management is primarily concerned with identifying the tasks involved and grouping them into units and departments, and defining the duties and responsibilities of people in different positions within each department for well coordinated and cooperative effort in the organisation.

1.2.3 Staffing: Staffing is concerned with employing people for the various activities to be performed. The objective of staffing is to ensure that suitable people have been appointed for different positions. It includes the functions of recruitment, training and development, placement and remuneration, and performance appraisal of the employees.

1.2.4 Directing: The directing function of management includes guiding the subordinates, supervising their performance, communicating effectively and motivating them. A manager should be a good leader. He should be able to command and issue instruction without arousing any resentment among the subordinates. He should keep a watch on the performance of his subordinates and help them out whenever they come across any difficulty. The communication system, i.e., exchange of information should take place regularly for building common understanding and
clarity. The managers should also understand the needs of subordinates and inspire them to do their best and encourage initiative and creativity.

1.2.5 Coordinating: Management has to ensure that all the activities contribute to the achievement of the objectives of the business as a whole. This requires integration of activities and synchronization of efforts. The heads of different departments should not treat each other as competitors but should work as organs of one body. As the proper functioning of every organ of a human body is important for a healthy body, the work of every department is important for the organization as a whole. Managers should, therefore, see that everybody in the organization understands its objectives and works in co-operation with others to achieve these objectives. This function of management is called co-ordination. It consists of harmonizing group effort so as to achieve common objectives.

1.2.6 Controlling: This function of management consists of the steps taken to ensure that the performance of work is in accordance with the plans. It involves establishing performance standards and measuring the actual performance with the standards set. If differences are noticed, corrective steps are taken which may include revision of standards, regulate operations, remove deficiencies and improve performance.

Therefore, production management is also very important, as it is a process of effective planning, coordinating and controlling the production that is the operation of that part of an enterprise. It means to say that production and operations management is responsible for the actual transformation of raw materials into finished products. The performance of the management activities is with regards to selecting, designing, operating, controlling and updating production system.

1.3 DEFINITION OF PRODUCTION MANAGEMENT:

The production management is defined as

- Production management is a function of management, related to planning, coordinating and controlling the resources required for production to produce specified product by specified methods, by optimal utilization of resources.

- Production management is defined as management function which plans, organizes, coordinates, directs and controls the material supply and processing activities of an enterprise, so that specified products are produced by specified methods to meet an approved sales programme. These activities are being carried out in such a manner that labor, plant and capital available are used to the best advantage of the organization.

1.4 OBJECTIVE OF PRODUCTION MANAGEMENT:

The objective of Production Management is to
Produce the desired product or specified product by specified methods so that the optimal utilization of available resources is met with.

To produce goods that has marketability at the cheapest price by proper planning of the manpower, material and processes.

To deliver right goods of right quantity at right place and at right price.

When the above objective is achieved, we say that we have effective Production Management system.

1.5 TYPES OF PRODUCTION PROCESS:

There are four different types of production process that are distinct and require different conditions for their working. Selection of production process is also a strategic decision. Therefore the production / manufacturing process is selected at the stage of planning for any industry. It should meet the basic two objectives i.e. to meet the specification of the final product and should be cost effective.

The manufacturing process is classified into four types.

- Job production
- Batch production
- Mass or flow production
- Process Production

1.5.1 Job Production: Herein one or few units of the products are produced as per the requirement and specification of the customer. Production is to meet the delivery schedule and costs are fixed prior to the contract.

1.5.2 Batch Production: In this, limited quantities of each of the different types of products are manufactured on same set of machines. Different products are produced separately one after the other.

1.5.3 Mass or flow production: Under this, the production is conducted on a set of machines arranged according to the sequence of operations. A huge quantity of same product is manufactured at a time and is stocked for sale. Different product will require different manufacturing lines.

1.5.4 Process Production: Under this, the production is conducted for an indefinite period for constant market demand.

1.6 SCOPE OF PRODUCTION MANAGEMENT:
Dairy Plant Management and Pollution Control

We plan our activities; we coordinate available resources and control our activities to achieve certain goals. Any organization must follow the principles of management for its survival and growth. The same is applicable to production management also.

Reading and learning production management will enable one to be capable of solving the problems of the organization, may be an Educational Institution, Production Shop, Hospital, Departmental shop or even a barber shop. The problems a manager face in various organizations are more or less similar to that of Production department but smaller in magnitude. Hence the knowledge of Production Management will help any professional Manager to tackle the problems of any business easily, including dairy industry.

- **Product**: Manufacturing system often produces standardized products in large volumes. The plant and machinery have a finite capacity. The facilities constitute fixed costs, which are allocated to the products produced. Variable costs are labor cost and materials costs. While manufacturing the product use value and economic values are added to the product. Hence the product is a store of values added during manufacture. Because the input costs and output costs are measurable, the productivity can be measured with certain degree of accuracy. Product can be transported to the markets and stored physically until it is sold.

- **Service**: Service system present more uncertainty with respect to capacity and costs. Services are produced and consumed in the presence of the customer. We cannot store the service physically. Because of this the service organizations, such as Hotels, Hospitals, Transport Organizations and many other service organizations the capacity must be sufficiently or consciously managed to accommodate a highly variable demand. Sometimes services like legal practice and medical practice involve Professional or intellectual judgments, which cannot be easily standardized. Because of this the calculation of cost and productivity is difficult.

- **Project**: Project system does not produce standardized products. The Plant, Machinery, Men and Materials are often brought to project site and the project is completed. The project is of big size and remains in the site itself after completion. As the costs can be calculated and allocated to the project with considerable accuracy, productivity can be measured. Once the project is completed, all the resources are removed from site.

1.7 BENEFITS DERIVED FROM EFFICIENT PRODUCTION MANAGEMENT:

The efficient Production Management will give benefits to the various sections of the society. They are:

- **Consumer** benefits from improved industrial productivity, increased use value in the product. Products are available to him at right place, at right price, at right time, in desired quantity and of desired quality.

- **Investors**: They get increased security for their investments, adequate market returns, and creditability and good image in the society.
Employee: They get adequate wages, job security, improved working conditions and increased personal and job satisfaction.

Suppliers: They will get confidence in management and their bills can be realized without any delay.

Community: Community enjoys benefits from economic and social stability.

The Nation will achieve prospects and security because of increased productivity and healthy industrial atmosphere.

1.8 FUNCTIONS OF PRODUCTION MANAGEMENT DEPARTMENT:

The functions of Production Management depend upon the size of the firm. In small firms the production manager may have to look after production planning and control along with personnel, marketing, finance and purchase functions. In medium sized firms, there may be separate managers for Personnel, marketing and Finance functions. But the production “planning & control” and “Purchase and stores” may be under the control of production management department. In large sized firms the activities of Production Management is confined to the management of production activities only. As such, there is no hard and fast rule or guidelines to specify the function of production management, but in the academic interest we can mention some of the functions, which are looked after by the Production Management department. They are:

1.8.1 Materials: The selection of materials for the product. Production manager must have sound knowledge of materials and their properties, so that he can select appropriate materials for his product. In a dairy plant, basic raw material is milk, which is highly perishable in nature. So special knowledge and care should be needed to transform into various dairy products.

1.8.2 Methods: Finding the best method for the process, to search for the methods to suit the available resources, identifying the sequence of process are some of the activities of Production Management.

1.8.3 Machines and Equipment: Selection of suitable machinery for the process desired, designing the maintenance policy and design of layout of machines are taken care of by the production management department.

1.8.4 Estimating: To fix up the production targets and delivery dates and to keep the production costs at minimum, production management department does a thorough estimation of production times and production costs. In competitive situation this will help the management to decide what should be done in arresting the costs at desired level.

1.8.5 Loading and Scheduling: The production management department has to draw the time table for various production activities, specifying when to start and when to finish the process required. It also has to draw the timings of materials movement and plan the activities of manpower. The scheduling is to be done keeping in mind the loads on hand and capacities of facilities available.
1.8.6 **Routing:** This is the most important function of production management department. The Routing consists of fixing the flow lines for various raw materials, components etc., from the stores to the packing of finished product, so that all concerned know what exactly is happening on the shop floor.

1.8.7 **Dispatching:** The Production Management department has to prepare various documents such as Job Cards, Route sheets, Move Cards, Inspection Cards for each and every component of the product. These are prepared in a set of five copies. These documents are to be released from Production Management department to give green signal for starting the production. The activities of the shop floor will follow the instructions given in these documents. Activity of releasing the document is known as dispatching.

1.8.8 **Expediting or Follow Up:** Once the documents are dispatched, the management wants to know whether the activities are being carried out as per the plans or not. Dairy Technologist go round the production floor along with the plans, compare the actual with the plan and feed back the progress of the work to the management. This will help the management to evaluate the plans.

1.8.9 **Inspection:** Here inspection is generally concerned with the inspection activities during production, but a separate quality control department does the quality inspection, which is not under the control of Production Management. This is true because, if the quality inspection is given to production Management, then there is a chance of qualifying the defective products also.

1.8.10 **Evaluation:** The Production department must evaluate itself and its contribution in fulfilling the corporate objectives and the departmental objectives. This is necessary for setting up the standards for future. What ever may be the size of the firm, production management department alone must do routing, scheduling, loading, dispatching and expediting. This is because the department knows very well regarding materials, methods, and available resources etc. If the firms are small, all the above-mentioned functions are to be carried out by Production Management Department. In medium sized firms in addition to routing, scheduling and loading, dispatching and expediting, some more functions like methods, machines may be under the control of production management department. In large firms, there will be separate departments for methods, machines, materials and others but routing, loading and scheduling are the sole functions of Production Management.
2.1 INTRODUCTION:

Gordon and Carson observed that production planning and control involve generally in the organization and planning of manufacturing process. Especially it consists of the planning of routing, scheduling, dispatching, inspection, and coordination, control of materials, methods machines, tools and operating times. The ultimate objective is the organization of the supply and movement of materials and labour, machines utilization and related activities, in order to bring about the desired manufacturing results in terms of quality, quantity, time and place.

Production planning without production control is like a bank without a bank manager, Planning initiates action while control is an adjusting process, providing corrective measures for planned development. Production control regulates and stimulates the orderly how of materials in the manufacturing process from the beginning to the end.

2.2 BENEFITS OF PRODUCTION PLANNING AND CONTROL:

Production planning and control can facilitate for dairy industry entrepreneur in the following ways

2.2.1 Optimum utilization of capacity: With the help of Production Planning and Control [PPC] the entrepreneur can schedule his tasks and production runs and thereby ensure that his productive capacity does not remain idle and there is no undue queuing up of tasks via proper allocation of tasks to the production facilities. No order goes neglected and no machine remains idle.

2.2.2 Inventory control: Proper PPC will help the entrepreneur to resort to just- in- time systems and thereby reduce the overall inventory. It will enable him to ensure that the right supplies are available at the right time.

2.2.3 Economy in production time: PPC will help the entrepreneur to reduce the cycle time and increase the turnover via proper scheduling.

2.2.4 Ensure quality: A good PPC will provide for adherence to the quality standards so that quality of output is ensured. To sum up we may say that PPC is of immense value to the entrepreneur in capacity utilization and inventory control. More importantly it improves his response time and quality. As such effective PPC contributes to time, quality and cost parameters of entrepreneurial success.

2.3 OBJECTIVES OF PRODUCTION PLANNING CONTROL:

The ultimate objective of production planning and control, like that of all other manufacturing controls, is to contribute to the profits of the enterprise. As with inventory management and control,
this is accomplished by keeping the customers satisfied through the meeting of delivery schedules. Specific objectives of production planning and control are to establish routes and schedules for work that will ensure the optimum utilization of materials, workers, and machines and to provide the means for ensuring the operation of the plant in accordance with these plans.

2.4 STEPS OF PRODUCTION PLANNING AND CONTROL:

2.4.1 Production planning: Production planning may be defined as the technique of foreseeing every step in a long series of separate operations, each step to be taken at the right time and in the right place and each operation to be performed in maximum efficiency. It helps entrepreneur to work out the quantity of material manpower, machine and money required for producing predetermined level of output in given period of time.

2.4.2 Routing: The main aim of routing is to determine the best and cheapest Production Planning and control. Production planning, production control planning, routing, scheduling, loading, dispatching, following up, Inspection corrective sequence of operations and to ensure that this sequence is strictly followed. In small enterprises, this job is usually done by entrepreneur himself in a rather adhoc manner. Routing procedure involves following different activities.

- An analysis of the article to determine what to make and what to buy
- To determine the quality and type of material
- Determining the manufacturing operations and their sequence
- A determination of lot sizes
- Determination of scrap factors
- An analysis of cost of the article
- Organization of production control forms

2.4.3 Loading: The next step is the execution of the schedule plan as per the route chalked out which includes the assignment of the work to the operators at their machines or work places. Gantt Charts are most commonly used in small industries in order to determine the existing load and also to foresee how fast a job can be done. It is a type of bar chart that illustrates project schedule. The charts explain the start and finish dates of terminal elements and summary elements of a project.

2.4.4 Scheduling: Scheduling is the last of the planning functions. It determines when an operation is to be performed, or when work is to be completed; the difference lies in the detail of the scheduling procedure. In a centralized control situation - where all process planning, loading, and scheduling for the plant are done in a central office- the details of the schedule may specify the
starting and finishing time for an operation. On the other hand, the central schedule may simply give a completion time for the work in a given department.

2.4.5 Production control: Production control is the process of planning production in advance of operations, establishing the exact route of each individual item part or assembly, setting, starting and finishing for each important item or the finishing production and releasing the necessary orders as well as initiating the necessary follow-up to have the smooth function of the enterprise.

2.4.6 Dispatching: Dispatching involves issue of production orders for starting the operations. Necessary authority and confirmation is given for:

- Movement of materials to different workstations
- Movement of tools and fixtures necessary for each operation
- Beginning of work on each operation
- Recording of time and cost involved in each operation
- Movement of work from one operation to another in accordance with the route sheet
- Inspecting or supervision of work

Dispatching is an important step as it translates production plans into production.

2.4.7 Follow up: Every production programme involves determination of the progress of work, removing bottlenecks in the flow of work and ensuring that the productive operations are taking place in accordance with the plans. It spots delays or deviations from the production plans. It helps to reveal defects in routing and scheduling, misunderstanding of orders and instructions, under loading or overloading of work etc.

2.4.8 Inspection: This is mainly to ensure the quality of goods. It can be required as effective agency of production control.

2.4.9 Corrective measures: Corrective action may involve any of those activities of adjusting the route, rescheduling of work, changing the workloads, repairs and maintenance of machinery or equipment, control over inventories of the cause of deviation is the poor performance of the employees. Certain personnel decisions like training, transfer, demotion etc. may have to be taken.
2.4.10 Re-planning: Re-planning is not corrective action. Re-planning revises routes, loads, and schedules; a new plan is developed. In manufacturing this is often required. Changes in market conditions, manufacturing methods, or many other factors affecting the plant will often indicate that a new manufacturing plan is needed.

2.5 WORK STUDY:

It is the systematic examination of the methods of carrying out activities so as to improve the effective use of resources and to set up standards of performance for the activities carried out.

Work study is the term that covers all aspects of the designed of work methods and the establishment of work standards. It is used to embrace the techniques of method study and work measurement which is employed to ensure the best possible use of human and material resources in carrying out a specific activity.

A time and motion study (or time-motion study) is a business efficiency technique combining the Time Study work of Frederick Winslow Taylor with the Motion Study work of Frank and Lillian Gilbreth. It is a major part of scientific management (Taylorism). After its first introduction, time study developed in the direction of establishing standard times, while motion study evolved into a technique for improving work methods. The two techniques became integrated and refined into a widely accepted method applicable to the improvement and upgrading of work systems.

Work study is the term used in Great Britain while in the USA it is called Time and Motion Study. The two terms are synonymous and are both concerned with discovering the best ways of doing jobs and with establishing time and output standards based upon such methods.
Lesson 3
Efficiency Factors, Losses, Financial And Managerial Efficiency

3.1 INTRODUCTION:

Operation of a dairy plant in a highly effective manner is possible only when all factors involved are synchronized. Perfection in efficiency may be considered impossibility. But the various operations which conform to the recognized standards of efficiency should at all times be equal to or above the standards. The overall efficiency of the plant operation is directly related to productivity and hence, it is absolutely necessary to maintain this efficiency as high as possible by optimizing the use of available resources and facilities.

3.1.1 DEFINITION:

Plant operating efficiency may be defined as the ability to produce the desired products with minimum efforts, expense and waste without sacrificing the workers' welfare.

3.2 FACTORS EFFECTING PLANT OPERATING EFFICIENCY:

Some of the factors that effect the plant operation efficiency are as follows

3.2.1 Suitable location: A dairy plant should be located in such an area where collection and distribution of milk and milk products will be smooth and economical. There should be sufficient space for further expansion of the plant building.

3.2.2 Services and utilities: There should be uninterrupted supply of services and utilities.

3.2.3 Well planned dairy building: This is an important criterion for better working condition of the plant as hygienic condition, ease and safe production, lighting and ventilation largely depend on it.

3.2.4 Continuous supply of raw material: Adequate supply of raw milk into the plant and its scheduled arrival enhances plant operation efficiency.

3.2.5 Quality of raw material: This eventually reduces the number of quality tests to be performed for accepting the milk. A 10% rejection means 10% wastage of reception time.

3.2.6 Specific work schedule: Work schedules are to be prepared in such a manner that no working hour is wasted. Work force should not be idle at any time of operation due to weak work schedule.

3.2.7 Efficient labor: Skilled labors are an asset for a dairy plant as they will save time by their efficiency and prevent waste and damage to the equipments also.

3.2.8 Training facilities: This will enhance work efficiency as the labour force gets training on production and processing equipments.
3.2.9 **Proper processing units:** Several equipments that are related to processing must be appropriate and up to the standard because these are the pivots for plant operation efficiency. Some of the major equipments should be as follows:

* **Milk receiving equipment:** For improving plant efficiency vacuum samplers, automatic weight records, etc. will save a lot of labour; vertical storage tanks saves lot of floor space and thus it allows space for free movement of workers.

* **Conveyors:** Instead of manual handling of cans, mechanical conveyors should be used as it will save time and physical damage to the floor.

* **Control panel:** The control panel should be within arm’s reach of the operator so that during crisis, the machine can be switched off very fast. It prevents worker's injury due to panic and rush.

* **Supply of clean water:** Water quality makes the operation efficiency greater. supply of water should be at sufficient pressure and flow rate in each section of plant Because, many a time hard water causes lot of scaling in the equipments. Reducing the heat transfer or reducing flow rates.

* **Cleaning method:** Instead of manual cleaning, CIP systems to be adopted as it saves lot of time and labour Thus, it increases plant efficiency.

* **Proper layout:** The entire processing line and equipments should be set up in a logical sequence. This will save processing cost and time, principles of Dairy plant layout to be followed

3.2.10 **Maximum use of floor space:** All the equipments should be as per capacity of the plant. Instead of keeping smaller capacity equipments in large number, bigger capacity should be preferred: For example, HTST pasteurizer, multipurpose vat, storage tanks should be of bigger size.

3.2.11 **Utilities:** All the four basic utilities, i.e., water, electricity, refrigeration and steam should be easily available in the processing plant.

* **Water:** Adequate and uninterrupted water supply is a must for the plant operation efficiency. There should not be any leaky valve or hoses left running. Wastage of water must be prevented.

* **Electricity:** Proper selection of motors, proper wiring, proper lighting and correct capacity fuses are very important in the efficient use of electricity. Any wastage of power must be prevented. Power factor must be carefully monitored as well as peak load demand, power factor 0.95.
* Refrigeration: Care should be taken for any refrigeration loss in the plant. The plant must be properly operated and maintained. Doors of the cold store room should be locked automatically to prevent refrigeration loss. Condensers must be cleaned periodically, compressors must be operated as for as possible at off peak load and night times.

* Steam: Boiler should be properly maintained. It should be properly installed and free from transmission loss. Use of only soft water is important. Regular descaling operation by qualified personnel is essential. Thermal efficiency of Boiler should be to the rated value

3.2.12 Stock of supplies and spare parts: Adequate quantity of consumable supplies to be kept in a neat and well maintained store. Cleaners and sanitizers use to be made judiciously so that it may not mix with edible items. All the glassware should be available in the stock, as any time it may be required due to damages.

3.2.13 Preventive maintenance: For all machine and equipments proper maintenance schedule to be followed to avoid breakdown loss. Trained personnel are needed for scheduled preventive maintenance.

3.2.14 Waste prevention: Carelessness and poor equipment are the chief sources of product waste. Increased waste means increase cost on waste disposal.

3.2.15 Well managed organization: Overall efficiency of a plant depends on good management practices (GMP) in a good organization; it is possible for everyone to know one's responsibility and authority. A well managed organization is the true solution to plant efficiency.

3.2.16 Total Quality Management(TQM):

It is also very important for food industry as well as dairy industry. Total Quality Management is a management approach to long term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services and the culture in which they work. Important concept in implementing TQM is Deming’s 14 points, a set of management practices to help companies increase their quality and productivity.

1. Create constancy of purpose for improving products and services
2. Adopt the new philosophy
3. Cease dependence on inspection to achieve quality
4. End the practice of awarding business on price alone; instead, minimize total cost by working with a single supplier
5. Improve constantly and forever every process for planning, production and service
6. Institute training on the job.

7. Adopt and institute leadership

8. Drive out fear

9. Breakdown barriers between staff areas

10. Eliminate slogans, exhortations and targets for the work force

11. Eliminate numerical quotas for the work force and numerical goals for management

12. Remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system

13. Institute a vigorous program of education and self improvement for every one

14. Put everybody in the company to work accomplishing the transformation.

3.3 ASSESSMENT OF EFFICIENCY:

It can be enumerated by the following ways:

3.3.1 Check-up: First of all it should be checked that the machines and equipments are at par with their published specifications, else adjustment to be made immediately before final installation. Sufficient instrumentation should be there to observe the same

3.3.2 Clocking the performance: Periodically, the performance of individual items or equipments to be monitored. In case wear and tear is above the normal limit, it must be adjusted immediately. This is possible by maintaining log books about the equipment accurately.

3.3.3 Synchronization: It is coordination between different machines, equipments to prevent any unscheduled breakdown by periodically determining that the entire plant is operating as a coordinated unit and to make corrective adjustments in machines or processing schedules.

3.4 FINANCIAL AND MANAGERIAL EFFICIENCY:

As manager he should be aware of financial matters of the organization and utilize properly the fund for various activities to get the necessary financial resources, their profitable assignment and usage.

The financial management efficiency contain the following:

> To evaluate the effort, from the financial point of view, of all the actions that are about to be made in a given administration period;
To provide, at the right moment, in the structure and the quality conditions claimed by necessities, the capital, at the lowest possible cost;

> To follow how the capital is used;

> To influence the decision factors in each performance centre in order to insure an efficient usage of all funds attracted in the various departments of the organisation;

> To insure and maintain the financial balance according to the company’s needs;

> To try to obtain the anticipated financial result and to distribute it on destinations.
Lesson :4
Industrial Legislation In India, Particularly In Dairy Industry

4.1 INTRODUCTION: To meet a country’s sanitary and phyto sanitary requirements, food must comply with the laws and regulations to gain market access. These laws ensure the safety and suitability of food for consumers, in some countries; also govern food quality and composition standards.

The requirement of food regulation may be based on several factors such as whether a country adopts international norms developed by the Codex Alimentarius Commission of the Food and Agriculture Organization of the United Nations and the World Health Organization; Good agricultural and manufacturing practices; or a country may also have its own suite of food regulations.

4.2 FOOD SAFETY AND STANDARDS ACT: It has been established under Food Safety and Standards Act, 2006 which consolidates various acts and orders that have handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.

The Indian Parliament has passed the Food Safety and Standards Act, 2006 that overrides all other food related laws. It was followed by Food safety and Standards Rules 2011 & Food safety and Standards Regulation 2011. It will specifically repeal eight laws:

* The Vegetable Oil Products (Control) Order, 1947.
* Essential Commodities Act, 1955 relating to food.
* The Solvent Extracted Oil, De oiled Meal, and Edible Flour (Control) Order, 1967.

4.3 FUNCTIONS OF FOOD SAFETY AND STANDARDS ACT:

All food imports will therefore be subject to the provisions of the Act and any rules and regulations made under the Act. FSSAI has been mandated by FSS Act, 2006 for performing the following functions:
* Framing of regulations to lay down the standards and guidelines in relation to articles of food and specifying appropriate system of enforcing various standards thus notified.

* Laying down mechanisms and guidelines for accreditation of certification bodies engaged in certification of food safety management system for food business.

* Laying down procedure and guidelines for accreditation of laboratories and notification of the accredited laboratories.

* To provide scientific advice and technical support to central Government and State Governments in the matters of framing the policy and rules in areas which a direct or indirect bearing of food safety and nutrition.

* Collect and collate data regarding food consumption, incidence and prevalence of biological risk, contaminants in food and residues of various contaminants in food products, identification of emerging risks and introduction of rapid alert system.

* Creating an information network across the country so that the public, consumers, panchayats etc receive rapid, reliable and objective information about food safety and issues of concern.

* Provide training programmes for persons who are involved or intend to get involved in food business.

* Contribute to the development of international technical standards for food, sanitary and Phyto sanitary standards

* Promote general awareness about food safety and food standards

4. 4. OTHER IMPORTANT ACTS:

4.4.1 Prevention of food adulteration act: A basic statute (Prevention of Food Adulteration Act (PFA) of 1954 and the PFA Rules of 1955, as amended) protects India against impure, unsafe, and fraudulently labeled foods. The PFA standards and regulations apply equally to domestic and imported products and cover various aspects of food processing and distribution. These include food color, preservatives, pesticide residues, packaging and labeling, and regulation of sales. All imported products must adhere to the rules specified in the Act and its regulations, including those covering labeling and marketing requirements.

4.4.2 Weights and measures: Standards for weights and measures are administered by the Ministry of Consumer Affairs, Food and Public Distribution under the Standards of Weights and Measures Act, 1976 and related rules and notifications. All weights or measures must be recorded in metric units and certain commodities can only be packed in specified quantities (weight, measure or
number). These include baby and weaning food, biscuits, bread, butter, coffee, tea, vegetable oils, milk powder, and wheat and rice flour.

4.4.3 **Essential commodities act, 1955**: The main objective of the Act is to regulate the manufacture, commerce, and distribution of essential commodities, including food. A number of Control Orders have been promulgated under the provisions of this Act.

4.4.4 **Standards of weights and measures act, 1976 and the standards of weights and measures (packaged commodities) rules, 1977**: The Act governs sale of packaged commodities and provides for mandatory registration of all packaged products in the country.

4.4.5 **Consumer protection act, 1986**: The Act provides for constitution of District Forum/State/National Commission for settlement of disputes between the seller/service provider and the consumer.

4.4.6 **The infant milk substitutes, feeding bottles and infant foods (regulation of production, supply and distribution) act, 1992 and rules 1993**: This Act aims at promoting breast feeding and ensuring proper use of infant milk substitutes and infant food.

4.4.7 **The insecticide act, 1968**: The Act envisages safe use of insecticides so as to ensure that the leftover chemical residues do not pose any health hazard.

4.4.8 **Export (quality control and inspection) act, 1963**: The Act aims at facilitating export trade through quality control and inspection before the products are sold to international buyers.

4.4.9 **Environment protection act, 1986**: This Act incorporates rules for the manufacture, use, import and storage of hazardous microorganisms / substances / cells used as foodstuff.

4.4.10 **Pollution control (ministry of environment and forests)**: A no-objection certificate from the respective State Pollution Control Board is essential for all dairy plants.

(i) Industrial Licenses: No license is required for setting up a dairy plant in India. Only a memorandum has to be submitted to the Secretariat for Industrial Approvals (SIA) and an acknowledgement obtained. However, a certificate of registration is required under the Milk and Milk Products Order (MMPO), 1992.

4.4.11 **Indian Boiler act**: Indian boiler regulations are the standards in respect of materials, design and construction, inspection and testing of boilers and boiler components for compliance by the manufacturers and users of boilers in the country. These regulations are being updated regularly by amending them in line with fast changes in boiler technology by the Central Boilers Board. The current version of these regulations is known as the Indian Boiler Regulations, 1950 with amendments up to 22<sup>nd</sup> February, 2005.

4.5 **VOLUNTARY STANDARDS**:
There are two organizations that deal with voluntary standardization and certification systems in the food sector. The Bureau of Indian Standards looks after standardization of processed foods and standardization of raw agricultural produce is under the perview of the Directorate of Marketing and Inspection.

4.5.1 Bureau of Indian standards (BIS): The activities of BIS are two fold the formulation of Indian standards in the processed foods sector and the implementation of standards through promotion and through voluntary and third party certification systems. Manufacturers complying with standards laid down by the BIS can obtain and "ISI" mark that can be exhibited on product packages. BIS has identified certain items like food colors/additives, vanaspati, and containers for packing, milk powder and condensed milk, for compulsory certification.

4.5.2 Directorate of marketing and inspection (DMI): The DMI enforces the Agricultural Products (Grading and Marketing) Act, 1937. Under this Act, Grade Standards are prescribed for agricultural and allied commodities. These are known as "Agmark" Standards. Grading under the provisions of this Act is voluntary. Manufacturers who comply with standard laid down by DMI are allowed to use "Agmark" labels on their products.

4.5.3 Management systems for quality and food safety: ISO-9000 Quality Management Systems. The ISO-9000 system is looked at as a system with minimum quality requirements. It builds a baseline system for managing quality. The focus, therefore, is on designing a total quality management system, one that complies with external standards, but includes the specific requirement of industry and integrates elements of competitiveness.

4.5.4 Export (quality control and inspection) act, 1963: The Export Inspection Council is responsible for the operation of this Act. Under the Act, a large number of exportable commodities have been notified for compulsory pre-shipment inspection.

4.6 OTHER GOVERNMENT REGULATIONS:

4.6.1 Industrial license: No license is required for setting up a Dairy Project in India. Only a memorandum has to be submitted to the Secretariat for Industrial Approvals (SIA) and an acknowledgment is to be obtained. However Certificate of Registration was required under the Milk and Milk Products Control Order (MMPO) 1992 earlier, but now from FSSAI.

4.6.2 Foreign investment: Foreign Investment in dairying requires prior approval from the Secretariat of Industrial Approvals, Ministry of Industry, as dairying has not been included in the list of High Priority Industries. Automatic approval will be given upto 51% Foreign Investment in High Priority Industries. In case of other Industries, proposals will be cleared on case to case basis. Government may allow 51% without enforcing the old limit of 40% applicable under Foreign Exchange Regulations Act at its discretion.

4.6.4 Foreign technology agreements: Foreign Technology Agreements are freely allowed in high priority industries under the following terms: Lump sum payment of Rs 10 million royalty payment of 5% on domestic sales and 8% as exports subject to total payment of 8% on sales turnover, over a 10 year period from the date of agreement or 7 years from commencement of production. Foreign Technology Agreements in dairying also need prior approval. Foreign Exchange required for payment of royalty will have to be purchased at market rates. Foreign Technicians can be freely hired.

4.6.5 Import of capital goods: Import of capital goods is automatically allowed if it is financed through Foreign Equity. Alternatively, approval is needed from the Secretariat of Industrial Approvals.

4.6.6 Import of second hand capital goods: Import of Second hand goods is allowed subject to the following conditions: Minimum residual life of 5 years. The equipment should not be more than 7 years old. A certificate from the Chartered Engineers of the country of origin certifying the age and the residual life is to be produced.

4.6.7 Dividend balancing: Remittances of dividend should be covered by earnings from exports recorded in the years prior to the payment of dividend or in the years of the payment of the dividend.
5.1 INTRODUCTION:

Manpower planning or human resource planning means deciding the number and type of the human resources required for each job, unit and the total company for a particular future date in order to carry-out organizational activities.

5.1.1 Definition of manpower planning:

* E.W. Vetter defined manpower planning as "a process by which an organization should move from its current manpower position to its desired manpower position. Though planning management strives to have the right number and right kind of people at the right place at the right time, doing things which result in both the organization and the individual receiving maximum long-run benefit."

* According to Leon C. Megginson, manpower or human resources planning is "an integrated approach to performing the planning aspects of the personnel function in order to have a sufficient supply of adequately developed and motivated people to perform the duties and tasks required to meet organizational objectives and satisfy the individual needs and goals of organizational members."

5.1.2 Objectives of manpower planning: The important objectives of manpower planning in an organization are

* To recruit and retain the human resources of required quantity and quality;

* To foresee the employee turnover and make the arrangements for minimizing turnover and filling up of consequent vacancies;

* To meet the needs of the programmes of expansion, diversification etc.;

* To foresee the impact of technology on work, existing employees and future human resource requirements;

* To improve the standards, skill, knowledge, ability, discipline etc.;

* To assess the surplus or shortage of human resources and take measures accordingly;
* To maintain congenial industrial relations by maintaining optimum level and structure of human resources;

* To minimize imbalances caused due to non-availability of human resources of the right kind, right number in right time and right place;

* To make the best use of its human resources and

* To estimate the cost of human resources.

5.1.3 Benefits of man power planning:

Man power planning anticipates not only the required kind and number of employees but also determines the action plan for all the functions of personnel management. The major benefits are:

* It checks the corporate plan of the organization.

* It offsets uncertainty and changes to the maximum extent possible and enables the organization to have right men at the right time and in the right place.

* It provides scope for advancement and development of employees through training, development etc.

* It helps to anticipate the cost of salary, benefits and all the cost of human resources, facilitating the formulation of budgets in an organization.

* To foresee the need for redundancy and plan to check it or to provide alternative employment in consultation with trade unions, other organizations and the government through remodeling organizational, industrial and economic plans.

* To plan for physical facilities, working conditions and the volume of fringe benefits like canteen, schools, hospitals, conveyance, child care centers, quarters, company stores etc.

* It gives an idea of the type of tests to be used and interview techniques in selection based on the level of skills, qualifications, intelligence, values etc. of future human resources.

* It causes the development of various sources of human resources to meet the organizational needs.

* It helps to take steps to improve human resources contributions in the form of increased productivity, sales, turnover etc.
It facilitates the control of all the functions, operations, contribution and cost of human resources.

5.1.4 **Factors affecting man power planning:** The factors affecting man power planning can be classified into external factors and internal factors.

### 5.1.4.1 External factors:

* **Government policies:** Policies of the government like labor policy, industrial relations policy, and policy towards reserving certain jobs for different communities affect the man power planning.

* **Level of economic development:** Level of economic development determines the level of man power planning in the country and thereby the supply of human resources in the future in the country.

* **Business environment:** External business environmental factors influence the volume and mix of production and thereby the future demand for human resources.

* **Information technology:** Information technology brought amazing shifts in the business which includes: business process reengineering, enterprise resources planning and supply chain management. These changes brought unprecedented reductions in traditional human resources and increase in software specialists. Added to this, the computer-aided design (CAD) and computer-aided technology (CAT) also reduced dependence on the existing human resource.

* **Level of technology:** Level of technology determines the kind human resources required.

### 5.1.4.2 Internal factors:

* **Company strategies:** Company's policies and strategies relating to expansion, diversification, alliances etc. determine the human resources demand in terms of quality and quantity.

* **Human resources policies:** Human resources policies of the company regarding quality of human resources, compensation level, quality of work life etc. influence human resources plan.

* **Job analysis:** Fundamentally, human resources plan is based on job analysis. Job description and job specification. Thus, the job analysis determines the kind of employees required.

* **Time horizons:** Companies with a stable competitive environment can plan for the long run whereas firms with an unstable competitive environment can plan for only short term range.
Type and quality of information: Any planning process needs qualitative and accurate information. This is more so with human resources plan.

Company's production/operations policy: Company's policy regarding how much to produce and how much to buy from outside to prepare a final product influences the number and kind of people required.

ade unions: Influence of the unions regarding the number of working hours per week, recruitment sources etc.

5.2 RECRUITMENT:

Recruitment is defined as "a process to discover the sources of manpower to meet the requirements of the staffing schedule and to employ effective measures for attracting that manpower in adequate numbers to facilitate effective selection of an efficient workforce."

Edwin B. Flippo defined recruitment as "the process of searching for prospective employees and stimulating them to apply for jobs in the organization."

Selection is a process of picking individuals (out of the pool of job applicants) with requisite qualifications & competence to fill jobs in Organisation.

5.2.1 Difference between recruitment and selection: Both recruitment and selection are the two phases of the employment process. The difference between the recruitment and selection is:

Recruitment is the process of searching the candidates for employment and stimulating them to apply for jobs in the organisation whereas selection involves the series of steps by which the candidates are screened for choosing the most suitable persons for vacant posts.

The basic purpose of recruitments is to create a talent pool of candidates to enable the selection of best candidates for the organisation, by attracting more and more employees to apply in the organisation whereas the basic purpose of selection process is to choose the right candidate to fill the various positions in the organisation.

Recruitment is a positive process i.e. encouraging more and more employees to apply whereas selection is a negative process as it involves rejection of the unsuitable candidates.

Recruitment is concerned with tapping the sources of human resources whereas selection is concerned with selecting the most suitable candidate through various interview and tests.

5.2.2 Objectives of recruitment

The objectives of recruitment are:
* To attract people with multi-dimensional skills and experiences that suit the present and future organizational strategies,

* To induct outsiders with a new perspective

* To infuse fresh blood at all levels of the organization,

* To develop an organizational culture that attracts competent people to the company

* To search or head hunt/head pouch people whose skills fit the company's values,

* To devise methodologies for assessing psychological traits,

* To seek out non-conventional development grounds of talent,

* To search for talent globally and not just within the company,

* To design entry pay that computes on quality but not on quantum, anticipate and find people for positions that do not exist yet.

5.2.3 Recruitment strategies: The recruitment strategies formulated by the companies include:

* **In sourcing or outsourcing:** Companies recruit the candidates, employ them, train and develop them and utilize the human resources of these candidates. This strategy is called 'in-sourcing'. Companies formulate and implement this strategy when the company strategy is for the stable growth. Some manufacturing and service companies, depend for their human resource requirements on such external organizations whose core business is to provide human resources. This strategy is called 'outsourcing'.

* **Vast and fast source:** The best strategy to get vast human resources immediately is internet.

5.2.4 Recruitment policy

The following factors should be taken into consideration in formulating the recruitment policy. They are

* Government policies;

* Personnel policies of other competing organizations;

* Organization’s personnel policies;
* Recruitment sources;

* Recruitment needs;

* Recruitment cost;

* Selection criteria and preference etc.

5.2.5 Modern sources of recruitment: A number of modern recruitment sources are being used by the corporate sector in addition to traditional sources. These sources are divided into internal and external.

5.2.5.1 Internal sources: The internal sources of recruitment are transfers, promotions, upgrading, demotion, retired employees, retrenched employees, dependents and relatives of deceased employees.

5.2.5.2 External sources: The external sources are press advertisements, educational institutes, placement agencies/outsourcing, employment exchanges, labor contractors, unsolicited applicants, employee referrals, recruitment at factory gate.

Presently e-recruitment is also encouraging.

5.3 TRAINING:

After an employee is selected, placed and introduced in an organization he/she must be provided with training facilities in order to adjust him to the job. Training is the act of increasing the knowledge and skill of an employee for doing a particular job. Training is a short-term educational process and utilizing a systematic and organized procedure by which employees learn technical knowledge and skills for a definite purpose.

Dale S. Beach defines the training as "The organized procedure by which people learn knowledge and/or skill for a definite purpose."

5.3.1 Training objectives: The personnel manager formulates the following training objectives in keeping with the company's goals and objectives:

* To prepare the employee, both new and old to meet the present as well as the changing requirements of the job and the organization.

* To prevent obsolescence.

* To impart the new entrants the basic knowledge and skills they need for an intelligent performance of a definite job.

* To prepare employees for higher level tasks.
To assist employees to function more effectively in their present positions by exposing them to the latest concepts, information and techniques and developing the skills they will need in their particular fields.

* To build up a second line of competent officers and prepare them to occupy more responsible, positions.

* To broaden the minds of senior managers by providing them with opportunities for an interchange of experiences within and outside with a view to correcting the narrowness of outlook that may arise from over-specialization.

* To develop the potentialities of people for the next level job.

* To ensure smooth and efficient working of a department

* To ensure economical output of required quality

* To promote individual and collective morale, a sense of responsibility, co-operative attitudes and good relationships.

### 5.3.2 Benefits of training

* Leads to improved profitability and/or more positive attitudes toward profits orientation

* Improves the job knowledge and skills at all levels of the organization

* Improves the morale of the workforce

* Helps people identify with organizational goals

* Helps create a better corporate image

* Fosters authenticity, openness and trust

* Improves the relationship between boss and subordinate

* Aids in organizational development

* Organization learns from the trainee
* Helps prepare guidelines for work

* Aids in understanding and carrying out organizational policies

* Provides information for future needs in all areas of the organization

* Organization gets more effective in decision-making and problem solving

* Aids in development for promotion from within

* Aids in developing leadership skill, motivation, loyalty, better attitudes and other aspects that successful workers and managers usually display

* Aids in increasing productivity and/or quality of work

* Helps keep costs down in many areas, e.g. production, personnel, administration etc.

* Develops a sense of responsibility to the organization for being competent and knowledgeable.

* Improves labor-management relations

* Reduces outside consulting costs by utilizing competent internal consulting

* Stimulates preventive management as opposed to putting out fires

* Eliminates sub-optimal behavior (such as hiding tools)

* Creates an appropriate climate for growth and communication

* Helps employees adjust to change

* Aids in handling conflict, thereby helping to prevent stress and tension.

**5.4 PROMOTION POLICIES:**

Performance appraisal is a method of evaluating the behavior of employees in the work spot, normally including both the quantitative and qualitative aspects of job performance. Performance here refers to the degree of accomplishment of the tasks that make up an individual's job. Some of the important features of performance appraisal may be captured thus:
Performance appraisal is the systematic description of an employee's job-relevant strengths and weaknesses.

* The basic purpose is to find out how well the employee is performing the job and establish a plan of improvement.

* Appraisals are arranged periodically according to a definite plan.

* Performance appraisal is not job evaluation. It refers to how well someone is doing the assigned job. Job evaluation determines how much a job is worth to the organization and, therefore, what range of pay should be assigned to the job.

* Performance appraisal is a continuous process in every large scale organization.

5.4.1 Promotions: Most of the internal candidates would be stimulated to take up higher responsibilities and express their willingness to be engaged in the higher level jobs. Management generally gives the promotion to an employee based on their performance and need of organization.
Lesson :6
Job Specifications, Job Evaluation, Job Enhancement, Job Enrichment, Management by Objectives

6.1 INTRODUCTION:

The success of an organization largely depends upon the team of workers put to work in an industry and therefore skilled and qualified workers should be recruited.

6.2 JOB SPECIFICATION:

Job specification is the delineation of the knowledge, skills, and abilities along with the associated education, training, and experience required to successfully perform within a position. The stipulated criteria normally constitute the minimum recruiting criteria or minimum qualifications for the position.

Job specification is also the product of job analysis. It is a statement of acceptable human qualities necessary to perform the job. It specifies the types of person required on the job and further assists in the selection of appropriate personnel by outlining the particular working conditions to be encountered on the job.

A job specification should include

* Physical characteristics as height, weight, sight, physical structure, health, etc.

* Characteristics as decision-making ability, analytical view, mental ability etc.

* Personnel characteristics as behavior, mental stability, enthusiasm, leadership qualities, integrity etc.

* Responsibility, i.e., the sense of responsibility in a person to be appointed on the job.

The applicants are assessed on the basis of qualities mentioned in the job specification statement. The job description assists the candidate to understand the requirements of the job which are to be fulfilled by him and also helps the management in appraising the performance of the employee.

6.3 JOB EVALUATION:

Job evaluation deals with money and work. It determines the relative worth or money value of jobs.

Definitions of job evaluation
By International Labor Organization defined job evaluation as "as attempt to determine and compare demands which the normal performance of a particular job makes on normal workers without taking into account the individual abilities or performance of the workers concerned."

* Wendell L. French defined job evaluation as, "a process of determining the relative worth of the various jobs within the organization, so that differential wages may be paid to jobs of different worth."

### 6.3.1 Objectives of job evaluation:

The following objectives are derived from the analysis of the above-mentioned definitions:

* To gather data and information relating to job description, job specification and employee specifications of various jobs in an organization.

* To compare the duties, responsibilities and demands of a job with that of other jobs.

* To determine the hierarchy and place of various jobs in an organization.

* To determine the ranks or grades of various jobs.

* To ensure fair and equitable wages on the basis of relative worth or value of jobs. In other words, equal wages are fixed to the jobs of equal worth or value.

* To minimize wage discrimination based on sex, age, caste, region, religion etc.

### 6.4 JOB ENRICHMENT:

Job enrichment is enriching the jobs, adding more qualitative aspects. It is vertical expansion of jobs. The qualitative expansion such as increased responsibilities, more powers and autonomy are special features of job enrichment. Individual employee gets an opportunity to modify his performance and increase merit. Management has to provide opportunities which enrich jobs. Employees should feel enrichment should become motivator as pointed by Herzberg.

### 6.5 JOB ENHANCEMENT:

Job enhancement is when an employee is given new responsibilities or tasks that gives him/her the opportunity to develop his/her skills or abilities. A production person may be placed in marketing department and he will be more encouraged to get new assignment with his basic knowledge and on the other hand organisation will be benefited by utilizing his services for both activities.
Job enhancement is an effective way to help employees improve their essential skills, and it doesn’t require a lot of resources to be successful. It can:

* Better prepare employees for promotions and organizational changes
* Help address skill shortages
* Improve performance
* Increase job satisfaction
* Increase motivation and self-confidence
* Reduce employee turnover and stress
* Support a healthy learning culture in the workplace.

The following activities are simple ways to improve essential skills through job enhancement. They are suggestions and can be tailored to meet the specific needs and goals of the employee.

**6.6 MANAGEMENT BY OBJECTIVES:**

Management by Objectives (MBO) is a process whereby the superior and subordinate managers of an organization jointly identify its common goals, define each individual's major areas of responsibility in terms of results expected of him and use these measures of guides for operating the unit and assessing the contribution of its members. The MBO process is undertaken along the following lines:

* The subordinate and superior jointly determine goals to be accomplished during the appraisal period and what level of performance is necessary for the subordinate to satisfactorily achieve specific goals.

* During the appraisal period, the superior and subordinate update and alter goals as necessary due to changes in the business environment.

* Both superior and subordinate jointly discuss whether the subordinate achieved the goals or not. If not, they should identify the reasons for deviation like strike/lock-out, market change etc.

Peter Drucker for the first time explored the management by objectives for getting improved organizational performance and employee satisfaction. As management principles are widely accepted, the MBO is spreading to cover even non-business organizations to manage their performance as systematic setting of objectives and goals lead to better results.
The setting of overall objectives is done by management after considering the strengths, weaknesses, opportunities and threats. The key functional areas are identified first to formulate overall objectives. Key functional areas are those which have maximum impact on the overall performance. The key functional areas' performance is to be evaluated to understand their contribution in the organization. The objectives are generally used as measuring scales of performances. The inputs required for achieving the objectives are also appraised. Time and money factors are crucial items to have results-oriented performance. The department goals are guiding factors for deciding branch goals. Readjustment of department and sectional objectives is essential to arrive at practical and feasible objectives. The individual supervisor's objectives are developed based on sectional objectives. The employees-supervisor relationship is also discussed while formulating their objectives. The supervisor's objectives usually known as targets are quantifiable, feasible and are time and cost oriented. Their performance is judged on these bases. The corporate objectives are achieved through corporate plans and strategies. Similarly departmental, sectional and individual objectives are achieved through departmental plans, sectional plans and action plans respectively.

The performance achieved is compared with the objectives to find out the position, causes and constraints of achievements in the areas of organizational performance and employee's satisfaction. The appraisal system is diagnostic rather than purely evaluative. The suggestions are brought forward through mutual discussion and personal considerations. This is perpetual functions e.g., deciding objectives, plan formations, actions, evaluation, diagnosis and reformulation of objectives, plans, actions and suggestions.

Goals setting are the first and final step in job-designing. The jobs are framed, described and allocated as per the goals set by organization which are achieved by the employees. The deviations between performance and goals are diagnosed and improved goals are set for further improvement of organizational performance and employees' satisfaction.
Lesson :7
Safety Hazards, Hazards Prevention

7.1 INTRODUCTION: Regulation concerning health and safety at work may differ from country to country in detail, but some relevant provisions are embodied in all of them. It is the duty of every employee while at work to take reasonable care for the health and safety of himself and of other persons, who may be effected by his acts or omission at work.

7.2 SAFETY AT WORK: No persons shall intentionally or recklessly interfere with or misuse anything provided in the interest of health, safety or welfare in pursuance of any of the relevant statutory provisions.

* Every dairyman must be trained to be safety conscious and should know the correct use of protective clothing.

* Overall should be buttoned up, sleeves rolled up above the elbows or cuffs buttoned up, and a protective cap should be worn.

* Gloves may not be worn at all time, but a suitable barrier creams should be used to protect the skin. Cotton gloves with reinforced non-slip gripping surface are worn when handling oil or greases covered component or material. Heat resistance gloves should be used to give protection against burns. Leather gloves give protection against sharp corners when handling bulky or heavy equipment. Rubber gloves are worn when using cleaning fluids and to protect the hands from skin damage due to air blast when cleaning component by means of compressed air. Also the electricians have to use adequate protection gloves and shoes.

* Footwear worn should be reinforced safety shoes or boots with reinforced toecaps, especially at work demanding the lifting or relatively heavy components. Special care should be taken where the condition underfoot are hazardous such as excessive water on the floor.

* Goggles must be worn when a chisel, a sharpening tool or a grinder are used, and when cleaning with compressed air is performed. Suitable goggles to be worn while welding operation.

* Hazard warning signs, obligation and instruction should be widely displayed throughout the building on walls, vehicles, container, etc. Every potentially dangerous part of any machine whether power driven or not must be securely protected.

General safety rules should be displayed in places where they can be easily and frequently seen by the staff concerned. It is more effective to display them as a list of what should and what should not be done in connection with particular types of jobs.

Table 7.1 Safety colours

<table>
<thead>
<tr>
<th>Safety colour</th>
<th>Meaning purpose or Examples of use</th>
<th>Contrasting colors</th>
<th>Symbol colors</th>
</tr>
</thead>
</table>

Dairy Plant Management and Pollution Control

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<table>
<thead>
<tr>
<th>Color</th>
<th>Action</th>
<th>Description</th>
<th>Identification</th>
<th>Thresholds, dangerous passages, obstacles</th>
<th>Obligation to wear personal safety equipment</th>
<th>Identification of safety showers, first aid posts and rescue points</th>
<th>Emergency exit sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Stop</td>
<td>Stop signs identification and colors of emergency shutdown devices prohibition signs</td>
<td>White</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>Caution</td>
<td>Indication of hazards (fire, explosion, radiation, chemical, etc.) Warning signs identification of thresholds, dangerous passages, obstacles</td>
<td>Black</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>Mandatory action</td>
<td>Obligation to wear personal safety equipment Mandatory signs</td>
<td>White</td>
<td>White</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>Safety condition</td>
<td>Identification of safety showers, first aid posts and rescue points Emergency exit sign</td>
<td>White</td>
<td>White</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7.3 HAZARDS WARNING SIGNS

For the safety of yourself and all other personnel any hazard warning signs displayed inside or in the vicinity of the factory should be observed.

![Hazard Warning Signs Diagram](image-url)

These signs may appear in areas, on walls, vehicles (tankers) or containers, e.g. drums.
Fig. 7.2 Hazards warning signs
Dairy Plant Management and Pollution Control

1. Collect the evidence
   - Observe machine running (If safe to do so)
   - Use senses including:
     - Smell-burning
     - Touch-vibration
     - Hearing-noise
   - Question operator (Use good social skills)
   - Consider:
     - Packaging materials (bottles, cartons, etc.)
     - Raw materials (e.g., effect of water on machinery)
     - Overall process (changes to)
   - Refer to manual (Look for fault-finding aids)
   - Use test equipment (Built-in or otherwise)
   - Considered history of machine including:
     - Past breakdowns
     - Modifications
     - Planned maintenance

2. Analyze evidence
   - Based on evidence
   - If not done fault will re-occur

3. Locate fault
   - Must be taken after step 4
   - Must be done before returning to production

4. Determine and remove cause

5. Rectify fault
   - If not done fault will re-occur
   - Consider all evidence

6. Check system
   - www.AgriMoon.Com
8.1 INTRODUCTION:

Careful and proper operation of the plant will save it from damage and ensure trouble free operation. There are certain simple operational precautions which must be followed by the plant personnel. These in turn shall result in a sustained well being of the plant equipment, assisting in the maintenance of good hygiene and sanitation in the plant.

8.2 SAFETY PRECAUTIONS DURING CLEANING OPERATION:

8.2.1 Tanks and vats

- When cleaning large tanks or vats having agitator, the agitator switch should be locked and switched on before filling the product.

- While cleaning manually, a sturdy, four legged step ladder should be used to enter and to come out from the tank and clean the inner surface of the storage tank. Using can as a stool to enter or jumping out of a vat is dangerous.

- The CIP line should not be connected with the tank before the completion of manual cleaning. Also manhole of the tank should be kept open.

- Replacing of agitator gear box or motor should be done with utmost care.

- The light glass bulbs should be connected preferably with 24 V-DC power supply and proper earthing.

- For tightening the over head S.S pipe joints and fittings, the four legged step ladder or long hook spanner should be used.

- All the pipe lines should be clamped properly with supports.

- Pump parts, valves, sanitary fittings, etc., should be handled carefully during washing and sterilizing operations in order to protect the machined surfaces.

8.2.2 HTST pasteurizer

- Drain the brine solution, if used as cooling medium, from the pasteurizer. It may corrode the plates at high temperature.

- Disconnect separator and / or clarifier to prevent non- stainless steel parts in them from coming into contact with nitric acid.

- All other piping used during operation should be connected while cleaning.

- Filters if provided should be cleaned manually after dismantling.
Strong solutions of the detergents should not be used.

The cleaning temperature should not be exceeded with any detergent.

Detergents should be taken gradually to avoid high local concentration. Solid detergents such as caustic soda and TSP should be dissolved in 2-3 liters of water before use.

If air enters the plant, the plates may get a burnt-on coating which would reduce the heat transmission ability and increase the risk of corrosion. So, immediately after starting the plant, the air should be evacuated through vent cocks.

Fine sand-like deposits may take place in the plate heat exchanger, possibly from the water supply, the detergents used, the raw milk etc., building up at the bottom of plate passes. Scraps of debris may be trapped at plate contact points. This also can lead to corrosion of the plate surfaces. Whenever water stains appear on the outer surfaces, a good quality metal polish should be rubbed vigorously following the grain of the finish. On any account abrasive, steel wool, or wire brush should not be used on stainless steel surfaces. The following care should be taken on the pasteurizer plates:

- Periodic inspection of individual plate surfaces is essential.

- While the plant is opened for manual cleaning, both the sides of the plates should be checked for scaling.

- The surface should be very clean to avoid corrosion of plates.

- Cleaning should be done with nylon, fiber brush or coir and washing soda only. Never use wire brush, otherwise scratches may damage the plate surfaces.

### 8.2.3 Homogenizer

While cleaning the parts, use brushes only. Do not use metal sponges around these parts as particles of metal can lodge in the cylinder and be pressed into valve seats, plungers, etc., when operation is started.

Be careful not to allow metal parts to strike each other or other metal objects.

Only 3-way valves to be provided at feeding in and out.

### 8.2.4 Milk condensing plant

- It is always best to change over from milk to wash water while evaporator is still running and at the same time, to reduce the steam pressure, so that, the tubes are flushed with a good flow of hot water. This should be continued until the tubes are clean.

- It is important to use soft water for washing since the use of hard water will cause scaling in due course of time.
When the plant is dismantled for cleaning, the parts such as covers, manholes, distribution plates, etc., should be kept on rubber mat to avoid any damage.

Check that the condensing system including pre heaters is well cleaned.

Carry out physical inspection of calandria tubes using flash light by removing top and bottom covers.

Use only soft metal brushes like brass, copper and nylon for cleaning the evaporator tubes. Never use steel wire brushes.

After cleaning, proper care should be taken while assembling the parts.

8.2.5 Butter and ghee sections: The floor should always be clean and dry.

Whenever milk, cream, butter or ghee spills on the floor, the floor should be cleaned with teepol solution and hot water.

Only trained operators should operate the butter churns and butter packing machines.

After closing, the butter churn door should be locked properly.

Floor near ghee boiler should not be slippery

8.3 SAFETY PRECAUTIONS FOR HANDLING HAZARDOUS CHEMICALS:

Instructions for handling hazardous chemicals should be prominently displayed.

All containers should be clearly marked ‘ACID’ or ‘POISON’ as the case may be.

While manual handling, barrels or drums full of caustic and other chemicals should be handled by at least two persons.

A non-corrosive bottle carrier should be used while transporting acid bottles from storage to the plant.

Employees opening containers and / or handling acids and poisonous chemicals should wear personal protective equipment such as rubber aprons, splash proof goggles and long sleeves over rubber gloves.

While opening the chemical containers, the opener provided should be used and metal covers used after the drum has been opened.

When removing acid from containers, tilting cradles or acid siphon and pumps should be used.
• After removing acid or caustic solution, the container should be closed properly and kept away from each other.

• Containers of caustic soda should be stored in a place away from work areas or passage ways.

• If caustic gets on the gloves or equipment it should be washed off immediately with sufficient quantity of clean water.

• Cleaning agents should not be mixed with hot water having a temperature of 45°C under any circumstances.

• Usually, while feeding the washers and CIP tanks, chemical solutions should be made in a separate tank and, if possible, gravity flow should be used.

• While manual cleaning, the detergent solutions used may be neutral or slightly alkaline to avoid skin irritation.

8.4 HYGIENE PRECAUTIONS:

• Clean protective clothing must be worn. ‘NO SMOKING’ notices observed and all tools and equipment must be carried in closed tool boxes or bags.

• During maintenance operations, precautions must be concentrated on preventing the food product from being contaminated by extraneous material.

• It is therefore, essential that all fastening devices are secured firmly and that only fixing part such as washers or split pins used are non-corrosive when likely to be in direct contact with the product or passing above the product.

• Oil, grease, solvent and compounds used on food machinery must be those recommended for such use.

• Glass instruments such as thermometers must be properly encased, so that, they remain in position, even if broken.

• There must be no leakages on utility services, especially steam, refrigerants and cleaning solutions.

• Recycled water system must be frequently tested.

• Cleaning nozzles in washing devices must not be blocked or excessively worn-out.

• Storage area must be adequately ventilated.

• The balance tanks must be covered during the processing operations.

8.5 PLANT HOUSE – KEEPING:

• Floor should be maintained clean, dry and non-slippery.
• Whenever milk spills on the floor during receiving and packaging operations the floor should be immediately hosed and cleaned.

• Rubbish and damaged tins and bottles should be kept in bins especially meant for them.

• Milk cans, butter-oil tins, powder bags / containers, cases, cartons and rubber mats for cleaning should be piled only in designated areas.

• Dark areas should be artificially lighted and floors and stairways kept free of accumulated rubbish, broken glass, S.S. pipe lines, fittings and gaskets.

• Once a maintenance task has been completed, all debris, tools and equipment must be removed and the plant left ready for cleaning and sterilizing operations.
9.1 INTRODUCTION:

The determination of plant efficiency at all essential points of the process is the first step in creating a maintenance system which is fundamental to achieving optimal performance in any milk plant.

9.2 TYPES OF MAINTENANCE:

9.2.1 Preventive maintenance: It is a daily maintenance (cleaning, inspection, oiling and retightening), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. It is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance. Preventive maintenance is further divided into periodic and predictive maintenance.

- Periodic maintenance (Time based maintenance-TBM) which consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.

- Predictive maintenance is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition based maintenance. It manages trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designed to monitor conditions through an online system.

9.2.2 Corrective maintenance: It improves equipment and its components so that preventive maintenance can be carried out reliably. Equipment with design weakness must be redesigned to improve reliability or improving maintainability.

9.2.3 Breakdown maintenance: It means that people wait until equipment fails and repair it. Such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

9.2.4 Maintenance prevention: It indicates the design of new equipment. Weakness of current machines is sufficiently studied and is incorporated before commissioning new equipment.

9.3 MEANING OF PREVENTIVE MAINTENANCE:
The precise meaning of the term "preventive maintenance" depends on the concept of the organization of the plant, of its capacity and processing and manufacturing programme as well as on the availability of, and accessibility to specialized services of machinery manufacturers or their agents, who are usually equipped with an ample supply of spare parts. It also involves in

- Planning and scheduling
- Proper installation
- Periodic inspection
- Planned lubrication
- Adjustment of machines and instruments
- Replacement of worn and damaged parts
- Recording and reporting observations, adjustments, repairs, and replacements
- Periodically reviewing records on inspection, lubrication, repairs and performance of equipment
- Keeping an adequate supply of spare parts
- Determining maintenance costs
- Cleaning and painting equipment and buildings
  - Inspection and maintenance of all emergency, personnel and plant protective equipment
  - Maintaining full serviceability of all utilities

**Advantages of Preventive Maintenance**

- Less production interruptions
- Fewer large-scale repairs
- Less raw material and product spoilage
- Increased life expectancy of equipment
· Less standby equipment needed

· Identification of items with high maintenance costs leading to investigation and correction of causes, such as misapplications, operator abuse or obsolescence

· Better spare parts control, greater work safety and lower manufacturing cost.

The preventive maintenance programme (PMP) is the most essential part of the programme of work of the dairy engineer's group. It is divided into several parts.

The first comprises collecting and recording all basic information on machines and installations: the equipment records of the plant. This may be classified as the preparatory part of the PMP.

The second comprises identification of inspection objectives, frequency and location, and is known as the Inspection Schedule. This includes lubrication schedules and routine spare parts replacement programmes and may be classified as the plan of operations in which also the recording and reporting systems are defined. The third part of the PMP procedure is the action which starts with the analysis of the records and is followed by decisions on what must be done, by whom, when and by what means. It also includes decisions on who inspects and accepts the completion of the action ordered.

The last component of the action part of the PMP is the maintenance cost estimate. The application of PMP depends on well-equipped workshop facilities and trained staff. The variety of skills needed for performing all the duties specified above implies that training in the dairy engineer's group is an essential requisite of success.

9.4 OBJECTIVES OF PREVENTIVE MAINTENANCE (PM):

Preventive Maintenance is a procedure utilizing programmed and coordinated lubrication, internal and external inspections, timely adjustments, repairs and replacements by skilled and trained personnel under qualified supervision for the purpose of preventing unscheduled downtime, preserving equipment, maximizing overall plant performance, minimizing maintenance cost, and thereby contributing to an improved profit position. So, by definition we can draw the following principal objectives of the preventive maintenance.

- Increase the efficiency and improve the performance of all processing and auxiliary equipment.
Increase the overall productivity of the entire plant by achieving coordinated and continuous operation of all plant equipment.

• Increase the certainty of meeting daily production schedule.

• Reduce unscheduled downtime.

• Reduce costs of maintenance and repair.

• Reduce overall processing costs.

• Reduce utility usage.

• Reduce Bio-chemical Oxygen Demand (BOD) of sewage.

• Minimize property and personal hazards.

• Conserve raw materials.

• Conserve fuel.
10.1 INTRODUCTION:

The spare part programme is an important task to upkeep the all machineries for production. Most of the dairy plant purchase various equipment from different supplier. As a result, there is often practically no uniform standard of equipments in dairy plant. Therefore it is necessary to keep various types of spares and supplies to upkeep the machineries for smooth running of operations. So store should contain consumable items such as gaskets, standard lubricants and paints and three basic groups of engineering accessories:

- Equipment spare parts.
- Complete components.
- Pipes and fittings, bolts, nuts and washers, bars and plates of different metals, electric components and other general types of engineering accessories.

The total number of items stored often amounts to thousands, of which a negligible part or sometimes even the majority may be imported. The selection of spare parts kept in the store is based on the manufacturers' recommendations and on the plants own experience of local operating conditions. The quantities to be kept should ensure regular and trouble-free plant performance without overstocking the stores.

In the spare parts lists there are items which are on relatively steady demand such as rubber gaskets for milk pipes, plate gaskets for heat exchangers, graphite and rubber sealing for pumps, electric relays and special bulbs, selected bearings, springs and automatic switches, etc. Also some consumable items such as automatic recorder charts and inks, special lubrication components and even packaging materials to which packaging machines are particularly sensitive, such as aluminum capping foils for bottling.

It is much more difficult to decide on items which are used sporadically. The demand for them is erratic and only experience can tell what deserves to be stored in the plant. This could involve parts of machines which theoretically last for the lifetime of the machine, such as shafts carrying spray discs in milk driers, plates in heat exchangers and pressure and temperature indicators. There are instances when they need quick replacement and should be available in the store.

10.2 LUBRICATION SYSTEM:

Lack of lubrication is one of the principal causes of equipment breakdown. The best solution is to have a regular lubrication schedule, and perhaps a lubrication chart for each machine, setting the frequency of lubrication, type of lubrication needed, and places to be lubricated.
Modern equipment calls for certain types of lubricants for certain types of bearings e.g. light, high speed bearing will require a light oil, whereas a heavy duty, low speed bearing will require heavier oil.

Bearings that are operated at high temperatures must have a lubricant specially adapted for this use, just as those bearings that operate at extremely low temperatures will require zero oil.

Many dairy plants have rather high humidity and for that reason the moisture problem should be considered. Certain lubricants are available that resist rusting and corrosion due to moisture. There are also oils that resist emulsification with water and are advantageous for flooded systems of lubrication where gears and chains run in oil.

The most tightly enclosed oiling system will with time allow moisture to accumulate. It is essential to occasionally check the oil in an enclosed drive to make certain it is not contaminated with water. Usually the water will collect at the bottom and may be drawn off easily.

10.3 BENEFITS OF LUBRICATION:

The benefits of proper and timely lubrication can be summarized as:

- Less production downtime (because fewer breakdowns) with all its related in-plant savings and customers' benefits.
- Fewer major overhauls, hence less costly repair bills.
- Fewer repetitive repairs.
- Less spoilage and product waste, hence a factor in better quality control.
- Postponement or elimination of cash outlays for premature replacement of physical plant and/or equipment/ because of better conservation of assets and increased life expectancy.
- Requirement of less standby equipment thus reducing capital investment.
- Shift from inefficient “breakdown” maintenance to less costly scheduled maintenance/ hence better work control and saving due to
- Less plant outage and reduced maintenance costs.
- Better spare parts control, leading to minimum inventory yet having appropriate spares at hand when needed.
- Greater safety for workers and improved protection for plant.
- Reduced utility and fuel costs.
- Lower unit costs of manufacture.
Greater certainty in meeting production schedules.

These are all realistic benefits that apply in any industrial economy, including dairy and food industries. To sum up, the benefits of lubrication are the same as those accruing to any well manage and well maintained plant, besides the economies it provides in greater plant efficiency, reduced maintenance costs and lower overall manufacturing costs.
11.1 INTRODUCTION:

Adoption of good manufacturing practices is the key to producing 'quality products'. When the personnel involved in manufacture adhere to certain norms, their working hours turn out to be pleasant, orderly and safe.

The good manufacturing practices requirement specified are designed to:

- Assist employees to maintain high quality standards, wholesomeness and safety of products manufactured and distributed by the dairy plants.
- Educate employees about correct sanitary practices.
- Stress the importance of personnel hygiene and cleanliness.

11.2 PERSONNEL HYGIENE:

All employees must maintain a high degree of personal cleanliness to prevent dairy products from contamination.

11.2.1 Employee grooming and hygiene related items:

No person shall spit, use tobacco, pan masala, chew betel leaves, take food, drink water or consume beverages or store clothing or personal belongings in any room where dairy products are manufactured or stored or in places where utensils, packing materials or ingredients for the preparation of dairy products are stored.

No person who is a carrier of disease or who is suffering from any infectious disease, open sore or communicable infection of the skin, shall be engaged in the manufacture of dairy products. In case of doubt the authorized doctor shall check the employee for any illness.

11.2.1.1 Hair: Hair is an extraneous matter hazard and must be kept out of the product. Hair must be neatly combed.

- A head covering to contain the hair, as completely as possible, in the form of hairnet, and / or cap provided by the dairy, must be worn at all times. If the hair is not enclosed by a cap, then a hairnet must be worn.
- No hair pins, bobby pins, hair clips or any other similar clip is allowed to keep a head covering in place. They must be enclosed in the hairnet. Hair extending over the ears or beyond the top of the shirt collar must be protected by a hairnet.
Bump helmets are not considered effective hair restraints and, if worn, an approved hair covering restraint must also be worn underneath.

No person should comb their hair at the work place.

Men shall preferably be clean shaven. The mustache should be properly covered so that chances of hairs failing in the products do not arise. A neat closely clipped moustache and neat sideburns are permissible if:

- The mustache is no wider than around outer edge of mouth and extends no longer than the bottom of the mouth. Handlebar style moustache will not be permitted.
- The sideburns are trimmed no longer than the lobe of the ear. Curved sideburns extending towards the corner of the mouth will not be permitted.
- Beards are an extraneous matter hazard. Because of the risk of hair loss, any beard must be completely covered and enclosed with a clean, disposable mask.

11.2.1.2 Hands: Hands touch products or product packaging all the time and this may become hazardous to the products. Keep hands and finger nails clean. Keep finger nails properly trimmed. Long finger nails are unsuitable in a dairy.

* Wash hands thoroughly in a hand-washing facility before commencing work and after each absence from the work area.

* After visiting the rest rooms, toilet, after smoking and at any other time when hands have become soiled or contaminated, employees must wash their hands before returning to their work area.

* In areas designated as critical hygiene areas, hands must be sanitized in the solution provided upon entering the area.

* Perfumed hand lotions and hand soaps are not permitted.

* Any person with cuts or unprotected sores on fingers must not start work, but must report to their supervisor and then to the medical centre.

* Cuts and open sores on fingers must be covered by a colored band-aid type dressing applied by the authorized Medical Officer or an authorized person. Standard flesh colored band-aids or dressings are not acceptable.

11.2.1.3 Clothing: Clothing is provided to protect the product from contamination. Clothing must be clean at the start of production and kept clean during production.
* Where clothing becomes soiled rapidly, disposable or plastic aprons should be worn over it and changed frequently for additional protection against product contamination.

* If you work in a very dirty or contaminated area, such as effluent disposal area, change into clean clothes before entering the plant.

* Pockets above the waist are not allowed. Pockets must be removed or sewn shut to prevent use and to eliminate a product contamination risk.

* When sweaters are needed, they must be worn under the outer garment to avoid product contamination with loose fibers. Sweaters should be 'short haired (smooth)' close knit and lint-free.

* Maintain gloves used for handling food and food contact packaging supplies intact and in sanitary condition. Gloves shall be of food grade material. If gloves are worn for handling food and food packaging they must be kept clean and only worn for this purpose. Gloves shall be rinsed in sanitizing solution before handling any product. Hands must be washed and sanitized even though gloves are worn.

* Do not carry pens, pencils, thermometers, spectacles, tools, etc., in shirts, coats etc., above the belt or waistline, or behind the ear. This would prevent articles from falling into the product.
* Do not use decorative buttons on shirt or apron. They may fall in product accidentally.

### 11.2.1.4 Jewelry

**Jewelry:** Rings, ear rings, badges, watches and other jewellery must not be worn while on the job because:

- Hand jewelery cannot be adequately sanitized against bacteria transmission.
- Jewelery may fall into product.
- Jewelery is a safety hazard with machinery.

Exceptions for Wearing Jewelery:

* A necklace or chain where applicable worn under a shirt or T-shirt.
* Small plain sleeper ear rings.
* A plain wedding band which cannot be removed is the only exception to this requirement.

### 11.2.1.5 Shoes

**Shoes:** Keep shoes clean, neat and in good condition. Safety boots and shoes should be worn only at the work place and not in any other place to avoid contamination. In critical aseptic areas footbaths must be used by all personnel whenever they are provided. They are an essential part of sanitation procedure.
11.2.1.6 Other Habits: Smoking is permitted only in authorized areas. Hands must be washed after smoking and before re-entering the production area. Chewing of betel leaves, pan masala and tobacco is permitted only outside the factory premises. Mouth and hands must be washed after chewing and before re-entering the production area.

11.3 GENERAL SAFETY MEASURES TO BE FOLLOWED IN THE DAIRY PLANT:

- Food or drink is not permitted in the plant. Drinking water is provided at drinking fountains / basins.
- Maintain lockers clean and free of soiled clothing and food materials to prevent attraction of pests.
- Avoid uncontrolled, uncovered coughing or sneezing in manufacturing and packaging area.
- Wear safety goggles where chemical materials are used and handled.
- Hearing protection must be worn in designated area. They must be kept clean. Do not leave them on equipment surfaces when not in use.
- Mask should be used in designated areas.
- Nobody should be allowed to enter production area without wearing the apron and cap.
- Use of muffler is prohibited in production area.

11.4 WATER QUALITY:

11.4.1 Impurities in water: Rain water is nearest approach of chemically pure water. But it contains small amounts of organic matter dissolved gases; principally $O_2$ taken from the air. The composition of the ground over which and through which it flows after falling to the earth will determine the additional impurities that observe. The earth’s surface contains large amounts of mineral salts such as carbonated, $SO_4$ such as lime and Magnesia which are dissolved by water.

11.4.2 Dissolved matter: The substances commonly found in solution are minerals, salts, gases.

11.4.3 Suspended matter: The suspended matter impurities include mud & sand, vegetable matter decayed, waste and sewage, bacteria.

11.4.4 Amounts of impurities in water: Calcium and Magnesium salts may be present in solution in amounts upto 800 ppm. Most natural water contain only relatively small amounts of Na salts, although some parts of country there are water with high contents with Sodium salts. $CO_2$ is found in deep well water in quantities upto 40 ppm. Surface water ordinarily contain not more than a few ppm. Dissolved $O_2$ is not usually present in deep well water but is found in surface water in amounts varying upto the limit of solubility which is about 14 ppm at 0°C.
11.4.5 Colloidal suspensions: This consists of material of so finely divided that it cannot be seen under the microscope and existing in a state intermediate between true suspension and solution but removable by filtration. Matter in colloidal suspension does not settle out easily where ordinary suspended material will settle out with relative rapidity.

11.4.6 Purposes of purification:

The purifying done by cities, municipalities to make the water suitable for general domestic supply.

- Purified process to improve the visibility of water for their particular requirements including boiler feed.

General domestic supply is desired to make water wholesome and pleasant to drink and object of purification is to remove the bacteria that cause disease, turbidity, colour, taste and odour which cause the water to be distasteful to the consumer.

filtration & chlorination.

Sedimentation process used to settle out suspended solids in water under the influence of gravity. Water is preserved in reservoirs or storage basins until the greater part of suspended impurities settle to bottom decanted to the top.

Aeration or other process may be used to remove odors; special means may be required to remove iron and manganese.

Water is usually not softened by municipal supply. The softening is meant for the removal of dissolved salts which cause excessive soap consumption and scale deposition in boilers and pipelines.

11.4.7 Industrial water supply & softening: In this the softening occupies the most important place. Although sedimentation, filtration, aeration etc are frequently required as adjunct to the softening process. Hard water deposits scale in pipelines, boilers and cause economic loss.

11.4.8 Effect of hard water:

- Scale formation.
- Scale formation in pipelines and boilers.
- Cause insulating effect which prevents transfer of heat.
- Corrosion

11.5 WATER PURIFICATION METHODS:

11.5.1 Sedimentation:
11.5.1.1 Plain sedimentation: The largest use and single method for removing impurities in water is plain sedimentation. The water is allowed to stand quite or move very slowly through artificial or natural basins until such of suspended impurities settled to water and the relatively clear water form on top. Dissolved impurities including the mineral salts cannot be removed but only the suspended matter can be removed.

The degree of impurities removal depends on:

- Length of the retention period
- Size of suspended particle
- Temperature of water (Higher the temp, faster the rate of settling)
- Sedimentation basins and size of suspended particles

Sedimentation basins may be operated continuously or intermittently. For operation, two or more basins are required. One is for standing and another is for withdrawal of the water. Plain sedimentation does not include chemical to any sedimentation to the water. The amount of turbidity by plain sedimentation will cover 60 to 70% for bacterial removal.

11.5.1.2 Coagulation & sedimentation: To reduce the retention period of the sedimentation bags and using smaller basins efficiently a coagulant chemical is fed to water as it enters. The coagulant reacts with alkaline salts, which are naturally present in the water and forms gelatinous precipitate which settles with relative rapidity and carried down with suspended matter with water. The most commonly added chemical is alum or aluminium sulphate.

11.5.1.3 Water supply to dairy: An ideal water supply is one that is regular, adequate, soft cold and free from all impurities. The sources for water supply may be from wells, rivers, tanks and city water supply. About 4-5 liters of water is required per liter of milk handled depending on the type of plant before laying out the water supply system. Therefore, it is necessary to assess the qualitative requirement of water for the plant under consideration. The storage tank should be designed for about two days water requirement.

11.5.1.4 Water Requirements:

- Dairy plants require large quantities of water for steam formation, heating and cooling processes, for cleaning and washing equipments and floors, etc.
- Refrigeration machinery requires about 2 gallons per minute per ton of refrigeration.
- Single stage condensing pans require about 2 to 3 gallons of water per pound of water evaporated.
- Cooling of milk requires a ratio of 3:1, 3 parts of water to 1 part of milk.
Dairy Plant Management and Pollution Control

- Bottle washing requires one gallon per minute and washes approximately 4 bottles per minute. Can washing approximately 2 gallons of water per can is needed.

- Water is needed for washing equipment which may be from 20 to 50 gallons per 1000 pounds of milk.

11.5.1.5 Water resources: The sources of water supply are usually only two:

- The company's own supply.
- The public supply - Under the control of municipal authorities.

11.6 TREATMENT OF HARD WATER:

Hard water contains calcium and magnesium salts in solution as carbonates and sulphates. Hard water is not suitable for washing as it won't give froth with soap and is also unsuitable for cooling and for some of the industries. Therefore, hard water requires treatment before use. In a tank of hard water, proper proportion of milk and lime is added and stirred with mechanical stirrer and allow settling and the clear water is pumped out and then the tank is washed and the process is repeated. This is an intermittent system, but there will be water softness where the system is a continuous one.

11.6.1 Reutilization: Large quantities of water are required for removing the heat from certain equipments, e.g., refrigeration, compressors, milk condensing units, etc. It is a good practice to re-utilize the same water. But, to utilize the water, we have to cool the water to the desired temperature. For this purpose spray ponds and tower coolers will be very helpful.

11.7 STANDARDS FOR WATER IN A DAIRY PLANT:

As per BIS (IS : 425), water to be used in a processed food industry shall contain coliform less than 1 / 100 ml, SPC not more than 50 / ml. It should be free from thermophilic organisms. Chilled and hot water are free from these requirements. The hardness of water which is used in dairy should have less than 10 ppm of calcium carbonate.

<table>
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Table 11.1 Bacteriological Standards for Dairy Plant Water Quality

On the basis of these standards, the dairy can decide which kind of treatment is needed for its water supply. This is very helpful in determining the water quality of a plant and what preventive or control measures to be taken to tackle the problem.
11.8 WATER TREATMENT:

A good number of methods are available for water treatment. They are filtration, ozone treatment, etc. The most effective process is chlorine treatment. It is said that a residual chlorine level of 0.3-0.6 ppm is sufficient to produce safe tube well water supply.
Lesson :12
Cleaning And Sanitation; Different Type Of Cleaning And Sanitizing Agents

12.1 INTRODUCTION:

Cleaning is the process of removing food and other types of soil from a surface, such as utensils and equipments used in dairy and food industries etc. Cleaning is accomplished using a cleaning agent that removes food, soil, rust stains, minerals, or other deposits. The right cleaning agent must be selected because not all can be used on food-contact surfaces. (A food-contact surface is defined as a surface of equipment or utensil with which food normally comes into contact or a surface of equipment or a utensil from which food may drain, drip, or splash into a food or onto a surface normally in contact with food.) Sanitation of a food-processing plant involves keeping product contact surfaces of utensils and equipment clean and sterile. Clothing, air, packing materials, and product non contact surfaces of equipment, floors, walls, and ceilings must be sanitized to minimize contamination of the products from these sources. The bodies, particularly the hands, of employees are also sources of contamination, therefore high standards of personal health and cleanliness must be insisted upon. Moisture and heat contribute to microbiological insanitation of both product and environment. Moisture on product contact surfaces and in the products provides a medium through which nutrients become available to microorganisms and in which microorganisms may find other conditions suitable to their life processes. The physiological processes of viable microorganisms can adversely affect the safety and quality of milk and milk products.

12.2 TYPES OF SOIL:

The types of soil which the dairy-processing industry must remove from its equipment are as follows:

- Liquid milk films,
- Air-dried films,
- Heat-precipitated films,
- Heat-hardened films,
- Milk stone, and
- Miscellaneous foreign matter.

Microorganisms are not included separately here as a type of soil to be removed. Any viable microorganisms in the dairy-processing equipment constitute a distinct danger. Such microorganisms must be destroyed by proper sterilization or removed. Otherwise, the sanitizing process is incomplete. "Viable microorganisms" should therefore be added to this list.
Cleaning or sanitizing product contact surfaces of dairy apparatus, utensils, and equipment involves washing, or cleaning, and sterilizing; sanitizing includes both. Care must be taken to protect the surfaces from undue wear, erosion, or corrosion which shorten their useful life.

Soluble soil will dissolve and carried out in rinse or wash water. Insoluble soil components may have to be treated with a chemical detergent to make them soluble or to soften them so they are more easily removed.

### 12.3 SANITIZING MATERIALS:

**12.3.1 Water:** As a solvent, water carries both dissolved materials in solution and suspended materials including soil components. Water serves as a means of applying physical force during rinsing, surging, and jetting. It is the medium through which heat is applied during cleaning. The physical, chemical, and microbiological properties of the water supply are important when used for the sanitation of the dairy-processing plant.

**12.3.2 Heat:** Is important in cleaning and sterilizing dairy equipment. It increases both the speed of chemical actions and the dissolving capacity and solute holding capacity of water. If present in sufficient quantities, heat can destroy the viability of microorganisms. In hand washing procedures the amount of heat must be rigidly limited to prevent discomfort or injury to the workers hands. In mechanical washing procedures more heat is used. Its use must be controlled; however, to assure that cleaning is not made more difficult by hardening any soil on the product contact surface, and that the equipment surface or surface materials are not damaged. The cleaning solution is warmed or heated with steam. Steam can be used either to heat product contact surfaces so they dry quickly after washing or to sterilize such surfaces. A jet of steam is sometimes used to provide physical force surge and mix washing solutions in addition to heating them.

**12.3.3 Chemicals** are used in sanitation procedures for two principal reasons: to change soil so as chemically to soften, disperse, or dissolve it, and to destroy the viability of microorganisms. These chemicals are either detergents or sterilants.

**12.3.4 Detergents** include soaps, inorganic alkaline materials, acids, organic surface active or wetting agents, chelating chemicals, sequestering agents, sterilants, emulsifiers, colloids, abrasives, and inhibitors. The detergents to be used are selected according to the type of soil to be removed, the characteristics of the materials of which the soiled surface is made, the cleaning facilities and procedures to be employed, the characteristics of the water, and the cost of the detergents.

**12.3.5 Soaps** are used mainly for washing clothes, floors, walls, and windows. They are not suitable for product contact surfaces because they leave a film which is difficult to remove and which may leave undesirable flavors of odors which are absorbed by the product. Mild soaps are excellent for washing hands, and should always be available in the milk-processing plants for this purpose.
12.3.6 Alkaline detergents are generally available and economical. The more common of these are sodium hydroxide or caustic soda (NaOH); sodium bicarbonate, (NaHCO₃); sodium carbonate or soda ash (Na₂CO₃); sodium sesquicarbonate (Na₂CO₃·NaHCO₃·2H₂O), and trisodium phosphate (Na₃PO₄·12H₂O). Others have more recently come into use for specialized cleaning purposes. Two of these are sodium meta silicate( Na₂SiO₃·5H₂O); and sodium hexametaphosphate, (NaPO₃)₆.

12.3.7 Acids have come into increasing use as dairy detergents. They are generally used in weak solutions of about 0.1% or slightly more. Those more commonly used are phosphoric and nitric acids.

12.3.8 Surface active agents which include such materials as sodium alkyl sulphates and quaternary ammonium compounds. These materials help a detergent solution at surfaces or interfaces to spread the solution and to penetrate the sole.

The penetration of the soil carries the detergent not only into the soil, but also to the equipment surface beneath the soil. While both these actions assist the cleaning process, the latter is particularly important for it is the equipment surface that must be cleaned. These materials may also assist in stabilizing dispersions and emulsions, helping to keep particles of undissolved soil, once that soil is physically removed from the equipment surfaces, from settling out and returning to that surface during cleaning. The wetting property of a material can be illustrated by placing a drop of petrol in the palm of the open hand. The petrol instantly spreads over a portion of the palm surface. In contrast, a drop of water similarly placed in the hand will usually remain as a high compact drop, drawn by its own surface tensions as it is repulsed by the naturally oily condition of the skin surface.

12.3.9 Chelating agents are used along with other detergents, especially in hard water. They react with metallic ions, particularly Iron and copper, to form soluble compounds. Ethylene diamine tetra acetic acid and its sodium salts are frequently used as chelating agents. Chelation can be thought of as a selective form of sequestration. The action of sequestering agents is similar to chelaters, but involves a greater variety of ions including heavy metals and earth alkalies. Polyphosphates are often included in dairy detergent formulae for their sequestering properties.

12.3.10 Emulsifiers strengthen the ability of the solution to hold unsaponified fat which may be released from the product contact surface during the cleaning process. Materials which are suspended and emulsified pass out readily with the wash or rinse water.

12.3.11 Abrasives are irregular hard particles of sand, pumice used for grinding, abrading, or polishing. They might be included in a detergent mixture for very special uses such as cleaning floors or walls. Unless properly selected, especially for particle size, and properly used, they will etch and abrade most surfaces making many of them more difficult to clean properly thereafter. This action is particularly undesirable on a product contact surface.
12.3.12 Inhibitors prevents chemical action between two materials. They are used in dairy detergents to protect aluminum and tin surfaces from alkali or acid detergents. Sodium metasilicate is used to protect aluminum; concentrations of up to 0.5% in the washing solution are suggested. For the protection of tin, sodium sulphite can be used in concentrations of 0.25% or slightly more in the washing solution.

Chemicals and heat are sterilants widely used in dairy and other food industries for the microbiological sanitation of product contact surfaces. Chlorine, in solutions of sodium or calcium hypochlorite, is the most widely used of the chemical sterilants. For proper microbiological sanitation the chlorine solution used in dairy-cleaning operations should contain between, 50 and 300 ppm available chlorine. Equipment can be immersed in, or rinsed with; the chlorine solution or the solution can be sprayed on product contact surfaces. Contact of the solution with the entire surface involved must be assured. Chlorine is effective over a wide range of temperature. Hydrogen peroxide has been used to sterilize packaging material surface in aseptic packaging of heat-treated milk. Where available, quaternary ammonium compounds and iodophore might be used for sterilizing equipment. The causticity of several alkaline detergents gives them some germicidal property, but this is not sufficient to assure adequate microbiological sanitation in the dairy. Care must be taken in using any chemical in dairy equipment to assure that residues which may be carried into the product do not exceed legal limits.

12.4 HEAT IN SANITATION:

In sterilizing equipment, heat is applied by using hot air hot water, or steam. Some laboratory apparatus can be sterilized in hot dry air. The exposure recommended is 160°C for two hours or more. This procedure is not common for utensils and equipment used in the procurement, processing, packaging, and storage of dairy products. Because the thermal death point of microorganisms found in milk and milk products and dairy equipment, and their ability to survive high temperatures, Surfaces should be exposed to water hot enough to maintain a surface temperature in excess of 85°C for at least five minutes. If a higher degree of sterility is required steam must be used instead of hot water. The nutrient media and certain other materials used in microbiological tests of milk and milk products must be heated with steam in an autoclave up to 121°C for at least 20 minutes; this requires 1.055 kg/cm² g of steam pressure. Milk lines should be heated to 112°C, requiring about 0.5 kg/cm² of steam pressure in the lines. Steam can be applied by directing steam into the equipment long enough for product contact surfaces to be heated to at least 100°C. Where it is possible to check the temperature of the condensate flowing from a piece of closed equipment into which steam flows, sterility is considered complete when the condensate temperature reaches 100 °C.

12.5 SANITIZING EQUIPMENT:

- The bare hand is perhaps the oldest "tool" or "piece of equipment" used in washing procedures, but its use is increasingly limited in modern dairy plant sanitation.
A piece of cloth held in the hand may be used for washing. However, the cloth can be source of microbiological contamination or of odors. These preclude its use.

Brushes are commonly used in dairy-cleaning operations to apply physical force to surfaces, particularly to corners not easily reached. Their bristles physically remove particles of soil which otherwise might remain. The composition of the cleaning solution and the temperature at which it is used as well as the shape and size of the item being cleaned are some of the factors involved in selecting the right brush. If a brush is not properly selected or used, its bristles might abrade equipment surfaces, or it may prove of no use in the cleaning procedure.

Scouring pads, that is pads or wads of shavings or shreds of metal or plastic, are not regularly used in dairy-plant cleaning, but can be useful for specific purposes. Such pads must be used cautiously for they can badly damage a finely polished product contact surface.

Movement of solutions during the washing process, if rapid enough, can provide effective physical force during the cleaning operation. The surging of the solution helps to keep freed soil particles in suspension so they are removed with the washing solution. This action also facilitates dissolution of any soluble materials present.

Water or washing solution is often applied in a high speed stream produced by forcing the material through a small opening or jet. Such force is very effective in dislodging materials adhering to surfaces. The pressure on the washing solution, the diameter of the jet orifice, the distance from the tip of the jet to the surface being cleaned, the extent to which the jet stream is diverted or dissipated by any liquid through which it must flow, and other factors determine the effectiveness of a jet stream as a physical force in cleaning operations. Smaller items of equipment are usually washed and/or soaked in a special wash tank or vat which holds a quantity of the washing solution.


Initial draining removes some of the product or soil residue. Residue loosely adhering to the soiled surface will be flushed out with the rinse water. Ordinary water is used for rinsing since it is plentiful and inexpensive. This rinse water might be warmed slightly to soften and remove fat along with other residues. Cold water hardens the fat and causes it to adhere more firmly to the surfaces. If the rinse is too hot, however, it will harden some of the nonfat soil, making it more difficult to remove later on.

The wash water is warmed to a temperature the hand will tolerate for hand washing, or to a temperature near boiling for mechanical washing. The wash water shall contain the selected detergents in a concentration appropriate for the particular cleaning task. Washing involves the use of both chemical and physical forces. The chemical properties of the detergent in warm or hot solution when in contact with the soil is the chemical force. The manner in which the detergent solution and physical forces are applied must be regulated according to the soil involved. Soaking softens and dissolves fractions of most soil.
After washing, the wash water or detergent solution is drained out and the cleaning surface rinsed with clean warm water to remove remnants or traces of both the soil and the detergent solution. The order of the steps which then follow will depend upon the choice of sterilants. The problem with using a detergent which contains a sterilant is that of assuring the rinse which follows washing does not defeat what the sterilant accomplished. For the final rinse, water which is microbiologically clean and is therefore not a possible source of recontaminate is required. Separate sterilization might follow the use of a detergent, even one which contains a sterilant, to assure microbiological sanitation.

When hot water or a solution of chlorine is used, draining and drying follow the rinsing or the sterilization. When steam is used for sterilization, as in the mechanical can washer, it should be dry steam to facilitate the evaporation of any moisture adhering to the cans. When properly used, steam helps dry the can as well as sterilize it. The direct use of steam for sterilizing bottles is not advisable, as they susceptible for breakage thermal shock.

Many variations in the washing materials and cleaning equipment will be employed, and sanitation procedures will differ with the type of soil and the type of equipment being cleaned. More detailed information for each of many specific problems of sanitation encountered in the dairy-processing industry may be found elsewhere.
Lesson: 13
Waste Management in Dairy Industry

13.1 INTRODUCTION:
All the food processing plants, including multi-product factories, produce wastes in one form or the other. The food products contain a large amount of carbohydrates, proteins, fats and mineral salts. During flushing and washing operation of various process equipment, these nutrients enter the drainage and favor the growth of anaerobic and aerobic bacteria. As a result, the flushed water emits obnoxious odour and can become a disposal problem as such in the municipality sewerage.

13.2 DEFINITION OF WASTE MANAGEMENT:
Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials.

13.3 TYPES OF WASTES IN A FOOD PROCESSING PLANTS:
The wastes generated in a food processing plant can be classified according to their:
- Forms.
- Sources.
- Being avoidable or unavoidable.
- Value or their reuse potential.

13.3.1 Based on the forms: Wastes based on forms can be classified as:
- Solid wastes,
- Liquid wastes,
- Oily wastes,
- Gaseous wastes/water vapors.

13.3.1.1 Solid wastes: These refer to those wastes which are obtained in solid form either as a result of processing or are generated during maintenance. Examples are:
- Minute particles in the exhaust air coming out of a drier,
- Solid ghee residue in ghee section,
- Ash from Boiler, if solid fuel is being used,
Packaging section, where considerable packaging materials may be discarded in the form of LDPE films, cartoons, bottles etc.

Wastes generated by adverse events. (Explosions, fire etc.).

Damaged and contaminated equipment and contaminated soil.

13.3.1.2 Liquid wastes: These refer to those wastes which are obtained in liquid form as a result of processing, cleaning, flushing etc. The wastes resulting from processing may include un-reacted raw materials, impurities or byproducts generated in process because of operational deterioration, e.g., if the milk is not pasteurized at the right time and if it becomes sour then it will be dumped in the drain. Water used for cleaning purposes, acid, and lye as used in the CIP also comes under these wastes.

13.3.1.3 Oily wastes: These wastes results from the leakage in compressors, hydraulic machines, crankcase, and coolant leakage and motors where oil is required for lubrication. These wastes are differentiated from liquid wastes because they need a different disposal method.

13.3.1.4 Gaseous wastes/water vapors: These wastes refer to those released in the air in the form of gases or volatile vapors. The obnoxious fume from the chimney is a gaseous waste and pollutes the environment to a major degree. This chimney fuel consists of various gases like CO$_2$ and CO. Apart from it; the refrigerant leakage from pipe lines of the compressors also comes under this category. Gaseous wastes from processing plants include the water vapors formed in a concentrating section. These vapors increase the relative humidity of the surrounding and the energy they carry with them is wastage to the plant. Steam leakage from various points decreases the life of the tees and knobs used for regulation purpose, nuts and bolts because all of these corrode with time.

13.4 WASTE MINIMISATION:

As per Industrial Waste Management Policy premises which are subject to works approval require waste management plans incorporating waste minimisation. Each dairy plant should therefore assess opportunities for reducing waste arising from its operations. Waste reduction measures may include:

- Reducing use of water,
- Reducing use of chemicals,
- Recycling water and chemicals,
- Recovery and reuse of product from first reuse,
- Reuse/reprocessing of off-spec material,
- Recovering and reusing spilled raw materials and products.

13.4.1 PROCESS CONTROL:

Dairy configuration and the products made affect the nature and concentration of dairy wastes. The amount of product lost depends on design and operational factors including:
The range of process technologies in use.
The availability of adequate process monitoring, and plant and procedure alarms/interlocks.
The availability of automated operation – especially automated clean-in-place (CIP) systems and procedures.
The level of management and operator commitment, training and efficiency.
The level of routine equipment maintenance.

Most site losses come from activities associated with liquid handling and, to a lesser extent, with the discharge of air and solid waste.

13.4.1.1 Avoidable losses: Some examples of avoidable losses are:

- Leaking valves, pumps, pipelines or other fittings – the volume lost may not be large but the pollution load may be great
- Spills from overflows, malfunctions and poor handling procedures – spills usually happen over a short period but the amount and the high concentration of milk or product lost may be a significant increase in the pollution load
- Losses from processing and cleaning during the normal operation of plant and equipment

This includes the deliberate discharge of unwanted materials such as whey, spent cleaners and diluted product not thought to be worth recovering. Liquid milk production may lead to the generation of odour, wastewater, noise and solid waste. Best practice involves processing the predominant by-products such as whey, buttermilk and skim milk, into high value products like skim milk powder (SMP), buttermilk powder (BMP), whey powder, whey protein concentrate and casein, rather than being used as low value animal feed/fertilizer or being dumped as waste. Cream and butter are viscous and fatty and stick to equipment surfaces much more strongly than liquid milk, increasing the problem of removing residues. Hot water is an effective way to remove residual butterfat from cream processing, butter making equipment and ghee making equipment but the water temperature must not be too high (< 65°C). Accordingly, prepare a waste management plan.

To initiate the process of cleaner production, a change in culture to waste minimization is required. This involves moving from pollution treatment and control to anticipation and prevention of wastes.

13.4.1.2 Surface deposits: There are certain ways to prevent the build up of surface deposits include

- Minimization of surface area,
- Prevention of build-up of milk stone deposits,
- Maintenance of butter churns,
- Correct preparation before filling,
- Not over-working the batch (this does not often happen with continuous butter making).
To avoid spills, buttermilk collection facilities should be large enough to hold all buttermilk discharged. Buttermilk should be dried or used as animal feed and solids recovered from butter wash water also may be sold as stock feed. Suggestions for avoiding wastes during butter production, Cheese and dried milk products. Cheese generates a large volume of byproducts such as whey.

13.4.1.3 Waste reduction: Waste reduction can be achieved by

- Not overfilling cheese vats to stop curd loss.
- Completely removing whey and curds from vats before rinsing.
- Segregating all whey drained from cheese.
- Sweeping up pressings (particles).
- Screening all liquid streams to collect fines.

Waste reduction in evaporation and powder production can be done by operating the evaporators as following:

- Maintain a liquid level low enough to stop product boil-over.
- Run to specified length – excessively long runs with higher than specified running rates lead to blocked tubes which not only produce high pollution, but are difficult and time-consuming to clean.
- Use effluent entrainment separators to avoid carry-over of milk droplets during condensation of evaporated water.
- Recirculate low concentration milk or other feed-stock until it reaches the required concentration.
- Process rinsing with 7% or more of solids before scheduled shutdowns, or evaporate them during the next run rather than discharging to the sewer.
- Minimize air emissions by using fabric filters or wet scrubbers.
Lesson: 14
Solid Waste Management

14.1 INTRODUCTION:

The different types of solid waste include agricultural waste, paper waste, plastic waste, food waste, cloth waste, glass waste, building material waste etc.

14.2 SOLID WASTE:

Solid organic waste in dairy processing facilities mainly originates from production processes and includes nonconforming products and product losses (e.g. milk spillages liquid whey and buttermilk), grid and filter residues, sludge from centrifugal separators and wastewater treatment, and packaging waste (e.g. discarded cuts, spent ripening bags, wax residues from cheese production) arising from incoming raw materials and production line damage.

Solid waste is generally:

- off-spec product – for example, milk powders and heavy consistency product
- defective product packaging – for example, paperboard cartons, plastic containers
- recovered wastewater treatment sludges
- solid and semi-solid intermediate or finished product spills

14.3 SOURCES OF SOLID WASTE IN DAIRY PROCESSING PLANTS:

The types of solid waste typically produced by dairy processors include packaging waste such as cardboard, paper, cartons and plastic; organic wastes such as sludge and reject product; and office waste.

They can be generated during processing, or when raw materials and products are being transported, stored and handled.

<table>
<thead>
<tr>
<th>Category</th>
<th>Type of waste</th>
<th>Disposal stream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-organic</td>
<td>Cardboard boxes, paper, slip sheets</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>Plastic wrap</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>HDPE bottles and caps</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>Foil seals</td>
<td>Non recyclable</td>
</tr>
<tr>
<td></td>
<td>Liquid paperboard</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>Labels</td>
<td>Non recyclable</td>
</tr>
<tr>
<td></td>
<td>Plastic and metal drums and containers</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>Polystyrene</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>Office waste (e.g. toner cartridges, paper)</td>
<td>Recyclable</td>
</tr>
<tr>
<td></td>
<td>Canteen waste (e.g. aluminum cans, polystyrene cups)</td>
<td>Recyclable</td>
</tr>
<tr>
<td>Dairy Plant Management and Pollution Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous (e.g. waste oil, oily rags, damaged pallets)</td>
<td>Recyclable</td>
<td></td>
</tr>
<tr>
<td>Organic</td>
<td>Reject product including in-process</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Returned final product</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Raw material (e.g. liquid flavours)</td>
<td>Re work</td>
</tr>
<tr>
<td></td>
<td>Obsolete or out-of-date raw materials</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Lab samples and samples for online testing</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Separator de-sludge</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Bag house fines, dryer sweepings</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Effluent sludge</td>
<td>Animal feed / compost</td>
</tr>
<tr>
<td></td>
<td>Membrane retentate sludge</td>
<td>Animal feed / compost</td>
</tr>
<tr>
<td></td>
<td>Cheese fines</td>
<td>Animal feed</td>
</tr>
<tr>
<td></td>
<td>Fat recovered from effluent</td>
<td>Animal feed</td>
</tr>
</tbody>
</table>

The cost of generating and disposing of solid waste can include:

- treatment costs
- collection and transport costs
- disposal costs
- loss of product, including processing and raw material costs.

**14.4 SOLID WASTE MANAGEMENT:**

Reducing the loss of materials and improving the rate of reuse, recovery and recycling of valuable resources is a very important aspect of eco-efficiency. The many economic, environmental and social incentives for reducing and utilising solid waste more efficiently include:

- reduced treatment, collection and disposal costs
- reduced production costs as a result of recovering and reusing product
- increased revenue from recovering product
- increased revenue from new co-products
- improved risk management
- improved environmental responsibility
- improved resource utilisation.

**14.4.1 Biomanagement of sludge:**

Biotechnology Resource Centre which is located at Pune, Maharastra has developed the technologies for management of sludge produced by different effluent treatment plants as well as
city garbage and sewage. Wastes from aquaculture and animal husbandry are becoming increasingly severe for industries and municipalities due to waste disposal legislation. The Biomanagement of solid wastes include vermiculture technology, mushroom culture, growing algae on liquid effluents and aquaculture.
Lesson :15
Pollution: Causes and Effects, Control Measures.

15.1 INTRODUCTION:

Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. This occurs when only short-term economic gains are made at the cost of the long-term ecological benefits for humanity. During the last few decades we have contaminated our air, water and land on which life itself depends with a variety of waste products.

Pollutants include solid, liquid or gaseous substances present in greater than natural abundance produced due to human activity, which have a detrimental effect on our environment.

15.2 TYPES OF POLLUTANTS:

Pollutants can be classified as follows:

**Degradable or Non-Persistent Pollutants:** These can be rapidly broken down by natural processes. Eg: Domestic sewage, discarded vegetables, etc.

**Slowly Degradable or Persistent Pollutants:** Pollutants that remain in the environment for many years in an unchanged condition and take decades or longer to degrade. Eg: DDT and most plastics.

**Non-Degradable Pollutants:** These cannot be degraded by natural processes. Once they are released into the environment they are difficult to eradicate and continue to accumulate. Eg: Toxic elements like lead or mercury, heavy metals.

15.3 AIR POLLUTION:

Air pollution occurs due to the presence of undesirable solid or gaseous articles in the air in quantities that are harmful to human health and the environment.

Air may get polluted by natural causes such as volcanoes, which release ash, dust, sulphur and other gases, or by forest fires that are occasionally naturally caused by lightning.

15.3.1 Primary pollutants: Pollutants that are emitted directly from identifiable sources are produced both by natural events (for example, dust storms and volcanic eruptions) and human activities (emission from vehicles, industries, etc.).

There are five primary pollutants that together contribute about 90 percent of the global air pollution.

These are
15.3.2 Secondary pollutants: Pollutants that are produced in the atmosphere when certain chemical reactions take place among the primary pollutants are called secondary pollutants. E.g: sulfuric acid, nitric acid, carbonic acid, etc.

* Carbon monoxide is a colorless, odorless and toxic gas produced when organic materials such as natural gas, coal or wood are incompletely burnt. Vehicular exhausts are the single largest source of carbon monoxide. Vehicles are also poorly maintained and several have inadequate pollution control equipment resulting in release of greater amounts of carbon monoxide.

*Sulfur Oxides are produced when sulfur containing fossil fuels are burnt.

* Nitrogen Oxides are found in vehicular exhausts. Nitrogen oxides are significant, as they are involved in the production of secondary air pollutants such as ozone.

* Hydrocarbons are a group of compounds consisting of carbon and hydrogen atoms. They either evaporate from fuel supplies or are remnants of fuel that did not burn completely. Hydrocarbons are washed out of the air when it rains and run into surface water. They cause an oily film on the surface and do not as such cause a serious issue until they react to form secondary pollutants. Using higher oxygen concentrations in the fuel-air mixture and using valves to prevent the escape of gases, fitting of catalytic converters in automobiles, are some of the modifications that can reduce the release of hydrocarbons into the atmosphere.

* Particulates are small pieces of solid material dispersed into the atmosphere. The effects of particulates range from soot to the carcinogenic effects of asbestos, dust particles and ash from industrial plants that are dispersed into the atmosphere. Repeated exposure to particulates can cause them to accumulate in the lungs and interfere with the ability of the lungs to exchange gases.

* Lead is a major air pollutant that remains largely unmonitored and is emitted by vehicles. High lead levels have been reported in the ambient air in metropolitan cities. Leaded petrol is the primary source of airborne lead emissions in Indian cities. Pollutants are also found indoors from infiltration of polluted outside air and from various chemicals used or produced inside buildings. Both indoor and outdoor air pollution are equally harmful.
15.3.3 Effects of pollution:

15.3.3.1 On living organisms:

* **Carbon monoxide:** Prolonged smoking or exposure to air pollutants can breakdown the natural defenses causing diseases such as lung cancer, asthma, chronic bronchitis and emphysema. Exposure to air containing even 0.001 percent of carbon monoxide for several hours can cause collapse, coma and even death. As CO remains attached to hemoglobin in blood for a long time, it accumulates and reduces the oxygen carrying capacity of blood. This impairs perception and thinking, slows reflexes and causes headaches, drowsiness, dizziness and nausea. Carbon monoxide in heavy traffic causes headaches, drowsiness and blurred vision.

* **Sulfur dioxide:** It irritates respiratory tissues. Chronic exposure causes a condition similar to bronchitis. It also reacts with water, oxygen and other material in the air to form sulfur-containing acids. The acids can become attached to particles which when inhaled are very corrosive to the lung.

* **Nitrogen oxides:** It can irritate the lungs, aggravate asthma or chronic bronchitis and also increase susceptibility to respiratory infections such as influenza or common colds.

* **Suspended particles:** They cause aggravate bronchitis and asthma. Exposure to these particles over a long period of time damages lung tissue and contributes to the development of chronic respiratory disease and cancer.

* **Toxic particulates:** Toxic particulates such as lead, cadmium, benzene and formaldehyde can cause mutations, reproductive problems or cancer.

* **Ozone:** It is a component of photochemical smog causes coughing, chest pain, breathlessness and irritation of the eye, nose and the throat when inhaled.

15.3.3.2 On plants:

Chronic exposure of the leaves to air pollutants will break down the waxy coating that helps to prevent excessive water loss and leads to damage from diseases, pests, drought and frost.

It interferes with photosynthesis and plant growth, reduces nutrient uptake and causes leaves to turn yellow, brown or drop off altogether.

At a higher concentration of sulphur dioxide majority of the flower buds become stiff and hard. They eventually fall from the plants, as they are unable to flower.

15.3.3.3 On materials:

Air pollutants break down exterior paint on cars and houses.
All around the world air pollutants have discolored irreplaceable monuments, historic buildings, and marble statues.

15.3.3.4 On climate:

Atmospheric changes induced by pollution contribute to global warming, green house effect and acid rain.

15.3.3.4.1 Global warming: It is a phenomenon which is caused due to the increase in concentration of certain gases like carbon dioxide, nitrogen oxides, methane and to a lesser extent the CFCs.

15.3.3.4.2 Greenhouse effect: The atmospheric constituents such as water vapor, carbon dioxide, methane, nitrogen oxides and Chloro Fluro Carbons trap heat in the form of infra-red radiation near the earth’s surface known as the ‘Greenhouse Effect’.

15.3.3.4.3 Acid rain: When sulphur dioxide and nitrogen oxides are transported by prevailing winds they form secondary pollutants such as nitric acid vapour, droplets of sulfuric acid and particles of sulphate and nitrate salts.

15.3.4 Air quality in dairy plant:

The main emissions from dairy manufacturing processes are odours and particles.

Odours in and around milk processing plants come from the biological decomposition of milk derived organic matter, generally found in wastewater. Often these odours are due to poor housekeeping, overloaded or improperly run wastewater treatment and disposal facilities, and prolonged storage of strong wastes such as whey. Particles Particle emissions are caused either by combustion of solid or liquid fuel or, more often, spray drying of milk and whey. Excessive emissions are often sporadic and happen during plant upsets, shutdowns or startups. The use of solid or liquid fuel such as briquettes and oil can result in fallout – carbonaceous ash particulate is usually emitted during boiler upsets or tube soot-blowing operations. Milk powder particles – while not toxic – accumulate on flat surfaces such as roofing, guttering and rainwater tanks, and may seriously compromise the quality of storm water discharged from the site or taint the drinking water. A further source of annoyance to residents and factory workers is powder settling on nearby motor vehicles. The drier emissions depend on the product being dried – for example, skim milk tends to result in the highest emissions.

15.3.4.1 Measures to reduce emissions: The suggested measures to reduce emissions are

- Maintain aerobic conditions for wastewater processing.
- Use filters or scrubbers to eliminate or reduce particles. (Particles less than 20mg/Nm$^3$ represents best practice.)
Dairy Plant Management and Pollution Control

- Use automatic process control.
- Carry out continuous routine monitoring of emission points using audible, visible alarms.

15.3.5 Control measures for air pollution:

Air pollution can be controlled by two fundamental approaches:

1. Preventive techniques
2. Effluent control

*The devices for removal of pollutants from the flue gases through scrubbers, closed collection recovery systems through which it is possible to collect the pollutants before they escape,

*Use of dry and wet collectors, filters, electrostatic precipitators,

*Providing a greater height to the stacks can help in facilitating the discharge of pollutants as far away from the ground as possible,

*Industries should be located in places so as to minimize the effects of pollution after considering the topography and the wind directions,

*Substitution of raw material that causes more pollution with those that cause less pollution can be done

15.4 NOISE POLLUTION:

Noise is undesirable and unwanted sound. Not all sound is noise. Sound is measured in a unit called the ‘Decibel’.

There are several sources of noise pollution that contribute to both indoor and outdoor noise pollution. Noise emanating from factories, vehicles, playing of loudspeakers during various festivals can contribute to outdoor noise pollution while loudly played radio or music systems, and other electronic gadgets can contribute to indoor noise pollution.

The permitted noise level is 125 decibels, as per the Environment (Protection) (second amendment) Rules, 1999. Location specific noise limits are mentioned below in the text.

15.4.1 Effects of noise pollution on physical health:

The excessive noise causes physical damage to the ear and the temporary or permanent hearing loss often called a temporary threshold shift (TTS).
It can cause harmful effects on the circulatory system by raising blood pressure and altering pulse rates.

It causes emotional or psychological effects such as irritability, anxiety and stress.

It also causes lack of concentration and mental fatigue.

It can also lead to lowered worker efficiency and productivity and higher accident rates on the job.

15.4.2 Ambient noise levels (db)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Day-time</th>
<th>Night-time</th>
</tr>
</thead>
<tbody>
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<td>50</td>
<td>40</td>
</tr>
<tr>
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<tr>
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<td>55</td>
</tr>
<tr>
<td>Industrial Zone</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

15.4.3 Noise in dairy plant:

The principal causes of continuous noise include:

* Air discharges from drier stacks.
* Heater fans.
* Air supply fans.
* Ventilation.
* Boilers.
* Pumps.
* Cooling towers.
* Refrigeration units.
* Aerators on aerated lagoons.

Truck movements to and from the site or in streets are a source of noise, as are refrigeration compressors on trucks. This is a particular problem when fresh milk delivery means late night
Noisy operations at dairy plants include milk drying – which requires high airflows – and the movements of transport vehicles to and from the site. Depending on the distance to sensitive receptors such as residential areas, suitable noise suppression or abatement measures – such as noise silencers on equipment, enclosure of outdoor equipment, concrete housing for mechanical plant, mufflers on transport vehicles – may be required.

15.4.4 Noise control techniques:

There are four fundamental ways in which noise can be controlled: i) Reduce noise at the source. ii) Block the path of noise. iii) Increase the path length. iv) Protect the recipient.

One of the best methods of noise source reduction is regular and thorough maintenance of operating machinery.

Source reduction can be done by effectively muffling vehicles and machinery to reduce the noise.

In industries noise reduction can be done by using rigid sealed enclosures around machinery lined with acoustic absorbing material.

Isolating machines and their enclosures from the floor using special spring mounts or absorbent mounts and pads and using flexible couplings for interior pipelines also contribute to reducing noise pollution at the source.

Noise levels at construction sites can be controlled using proper construction planning and scheduling techniques.

A smooth flow of traffic also causes less noise than does a stop-and-go traffic pattern.

Proper highway planning and design are essential for controlling traffic noise.

Establishing lower speed limits for highways that pass through residential areas, limiting traffic volume and providing alternative routes for truck traffic, construction of vertical barriers alongside the highway are effective noise control measures.

Planting of trees around houses can also act as effective noise barriers.

In industries different types of absorptive material can be used to control interior noise.

Increasing the path length between the source and the recipient offers a passive means of control.
Municipal land-use ordinances pertaining to the location of airports make use of the attenuating effect of distance on sound levels.

Use of earplugs and earmuffs can protect individuals effectively from excessive noise levels.

**15.5 SOIL POLLUTION:**

Soil is a thin covering over the land consisting of a mixture of minerals, organic material, living organisms, air and water that together support the growth of plant life.

**15.5.1 Causes of soil pollution:**

- Runoff from pollutants like paint, chemicals, rotting organic material leaching out of landfill
- Polluted water discharged from factories
- Oil and petroleum leaks from vehicles washed off the road by the rain into the surrounding habitat
- Chemical fertilizer runoff from farms and crops
- Acid rain i.e. fumes from factories mixing with rain
- Sewage discharged into rivers instead of being treated properly
- Over application of pesticides and fertilizers
- Purposeful injection into groundwater as a disposal method
- Interconnections between aquifers during drilling
- Septic tank seepage, Lagoon seepage
- Sanitary/hazardous landfill seepage
- Cemeteries, Scrap yards (waste oil and chemical drainage)
- Leaks from sanitary sewer

**15.5.2 Some effects of soil pollution:**

* Pollution runs off into rivers and kills the fish, plants and other aquatic life,
* Crops and fodder grown on polluted soil may pass the pollutants on to the consumers,
* Polluted soil may no longer grow crops and fodder,
* Soil structure is damaged (clay ionic structure impaired).
* Corrosion of foundations and pipelines.
* Impairs soil stability.
* May release vapors and hydrocarbon into buildings and cellars.
* May create toxic dusts.
* May poison children playing in the area.

15.5.3 Causes of soil degradation:

Soil erosion can be defined as the movement of surface litter and topsoil from one place to another. While erosion is a natural process often caused by wind and flowing water it is greatly accelerated by human activities such as farming, construction, overgrazing by livestock, burning of grass cover and deforestation.

Loss of the topsoil makes a soil less fertile and reduces its water holding capacity. The topsoil, which is washed away, also contributes to water pollution clogging lakes, increasing turbidity of the water and also leads to loss of aquatic life.

There are several techniques that can protect soil from erosion.

* Area treatment which involves treating the land,
* Drainage line treatment which involves treating the natural water courses.
* Continuous contour trenches can be used to enhance infiltration of water reduce the runoff and check soil erosion.
* These are actually shallow trenches dug across the slope of the land and along the contour lines basically for the purpose of soil and water conservation.
* These bunds are stabilized by fast growing tree species and grasses.
* In areas of steep slopes where the bunds are not possible, continuous contour benches (CCBs) made of stones are used for the same purpose.
* Gardenias can also be used to convert wastelands into agricultural lands.
* In this narrow trenches with bunds on the downstream side are built along contours in the upper reaches of the catchments to collect run-off and to conserve moisture from the trees or tree crops.
* Live check dams which barriers created by planting grass, shrubs and trees across the
gullies can be used for this purpose.

* A bund constructed out of stones across the stream can also be used for conserving soil and water.
Lesson :16
Water Pollution, Causes and Effects, Control Measures

16.1 INTRODUCTION:

Water is the essential element that makes life on earth possible. Without water there would be no life. We usually take water for granted. It flows from our taps when they are turned on. Most of us are able to bathe when we want to, swim when we choose and water our gardens. Like good health we ignore water when we have it.

16.2 WATER AVAILABILITY ON THE PLANET:

Although 71% of the earth’s surface is covered by water only a tiny fraction of this water is available to us as fresh water. About 97% of the total water available on earth is found in oceans and is too salty for drinking or irrigation. The remaining 3% is fresh water. Of this 2.997% is locked in ice caps or glaciers. Thus only 0.003% of the earth’s total volume of water is easily available to us as soil moisture, groundwater, water vapor and water in lakes, streams, rivers and wetlands.

- **Surface water:** Water that is found in streams, rivers, lakes, wetlands and artificial reservoirs is called surface water.

- **Ground water:** Water that percolates into the ground and fills the pores in soil and rock is called groundwater.

- **Aquifers:** Porous water-saturated layers of sand, gravel or bedrock through which ground water flows are called aquifers. Most aquifers are replenished naturally by rainfall that percolates downward through the soil and rock. This process is called natural recharge. If the withdrawal rate of an aquifer exceeds its natural recharge rate, the water table is lowered. Any pollutant that is discharged onto the land above is also pulled into the aquifer and pollutes the groundwater resulting in polluted water in the nearby wells.

16.3. CAUSES OF WATER POLLUTION:

There are several classes of common water pollutants. These are

16.3.1 Disease causing pathogens: Disease-causing agents (pathogens) which include bacteria, viruses, protozoa and parasitic worms enter water from domestic sewage and untreated human and animal wastes.

16.3.2 Oxygen depleting wastes: These are organic wastes that can be decomposed by aerobic bacteria. Large populations of bacteria use up the oxygen present in water to degrade these wastes. In the process this degrades water quality. The amount of oxygen required to break down a certain amount of organic matter is called the biological oxygen demand (BOD). The amount of BOD in the water is an indicator of the level of pollution. If too much organic
matter is added to the water all the available oxygen is used up. This causes fish and other forms of oxygen dependent aquatic life to die. Thus anaerobic bacteria begin to break down the wastes. Their anaerobic respiration produces chemicals that have a foul odor and an unpleasant taste that is harmful to human health.

16.3.3 Inorganic plant nutrients: These are water soluble nitrates and phosphates that cause excessive growth of algae and other aquatic plants. The excessive growth of algae and aquatic plants due to added nutrients is called eutrophication. They may interfere with the use of the water by clogging water intake pipes, changing the taste and odor of water and cause a buildup of organic matter. As the organic matter decays, oxygen levels decrease and fish and other aquatic species die.

16.3.4 Water soluble inorganic chemicals: These are acids, salts and compounds of toxic metals such as mercury and lead. High levels of these chemicals can make the water unfit to drink, harm fish and other aquatic life, reduce crop yields and accelerate corrosion of equipment that use this water.

16.3.5 Organic chemicals: These which include oil, gasoline, plastics, pesticides, cleaning solvents, detergent and many other chemicals. These are harmful to aquatic life and human health. They get into the water directly from industrial activity either from improper handling of the chemicals in industries and more often from improper and illegal disposal of chemical wastes.

16.3.6 Sediment of suspended matter: These are insoluble particles of soil and other solids that become suspended in water. This occurs when soil is eroded from the land. High levels of soil particles suspended in water, interferes with the penetration of sunlight. This reduces the photosynthetic activity of aquatic plants and algae disrupting the ecological balance of the aquatic bodies. When the velocity of water in streams and rivers decreases the suspended particles settle down at the bottom as sediments. Excessive sediments that settle down destroys feeding and spawning grounds of fish, clogs and fills lakes, artificial reservoirs etc.

16.3.7 Water soluble radioactive isotopes: These can be concentrated in various tissues and organs as they pass through food chains and food webs. Ionizing radiation emitted by such isotopes can cause birth defects, cancer and genetic damage.

16.3.8 Hot water: Hot water let out by power plants and industries that use large volumes of water to cool the plant result in rise in temperature of the local water bodies. Thermal pollution occurs when industry returns the heated water to a water source.

16.3.9 Oil: Oil is washed into surface water in runoff from machines (lubricant) which also pollutes ground water.

16.4 GROUNDWATER POLLUTION:
Groundwater is easy to deplete and pollute, it gets renewed very slowly and hence must be used judiciously. Groundwater flows are slow and not turbulent hence the contaminants are not effectively diluted and dispersed as compared to surface water. Moreover pumping groundwater and treating it is very slow and costly. Hence it is extremely essential to prevent the pollution of groundwater in the first place. Activities at dairy plants have the potential to contaminate both surface waters and groundwater. Water and land pollution can be avoided by appropriate siting, design, management and control of the dairy plant.

16.5 SOURCES OF DAIRY WASTEWATER:

Approximately 65% of dairy factory losses enter waste water discharge streams and these can have a major impact on the environment.

The main sources of dairy processing plant waste water are:

- raw material (predominantly milk) and product losses from leaking equipment and pipe lines, and spills caused by equipment overflows and malfunctions and by poor handling procedures
- materials used for cleaning and sanitising
- by-products such as whey from the manufacture of cheese and casein.

16.6 COMPONENTS OF DAIRY WASTEWATER:

The major contaminants in dairy processing waste water are milk solids that contain milk fat, protein, lactose and lactic acid. Other minor constituents include sodium, potassium, calcium and chloride. Organic wastewater strength is measured by either BOD or COD. Typical process wastewater has a biochemical oxygen demand (BOD5) of about 2,000 mg/L and a dissolved solids concentration of 1,800 mg/L. BOD5 is a measure of the amount of organic matter that is able to be biologically oxidized over a five day period. Whey has a BOD5 concentration of 30,000-40,000 mg/L. Where the whey is not used as a by-product but is discharged as effluent, it will increase the BOD level of wastewater and cause treatment and disposal problems. Whole milk has a BOD of 100,000 mg/L. Although the throughput of milk in dairy plants is generally increasing, the technologies available for reducing and recycling wastes means that the volume of water used and wastewater generated is significantly less in modern plants. Because of the highly seasonal nature of milk production, during peak periods the volume of wastewater generated at dairy plants may be several times greater than during off peak periods. The batch nature of many processes, and intermittent operations such as cleaning and sanitizing, also means a wide daily variation in wastewater flows and quality. Options for dairy factory wastewater include:

- treatment to a suitable standard for reuse or recycling
• discharge to local authority sewers under a trade waste agreement (with pre-treatment as necessary)

• appropriate treatment and land discharge wherever practicable and environmentally beneficial.

Many dairy plants have technologies in place for recovering wastewater and/or condensate (from production of milk powder) for reuse in the dairy plant. Reuse and recycling can considerably decrease the volume of main water required to operate the plant and also reduce the cost of both mains water and wastewater disposal. Fats, milk solids and minerals can also be recovered from wastewater and recycled – either at the dairy plant or offsite. Cleaning chemicals can also be recovered and reused on site. Treatment and discharge to land, the dissolved salts contained in dairy plant wastewater can adversely affect soil structure if wastewater is used to irrigate land. Wastewater can also leach into underlying groundwater and affect its quality. Dairy plants should maximise the recovery, recycling and reuse of acids and alkali to minimise the dissolved salts and sodium levels in the wastewater. High salt levels affect the type of vegetation that grows. The volume and organic load of wastewater from just one dairy factory during peak season may well exceed the township's domestic waste. This may overload the sewage treatment plant, cause odours and give rise to poor effluent quality.

16.7 TREATMENT OF A WASTEWATER SYSTEM:

16.7.1. Segregation: Waste streams from the plant should be segregated – for example, whey can be reused to produce whey powder or stock feed. Used up cleaning solutions should be separated from other wastewater streams as they can be treated to recover cleaning agents. Highly saline wastewater should also be discharged separately to an evaporation pond where the salts can be recovered and recycled.

16.7.2. Equalisation and pH control: A balance tank or pond is used as equalisation tank to control pH and temperature. pH can be controlled by adding used up acid and alkali cleaners to neutralise each other.

16.7.3. Fat removal: Coarse milk solids should be removed by screening. Fats can constitute up to 50% of the organic load. Its recovery is therefore significant in any treatment process. Dissolved air flotation is a very effective method of separation of fat.

16.7.4. Removal of organic load: Organic load can be reduced by physical methods – such as microfiltration, reverse osmosis and flotation techniques – or by biological treatments – such as activated sludge systems, trickling filters and anaerobic digesters. Lagoons, land irrigation and grass filtration systems can also reduce organic loads but reduction will occur at a slower rate than the previous methods. Best practice management of the waste stream may include removal of product before treatment.
Activated sludge: A highly effective method for treatment of dairy plant waste water is the oxidation ditch. This is a development of the extended aeration process where aeration, settling and withdrawal of effluent all takes place in the same tank. The oxidation ditch process is characterised by a long retention time and low net sludge yield. This type of treatment lends itself to biological nitrogen removal.

Trickling filters: The best trickling filters have a free passage of air to prevent the generation of odours but are sensitive to high or low pH which may result in killing the biomass.

Lagoons: Highest quality wastewater and low odour generation can be achieved in aerated lagoons which use floating aerators to force oxygen input and reassemble activated sludge systems.

16.7.5. Advanced treatment for reuse

Membrane filtration: This process has the potential for acid and alkali recovery and recycling. Best quality wastewater is obtained by pumping effluent through porous media containing millions of tiny pores. The media area is regularly cleaned by high pressure backwash using water and/or air. The removal of dissolved solids is best achieved by the passage of water through a semi-permeable membrane that restricts the movement of salts. This process for the desalination of wastewater is based on the osmotic pressures on either side of the membrane.

16.7.6. Land irrigation: In some areas, treated wastewater can be either sprayed on the land or used for irrigation.

16.8 MEASURES TO REDUCE WATER POLLUTION IN DAIRY PLANT:

The following measures have to be taken to control the water pollution in dairy plant.

- Prevent/reduce raw material and product losses.
- Reduce water usage (as minimum as possible)
- Treat wastewater to a suitable standard for reuse or recycling
- Design and construct wastewater treatment system and use the waste water for irrigation.
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