Planning a Dairy Plant

Points to be considered by NEW ENTREPRENEUR in setting up a Dairy Plant

- Consumer profile
- Marketing Potential
- Location of the Plant
- Availability of milk
- Milk to be handled
- Product mix
- Availability of required quantity of potable water
- Availability of funds
- Seasonal fluctuations in the availability of milk
- Type of milk available-cow or buffalo or both in what quantities
- Milk is highly perishable if not chilled to less than 4 degree Celsius or Pasteurized or any other process within 4 hours of milking. To meet this timeline two Plants are suggested.

If the planning is to market packed milk and products, preference is to packed milk, balance available milk is converted to products.

Rural Dairy

In the rural areas, where plenty of milk is available at reasonable price but there is no market, a 100,000 liters capacity per day dairy can be set up, with facilities to convert milk into powder, butter, ghee and marketing liquid milk in bulk. This bulk milk can be transported to a dairy near the urban areas (URBAN DAIRY) to pack and market milk and milk products to targeted consumers. Both dairies can be owned by the same entrepreneur or an arrangement with other.

Market Milk Plant / Urban dairy of 50,000 liters capacity, selling liquid milk to urban consumers is a profitable and safe venture. Based on logistics, milk can be procured from rural dairy in bulk or directly from producers or from chilling centers, set up by this dairy at convenient milk collecting locations.
The demand is constantly increasing due to rapid growth of middle class urban population. Testing facilities at milk collection centers, processing, packing, and product manufacturing facilities have to be created to ensure quality as defined for milk and milk products in FSSAct-Rules & Regulations are maintained throughout the chain.

**Essential Features in Planning of “Market Milk Plant”**

The capacity of the milk plant in terms of handling milk and the equipment required for receiving, processing, storage and packaging of milk is based on the following essential features of plant operation:

- Marketing Potential
- Availability of raw milk, quality and price
- Product mix

**Marketing potential:**

Milk is an essential commodity for any household. The demand is constantly increasing due to rapid growth of middle class urban population. Towns and cities have significant scope for sale of quality liquid milk.

The financial viability of the project is directly related to the milk marketing capacity of the plant. The lower the volume higher is the risk of running into losses. Milk plant of 50,000 LPD is considered economically viable. It may take two to three years to reach the targeted capacity. Efforts to market milk and products should never be stopped. Substantial investment is required towards brand building.

**Availability of Raw Milk, quality and Price:**

Seasonal fluctuation in the milk production termed as ‘Flush’ and ‘Lean season.’ Earlier it was 2:1, but it has been considerably reduced due to availability of crossbred Cows. Facilities should be available to use milk powder and butter in lean season. Prime consideration is to procure adequate quantity of good quality milk. Procurement price should be reasonable.
Each milk collection centre has to be equipped with milk testing and measuring facilities to ensure milk quantity of acceptable quality.
The milk is usually transported in hired trucks in 40 liter cans.
If the milk producing area is far away from the processing plant, say about 50 km and beyond, it is necessary to provide chilling facilities to cool the milk to 4 degree C before transporting to the dairy in the hired insulated road milk tankers.

**OR**

Install ‘Bulk Milk Cooler’ of 1,000 to 2,000 liter capacity each to chill milk at the village level

**OR**

Setup a full-fledged ‘Chilling Centre’ of 10,000 to 50,000 liter capacity for a cluster of villages. Chilling provision prevents the milk from turning sour.

- market milk plant may not necessarily have its own procurement system of raw milk.
  It can tie up with other dairies or chilling centers to buy the required quantity and quality of milk within a reasonable price limit.
In such cases, no investment is required on the milk procurement system.

- **Product Mix:**
  - In a market milk plant, the majority of milk is sold is liquid milk.
  - Small percentage is converted to value-added products, depending on the local consumer preference.
  - Buffalo milk contains minimum 6% fat and 9% solids-not-fat (SNF).
  - Cow milk has a minimum of 3.5% fat and 8.5% SNF.
  - Mixed milk (buffalo+cow) normally contain fat from 5% to 5.5% and SNF 8.5% to 8.7%.
  - Milk is standardized as toned, double toned, standardized, Cow, Buffalo or FCM.
  - If packed as cow/buffalo It has to be pure, no mixing is allowed.
  - During the standardization process, milk fat and SNF are adjusted to the required levels
  - Specifications for various types of milk are available in FSS Act.
Rural Dairy

- ‘Rural Dairy’ is set up when milk is available in abundance but, there is no market in that area.
- Best form of preserving milk fat is to convert it into butter and ghee.
- Solids-not-fat (SNF) to skimmed milk powder (SMP). The prevailing situation offers an opportunity to undertake manufacture and market SMP, butter and ghee locally.
- For selling butter, a chain of deep freeze facilities is required at consumer outlet points.
- Safest way to start is to manufacture and pack SMP & Ghee.
- Rural Dairy should be of minimum 1,00000 LPD capacity with a powder plant of minimum 10 MT capacity for an assured return on the investment.

Investment Decision

A techno-economic feasibility report has to be prepared for submission to the bank for financing the project. The key indicators are:

1. Break-even analysis
2. Internal rate of return
3. Sensitivity analysis

In layman’s language, there must be sufficient margin available between the purchase and selling price of milk and milk products to cover all the overhead costs (fixed and variable) plus profit to repay the loan amount plus interest to the bank within the scheduled period. The fixed costs are: interest on the capital and depreciation on the plant equipment and building.

Cost Estimates

The cost estimates of a dairy project are broadly divided into the following three sections:

- Plant and equipment
- Utilities/service equipment
- Land and civil construction works
Plant and equipment

The equipment and their rated capacity are based –

1. On the process requirement and
2. Future scope of expansion of the dairy plant.

If a pasteurizer of 10,000 litres/hr is selected, the other equipment connected in line like Separator, Homogenizer should have the matching capacity.

When this plant is expanded to handle 100,000 litres of milk per day, the same pasteurizer can take care of the extra load by running the initial investment on the plant. If there is a fund constraint, a pasteurizer of 5,000 litres/hr. with matching capacity separator and homogenizer line may be installed, leaving enough space to install a parallel line at the time of future expansion of the plant. Therefore, selection of the process equipment should not only consider existing load but also of the future extra load as well as availability of funds.

Similarly, the utilities/service section equipment (transformer, boiler, refrigeration plant, cold store, well water pump and water storage facilities) should be decided keeping in view the future expansion of the plant. However, milk storage tanks, silos, cream storage tanks, pouch filling machines required for packaging of milk, milk testing equipment, milk cans for procurement, crates for milk marketing should be purchased in phases as per requirement. This can considerably help in reducing initial investment on the project.

Utilities/service Section Equipment

Water, steam, power and refrigeration needed in a dairy plant would be as per their requirement given by the manufacturers of equipment.

The capacity of each of the service equipment is decided according to their peak load demand in relation to operational hours of the plant. It is better to install service equipment in parallel, in order to cope with the variable service load. Besides, it acts as stand-by unit in the event of any breakdown.

Land and Civil Construction Works

Land: Keeping in view the future expansion around 10,000 square metres of land is required for a one lakh litre dairy plant. In the selection of site, the following points should be kept in view:

The level of the land should be high enough to avoid flooding of the area during monsoon season while the dairy effluents can be easily discharged into the drain on a natural gradient of the land;
There must be clean environment around the plant site in order to maintain hygienic standard of the milk plant; and

The cost of the land should not be exorbitant to avoid unnecessary escalation of the project's capital cost.

**Design and Construction of Building**

The equipment layout and building design have to be integrated to ensure that there is adequate space around the equipment for men and material movement and for maintaining hygienic standard for safe processing and storage of milk and milk products.

While designing the plant, due consideration should be given to the statutory and other legal requirements.

The dairy building is sub-divided into following sections:

(A) Dairy block  (B) Service block  (C) Ancillary structures.

**(A). Dairy Block:**

It is the heart of the building, where the following operations take place and each operational area is separated by partition walls to maintain hygienic standards. They are:

1. Milk filled cans reception section
2. Milk processing and storage section
3. Milk products manufacturing sections
4. Packaging sections are separately provided for milk, butter, ghee and milk powder
5. Empty pouch crates reception and washing sections are adjacent to pouch filling section
6. Milk and milk products like butter, ghee, milk powder storage rooms are adjacent to their respective packaging sections
7. Quality control laboratory
8. CIP (Chemical and detergent stores)
9. Miscellaneous items and packaging material stores.

The dairy block has several special design features which are discussed here:
• The plinth level should be 1,100 mm to facilitate loading and unloading of milk cans, crates and loading of packed milk products on the truck from the dairy dock.

• The milk reception dock, cold store, deep freeze and milk pouch crate areas have cast iron/Mandana stone flooring.

• The process hall has Mandana stone flooring.

• The other areas of the dairy block have Kota stone or terrazzo tiles.

• The milk reception dock, can washing area, crate washing area, pouch filling area, milk and milk product processing hall and cold store have dado of Kota stone / glazed tiles up to a height of 1.5 metres to prevent absorption of moisture on the wall and to prevent growth of mould.

• The dairy building is subjected to frequent washing and cleaning and hence the floor should have proper slope, special water sealed trap. Brass covered c.r. drains are laid in the floor for proper drainage of dairy wash water to the effluent treatment plant.

• The height of the building should be adequate for proper ventilation but at the same time, all measures should be taken to prevent entry of birds, flies, insects, dust and dirt.

• Inside the building there should be proper moisture protective good lighting system.

• All the doors and windows should be made of steel or aluminium, non-absorbent to water.

• The building design and site layout should have provision for future expansion.

(B) Service Block:

In this block, electrical substation, steam generation unit, refrigeration plants are installed inside the building in separate rooms.

while the Fuel oil storage tanks are installed outside the building. Here too, the statutory provisions as given by the explosives, electrical, boiler and factory inspectorate should be kept in view.

The building is constructed of steel structure with IPS ironite flooring and plinth level at 500 mm. The construction cost is much lower as compared to the dairy block.
(C) Ancillary Structures:

The ancillary structure comprises overhead RCC water tank, hard park, internal tarmac roads, compound wall and effluent treatment plant. The dairy surroundings need to be maintained clean in order to maintain hygienic standard within the dairy processing area. Therefore, road should be tarmac and good lawn should be maintained with proper drainage to keep it dust and dirt free.

The most important is the design and construction of effluent treatment plant (ETP), with proper arrangement to either drain the treated water or utilize it in the maintenance of lawn and garden. The pollution control board has laid down statutory requirements and those must be fulfilled before getting clearance to run the plant.

Project Execution

Given below is a broad guideline on project execution:

- The preliminary project report (prepared by self or with the help of outside agency) to be submitted to the bank for loan.
- After financial sanction, prepare a detailed project report.
- The detailed project report should include selection of site, architectural drawings of buildings, civil tender document, and dairy plant, equipment and service equipment tender document.
- Establish a project cell to implement and monitor the progress of the project.
- The project cell has to discharge the following tasks:
  - Coordination with consultant for preparation of plans, drawings, civil and equipment specification, invitation of tender and award of work. Coordination with State Government and other statutory authorities for timely completion of projects. These authorities are factory inspector, electric inspector, boiler inspector, and pollution control board.
  - Coordination with the concerned agencies to ensure that all infrastructure facilities are available on time. These facilities are construction of approach road, temporary power connection during construction period and permanent power connection at the time of commissioning of plant, supply of water from corporation or by boring of tube well.
Besides, public drainage line should be accessible to connect treated dairy effluent line.

- Hiring or construction of temporary warehouse for safe storage of plant and equipment, building materials, etc, received at site.
- Arrangement of proper security at site.
- Holding coordination meetings with all concerned agencies to review progress of the project work.
- Recruitment of personnel for the milk plant and organization of their training in its operation, maintenance and management.
- Purchasing of consumable store items like chemicals, detergents, glass-ware, oils, lubricants and packaging materials prior to commissioning of the plant.
- Liaisoning with the bank to maintain proper flow of funds for timely payment to suppliers and contractors.
- Maintenance of project account, auditing of account and periodic review of progress of fund utilization.
- Along with the progress of milk plant construction, field survey work must be taken up to identify milk procurement routes, village milk collection and chilling centres, selection and training of personnel for management of chilling centre, running and maintenance of bulk milk cooler and testing of milk. A proper plan of sales promotion and advertisement to be launched for consumer awareness about the availability of milk, time of supply, prices, brand name and location of milk selling booths.
- Selection of milk vendors or booths agents and their terms of contract. The project must be cost effective, functional and its execution should be left to the professionals. The target should be to complete the project within the time.

**Product Manufacturing**

The cost estimate of plant and equipment for production of ghee, chhach, lassi, dahi and paneer is given below:
Ghee

The production programme is planned to convert 1,000 kg of cream containing 40%, fat to ghee, after conversion of cream to butter and later from butter to ghee. Equipment required are:

1 Cream storage tank-1,000 litre
1 Cream chiller-1,000 LPH
1 Cream pump-1,000 LPH
1 Butter churn - 500 kg
1 Butter trolley - 200 kg
1 Butter melting vat- 500 kg.
1 Steam jacketed pan with agitator 500 kg
1 Ghee settling and storage tank-500 kg
1 Ghee pump-500 LPH
1 Ghee pouch filling machine-500 pouches/hour

Total cost: 12.00 Lakhs

Chhach and Lassi

The estimated production per batch is 5,000 htres. Equipment required are:

1 Curd setting-rum-mixing tank-5,000 litres
1 Chhach storage tank-5,000 litres
*1 PHE (Chilling 4 Degree, heating in two stages 40° and 90°)-2,000 LPH
*1 Multipurpose vat and pump- 1,000 Htres
*1 Balance tank-50 litres
*1 Milk pump-2,000 LPH
1 Homogenizer-2,000 LPH
1 Steam jacketed pan-500 litres
1 Pouchfillingmachine-2,000 pouches/ hour

Total cost: Rs. 20.00 Lakhs

*These equipment are common for lassi, chhach and dahi. In this estimate, the cost of steam jacketed pan has not been included, since it is already available for production of ghee. This equip-
ment is required for production of sugar syrup in batches for lassi production only. The homogenizer is not essential for lassi but it is required for chhach.

**Dahi (500 kg/batch)**

The additional equipment required for manufacture of dahi are:

2 Starter Culture mixing milk-tanks before cup filling machine of 50 litres each  
1 Preformed Cup filling and sealing machine-1,000 cups/hour  
1 Incubation room for maintaining temperature at desired temperature.

**Total cost: Rs 3.00 Lakhs**

In this cost estimate, the cost of common equipment is excluded. For the incubation room, the cost of thermostatically controlled heater has been included, while the cost of the construction of the incubation room is part of building cost, hence excluded. The most costly item is the cup filling machine. An automatic machine may cost around Rs 10 lakhs. Here a semi-automatic machine has been considered costing around Rs 2 lakhs.

**Paneer**

Here the list of equipment and estimated cost is given for production of 48 kg paneer from 300 litres of milk per batch (the yield of paneer depends on the total solid in the milk):

1 Paneer vat-400 litres  
1 Chilled water tank-400 htres 1 Paneer press  
10 Paneerhoofs (each hoof can hold 5 kg) 1 SS table and knives.

**Total cost: Rs.3.00 Lakhs**

In this cost estimate, cost of PHE for initially heating milk to 90°C has not been included since it is already available in the lassi and chhach section of the dairy. No packing machine has been included presuming manual packaging.
Continuous Paneer manufacturing machines are also available in the market along with packing facilities.

**Factory Location - Some guidelines:**

A Suitable site must be located for establishment of the dairy plant. Prior to the selection of site, Approximate land area required for the factory must be known. Due attention should also be paid to orientation of the building, keeping in view the north-south points, wind direction, approach road and final effluent discharge point.

The hygienic environment around the factory is the top priority in the selection of site. It should be located in such areas, which are free and likely to remain free, from flooding and objectionable odours, smoke, dust and other contaminants. The best course is to obtain flood level data from the local authorities to ensure that the area is not prone to flood.

The surroundings of the premises should have no trees, food stores, free from refuse, rubbish, overgrown vegetables and waste materials. These attract insects, birds, rodents, which would finally enter the dairy premises. Another essential requirement is the source of adequate supply of water, either underground (tube well) or from municipality. The quality of water must be tested, particularly to detect level of carbonates and bicarbonates of calcium to determine hardness of water and minerals as well as iron. If the water is hard, it causes scaling. Consequently, water treatment and often installation of a demineralization plant become essential.

There must be adequate space for construction of the effluent treatment plant (ETP) at such a location and distance, in relation to the prevailing wind, so as to avoid pollution of milk products processing and storage areas. A nearby drain or water stream is essential to discharge the treated effluent water.

The sub-soil condition is required to be investigated to estimate cost involved in laying the foundation of the building. For instance, ‘pile foundation’ is costly, but cannot be avoided if there is black cotton soil or the load bearing capacity of the soil is poor.
Location of the electrical sub-station and its capacity, location of poles, HT/LT lines, require investigation to estimate expenditure on connecting the power lines from the nearest pole or sub-station to the factory site is essential.

The site must be approachable from the main or lateral road if required, by constructing service road and culvert up to the factory premises, for movement of transport vehicles. Availability of public transport system for to and from movement of employees must be checked If such facilities are not available while the site fulfils all other criteria, employers may consider providing transport facilities to their employees.

While drawing a site map, contour of the land, north point, wind direction and other relevant information must be recorded to facilitate general layout of the building with proper orientation and to estimate cost involved in the excavation or filling of the land, road and building construction areas.

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