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CERTIFICATION COURSES

Dairy and Food Process and Products Technology

PROF. TRIDIB KUMAR GOSWAMI
AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT
IIT KHARAGPUR

Lecture No. 56 : Over Run and Calculation for Preparing Ice Cream Mix

OVERRUN

BY VOLUME

$$\text{Overrun \%} = \frac{\text{volume of ice cream - volume of mix}}{\text{Volume of mix}} \times 100$$

e.g., ((9.5 - 5.0) / 5.0) X 100 = 90%

BY WEIGHT

$$\text{Overrun \%} = \frac{\text{Weight of I gal mix - weight of 1 gal ice cream}}{\text{Weight of 1 gal ice cream}} \times 100$$

e.g., ((8.85 - 5.06) / 5.06) X 100 = 74.9%

1 gal = 3.7854 Lit.

Example :

If 20 litre of fruit weighing 5 kg/litre is added to 100 litre of mix weighing 4.5 kg/litre, and 200 litre of ice cream is produced, what is the overrun in the mix?

Solution:

Ignoring fruit in the mix,

Overrun = (200-100)X100/100 = 100%

Considering fruit in the mix,

Overrun = (200-120)X100/120 = 66.6%

Then actual overrun is (200 - (100+20))X100/100 = 80%

Percentage of water frozen:

Temp ^{o}F									
25	*24*	*23*	*22*	*21*	*20*	*19*	*18*	*17*	*-15*
Water frozen %									
33	*41*	*47*	*52*	*56*	*59*	*62*	*64*	*67*	*90*

Thank You!!

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Lecture No. 57 : Transportation of Ice Cream vis a vis Frozen Foods

Transportation of

ice cream

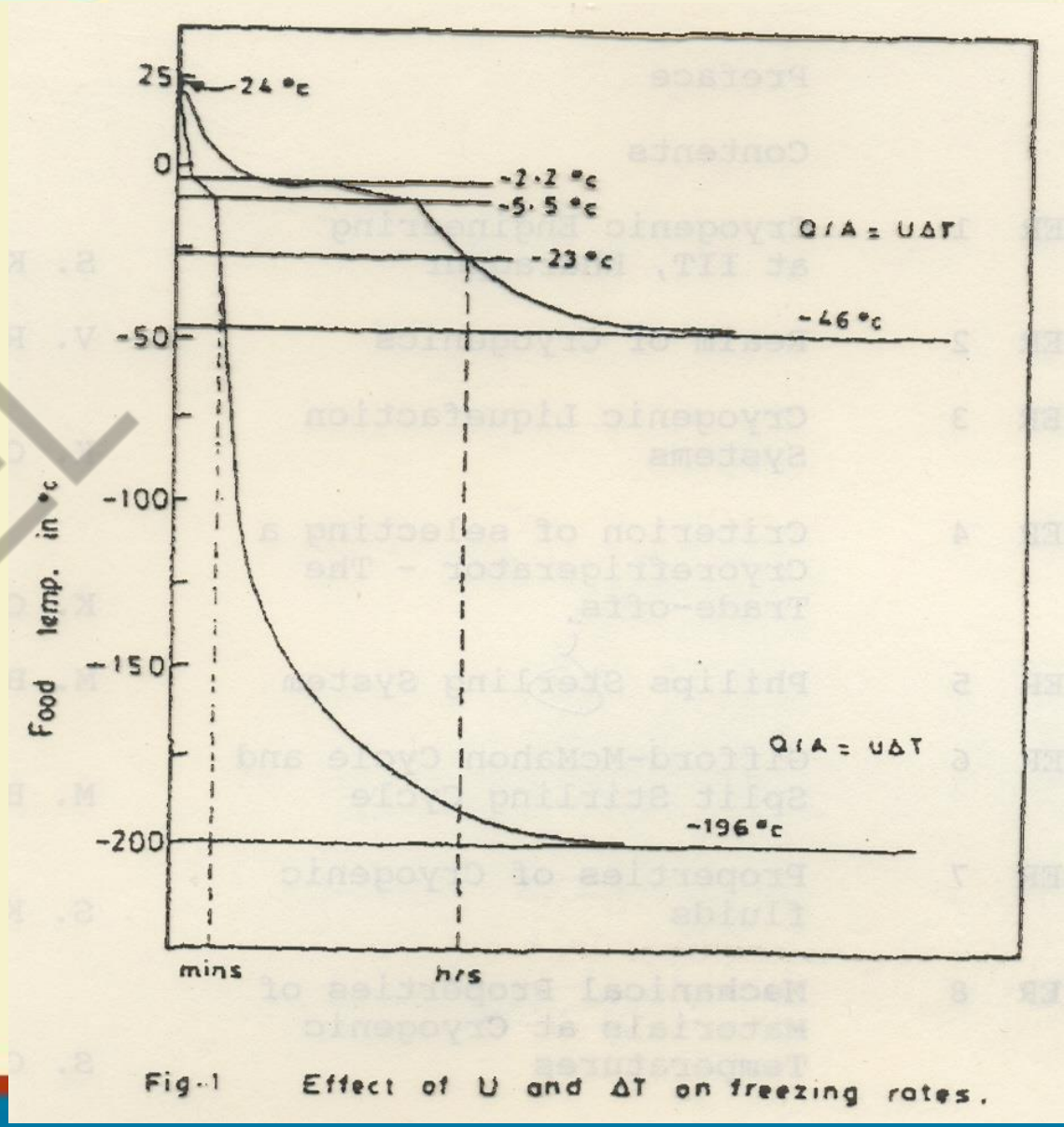


Fig.-1 Effect of U and ΔT on freezing rates.

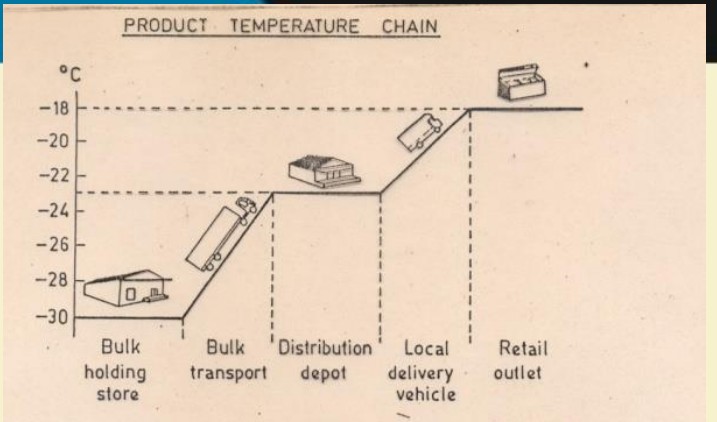


Fig. 2.5 Product temperature chain (Cardy,1969).

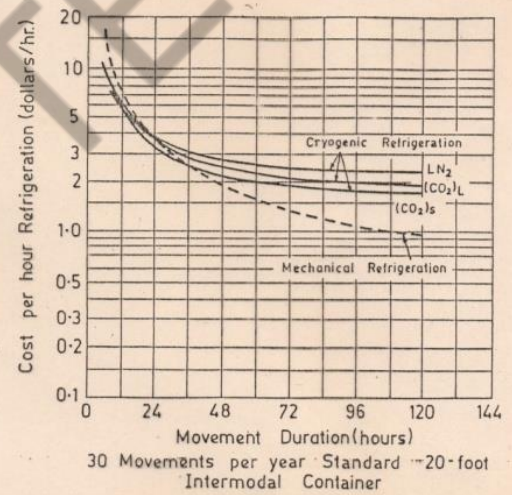
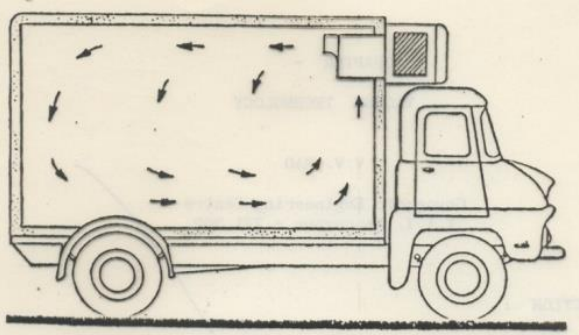
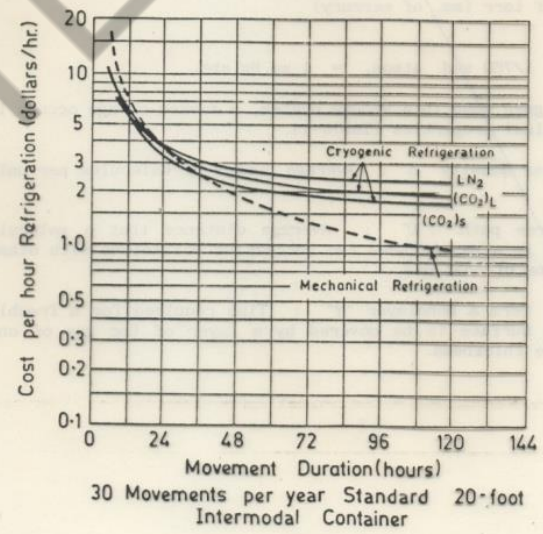


Fig. 2.6 Comparative refrigeration costs for transporting frozen cargo by cryogenic and mechanical refrigeration system (Richardson and Pastuhov, 1969)



Mechanically refrigerated transport system (Raychaudhuri,1978).



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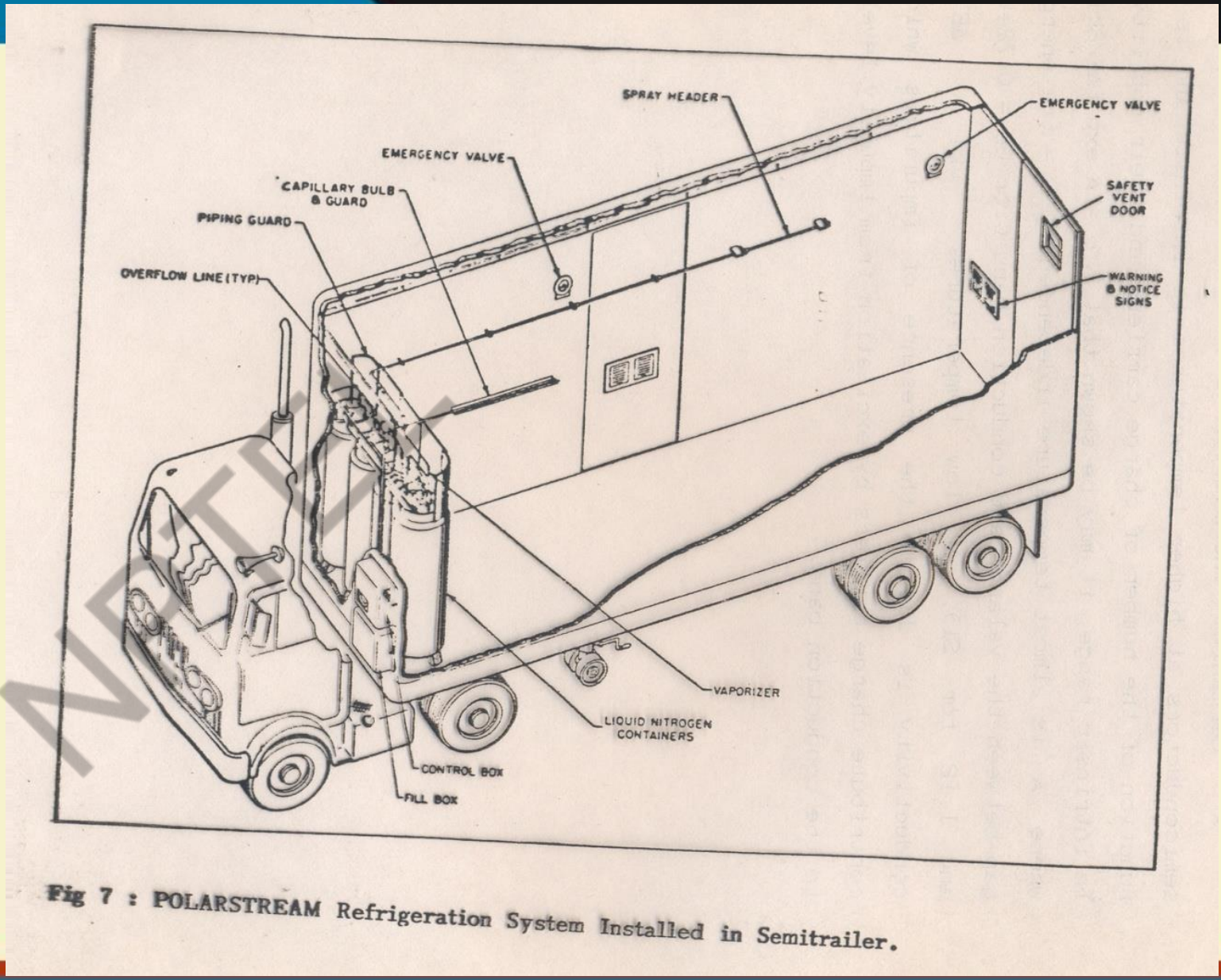
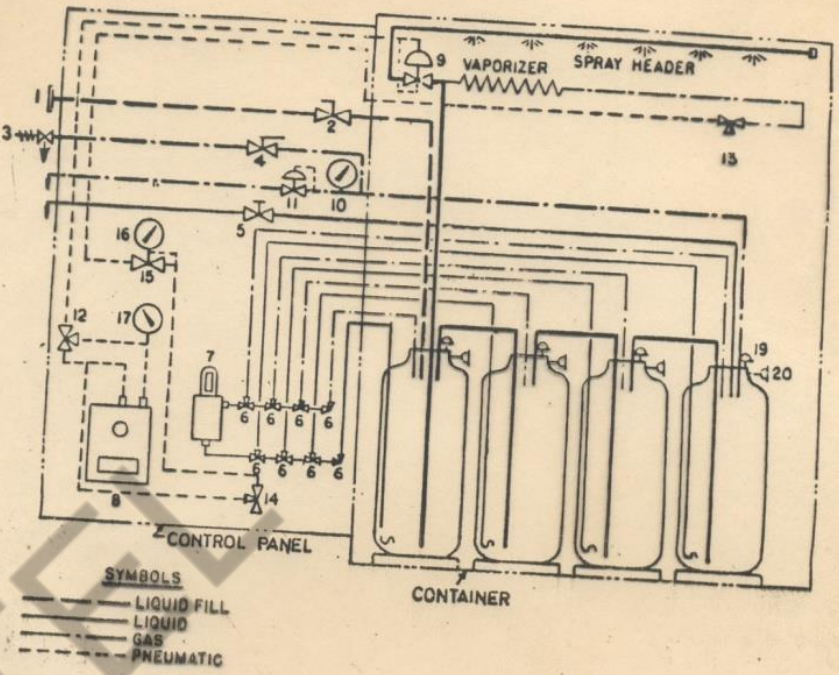


Fig 7 : POLARSTREAM Refrigeration System Installed in Semitrailer.



LEGEND

1. LIQUID FILL CONNECTION
2. LIQUID FILL VALVE
3. BACK PRESSURE RELIEF VALVE
4. GAS VENT VALVE
5. FULL TRYCOCK
6. LIQUID LEVEL GAUGE VALVES
7. LIQUID LEVEL GAUGE
8. TEMPERATURE CONTROLLER
9. LIQUID CONTROL VALVE
10. CONTAINER PRESSURE GAUGE
11. PRESSURE RELIEF VALVE(22 PSIG)
12. PNEUMATIC RELAY
13. EMERGENCY VALVE
14. MAIN CONTROL VALVE
15. PRESSURE REGULATOR
16. PRESSURE REGULATOR GAUGE
17. CONTROLLED PRESSURE GAUGE
18. AUTOMATIC VENT CONTROL VALVE
19. CONTAINER BURSTING DISK(275 300)
20. CASING BURSTING DISK(18 PSIG)

Note : The individual components may not be installed in the relative locations shown on the diagram.

FIG. 8 : FLOW DIAGRAM

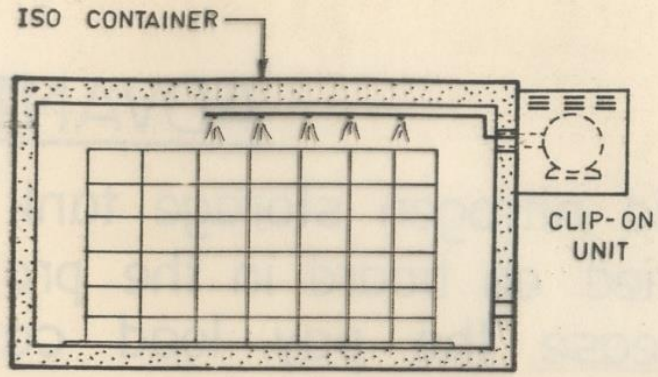


Fig. 10 Sectional sketch diagram of polarstream clip-on.

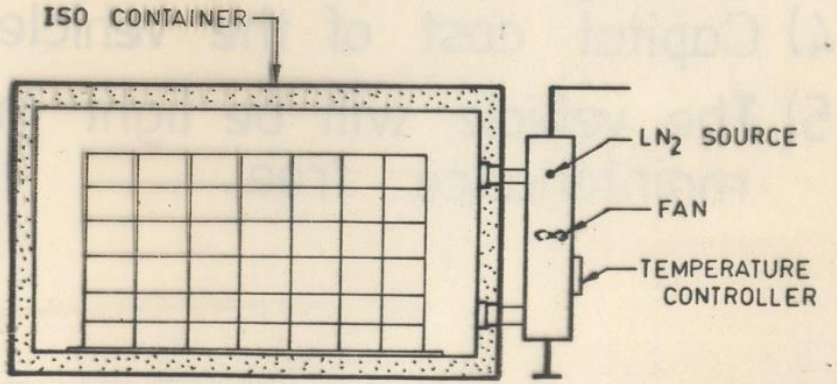
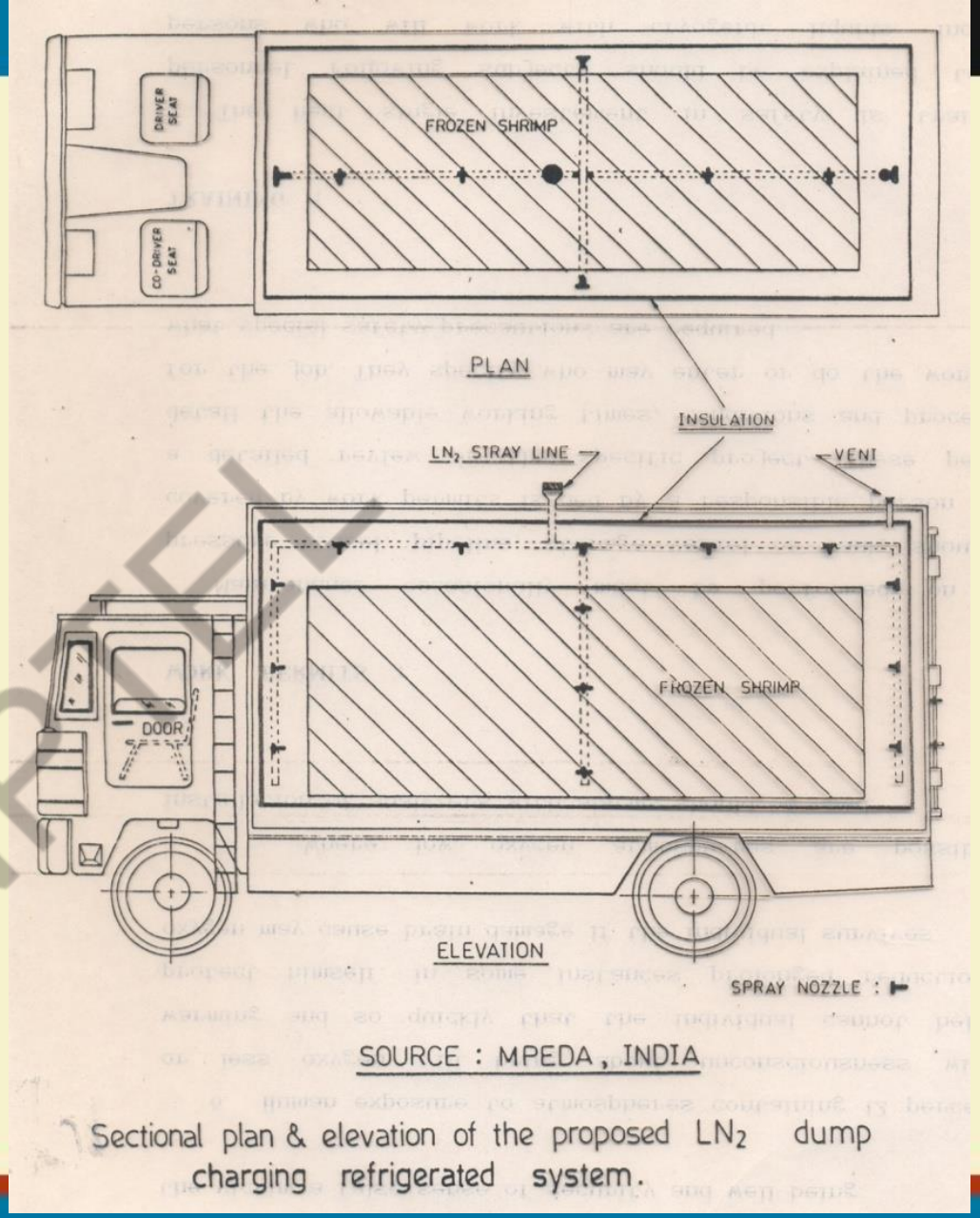
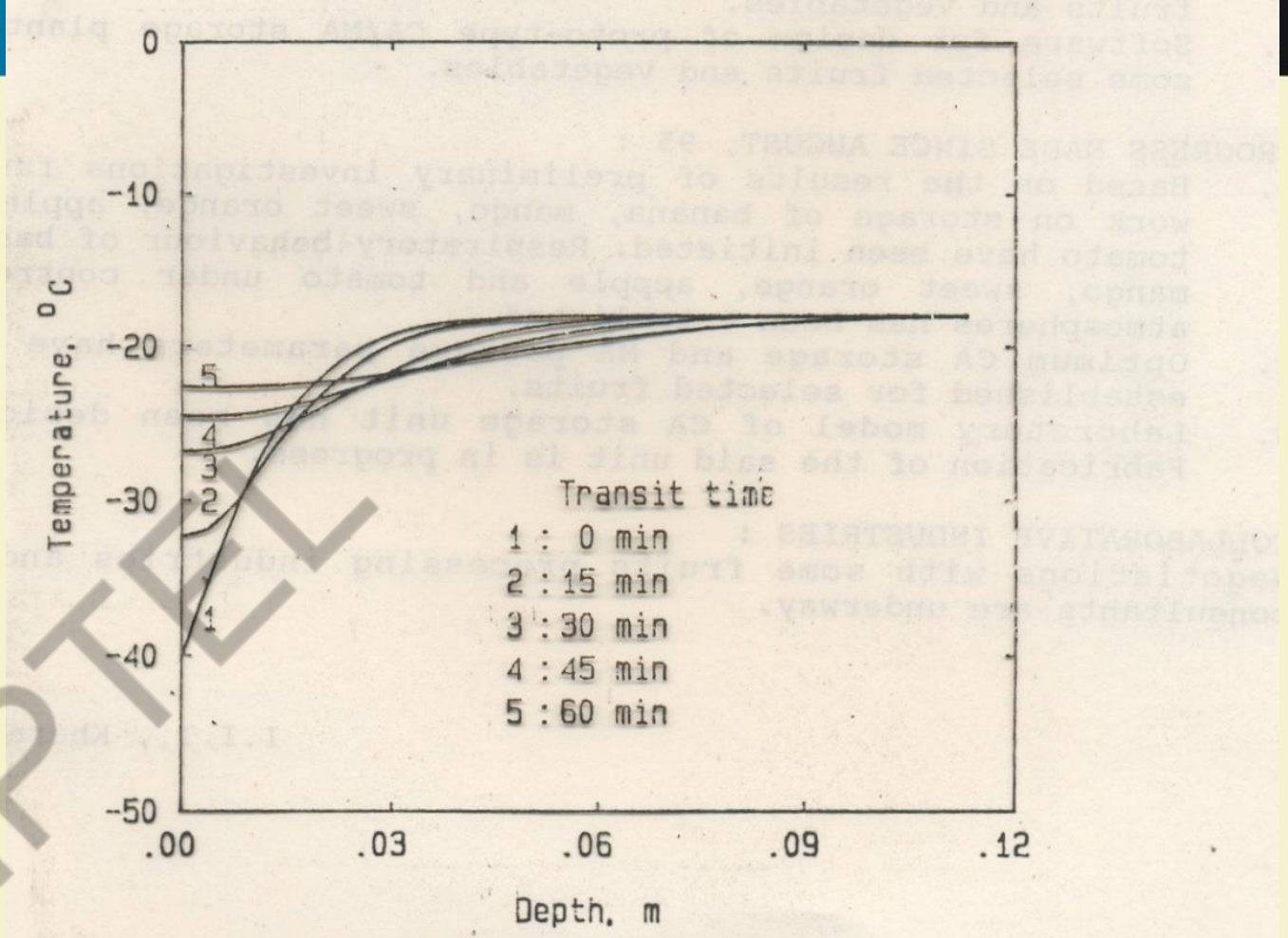


Fig. 11 Sectional sketch diagram of cryofan.

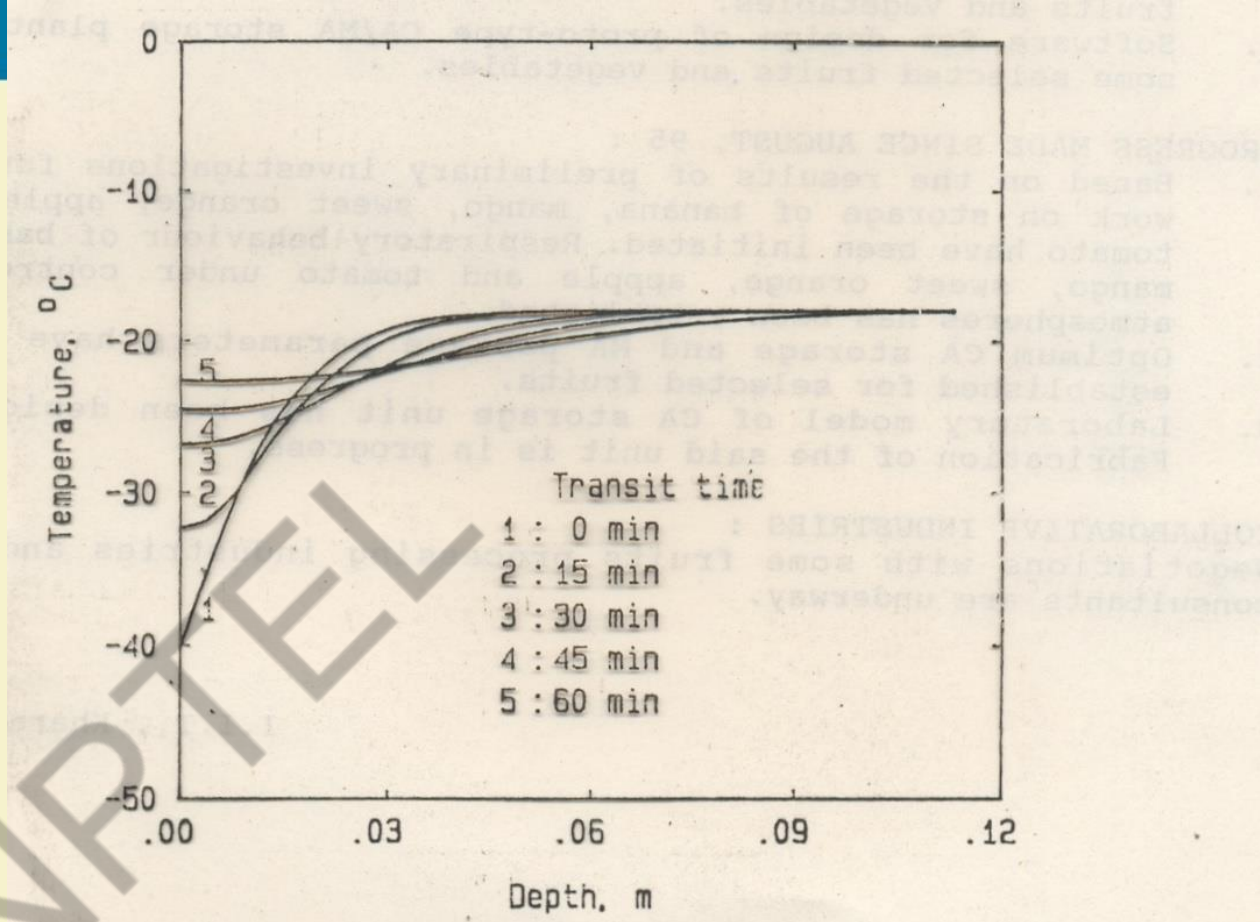


SOURCE : MPEDA, INDIA

Sectional plan & elevation of the proposed LN_2 dump charging refrigerated system.



Temperature profiles in the frozen shrimp block along a length of 1.88 m during transit : (1) immediately after spraying, i.e., t = 0 min, (2) t = 3 min, (3) t = 15 min, (4) t = 30 min, (5) t = 60 min. Liquid nitrogen consumption = 90 kg. Initial temperature = -18 °C, ambient temperature = 30 °C.



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Thank You!!

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Lecture No. 58 : Packaging of Food Materials

Vacuum Packaging:-

Vacuum packaging is another way to increase the shelf life of food products. Here the product is placed in an air-tight pack, the air sucked out and the package is sealed. By removing air from around the product, the levels of oxygen in the packaging are reduced, impeding the ability of oxygen-breathing microorganisms to grow and spoil the product. The lack of oxygen also reduces the amount of spoilage due to oxidation – the process that causes apples and bananas to turn brown, for example.

A certain amount of oxygen will remain, however, because it is not possible to create a total vacuum. Air contains around 21 per cent oxygen at normal atmospheric pressure – 1000 millibar. As the air is withdrawn during the vacuum packaging process, the pressure inside the package is reduced.

If, for example, the pressure is reduced to 100 millibar, an equivalent of around 2.1 per cent oxygen will remain; if it is reduced to 10 millibar, there will still be in effect 0.21 per cent oxygen present.

Is vacuum packaging more effective than modified atmosphere packaging? As with most things, it is a case of 'horses for courses' (racehorse performs best on a racecourse to which it is specifically suited) – it depends on the product being packaged.

Flushing with inert gas:- Benifits

- Nitrogen (N_2) is an inert gas, and is used as a filler gas because of its insolubility in water.
- Nitrogen on its own can delay oxidative rancidity in low water activity products.
- Flushing of potato crisps with nitrogen is said to increase the shelf – life from about 60 days without N_2 to about 120 days with N_2.
- Another advantage of N_2 flushing is that uniform pillow packs are produced, which prevent damage of the fragile snack products during handling and distribution.
- **The use of gas flushing has brought improvements in the barrier properties of packaging materials and in seal performance.**
- The use of this technique has been shown to double or triple the shelf – life of these products

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Lecture No. 59 : Modified Atmosphere Packaging

Modified Atmosphere Packaging (MAP):-

Genesis:- Normal air contains 21% O_2 and 0.03% CO_2.

it was found that low O_2 and high CO_2 levels slow ripening, reduce the development of some peel disorders and inhibit pathogen growth.

MAP was first recorded in 1927 as an extension of shelf-life of apples by storing them in atmospheres with reduced O_2 and increased CO_2 concentrations.

In the UK, Marks and Spencer introduced MAP meat in 1979. In 1981, bacon, fish (both fresh and cured), sliced cooked meats were introduced into the commercial market.

What is meant by MAP?

Modified Atmosphere Packaging (MAP) is a long established and continuously increasing technique for extending the shelf-life of fresh food products.

It requires specialized machinery to flush out air from the packaging and replace it with a different gas or mixture.

MAP aims to provide longer shelf-life, maintain sensory attributes like colour or appearance and achieve the food safety of the product.

Gases used in MAP and their functions:-

- **Carbon di oxide (CO_2)** – it inhibits the increase of most aerobic bacteria, and is the most important gas in MAP. Tentatively, the higher the [CO_2] the longer the durability of the perishable food.
- **Nitrogen (N_2) –** An inert gas used to expel air, especially O_2 out of the packaging, used as a filling gas to equalize the effect of CO_2 absorption by the perishable.
- Oxygen (O_2) – Should be excluded from MAP, except some cases where it can bring positive results in food preservation, helps in keeping colour, makes respiration possible.

Novel MAP gases used:- **High O_2 MAP, Argon, and Nitrous Oxide (N_2O) MAP.**

- High O_2 MAP inhibits particular enzymatic discolouration, prevents anaerobic fermentation.
- Argon, and Nitrous Oxide (N_2O) are classified as miscellaneous additives, particularly **in EU**.
- Argon can more effectively inhibit enzymatic activities, microbial growth and degradative chemical reactions in some perishable foods.
- Argon, and N_2O increase the shelf-life by reducing the fungal growth.

A gas composition used in MAP for different agricultural produce.

Gas	Red meat	Pork steak	Beef	Chicken	Hard Cheese	Fish	Trout	Fresh Pasta	Prebaked rolls	Pizza	Pro. Meat rolls	Cooked ham	Fried Sausage	Fruit & vegetables	Ready made Salad
CO_2 (%)	30	20	20	30	20	40	15	50	70	70	30	40	30	5	30
N_2 (%)	---	30	---	50	80	30	65	50	30	30	70	60	70	90	50
O_2 (%)	70	50	80	20	---	30	20	---	---	---	---	---	---	5	20

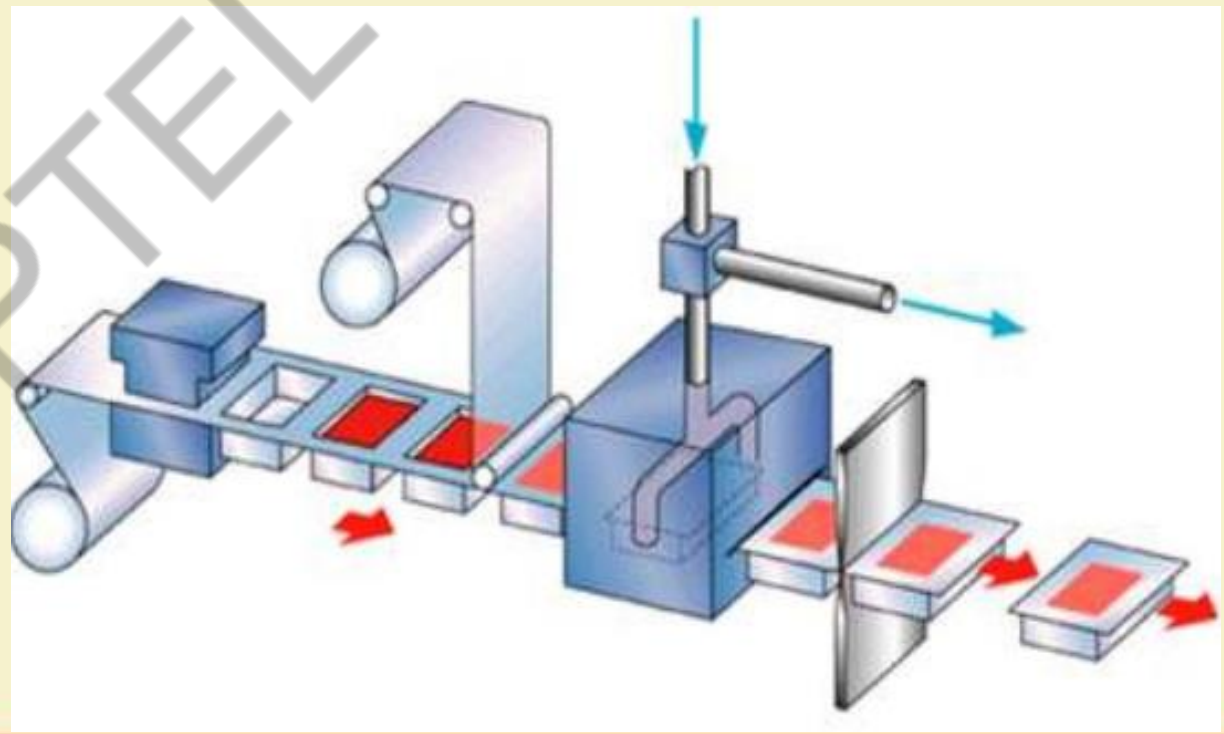
Compensated Vacuum used for MAP:-

- ✓ **Removes air from inside the package and then breaking the vacuum with the desired gas mixtures.**
- ✓ Replacement of air being done in two stages, speed of operation is much slower than the gas flush technique.
- ✓ For O_2 sensitive food materials compensated vacuum is the best choice.

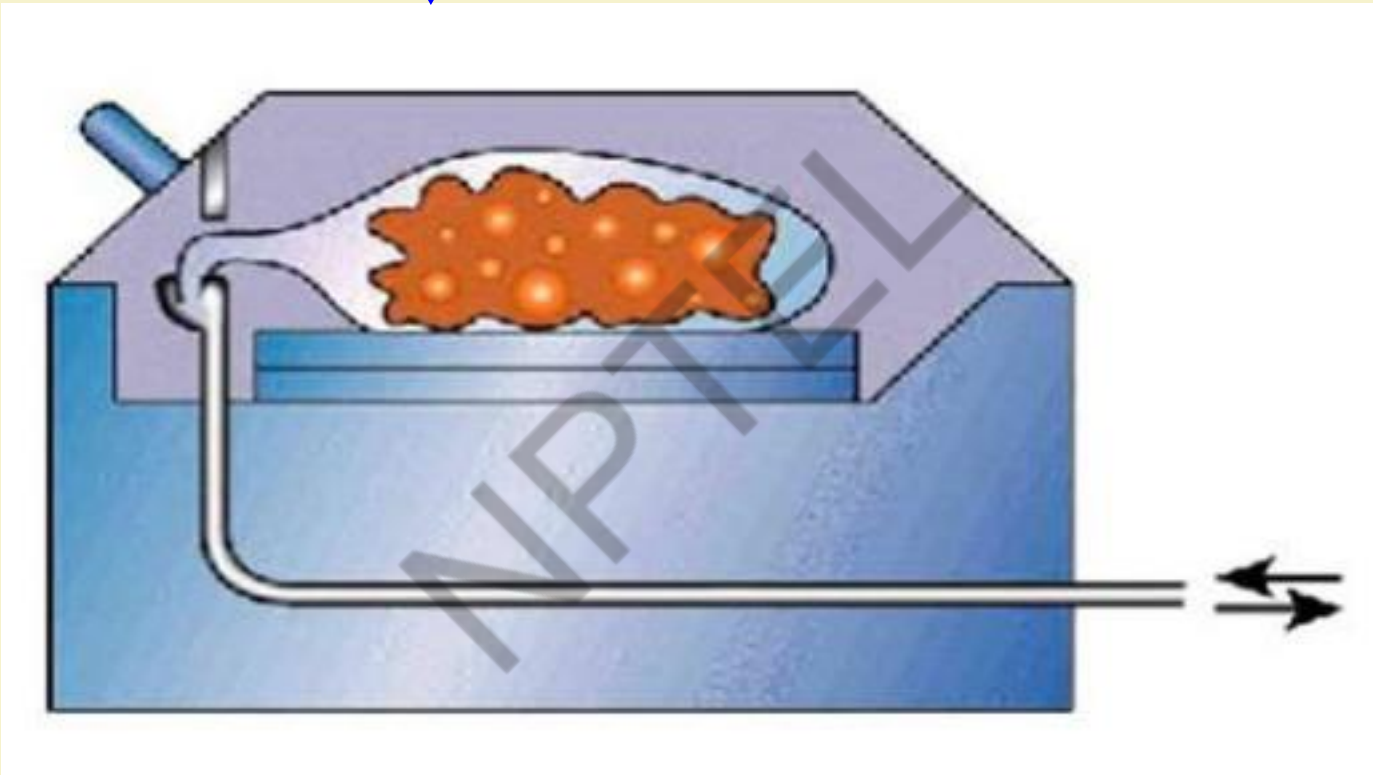
Machines used in MAP:-

- **Thermo-forming packaging machines**
- **Vacuum creating machine**
- **Form fill seal machine, either horizontal or vertical.**

Thermo – forming machine ➢

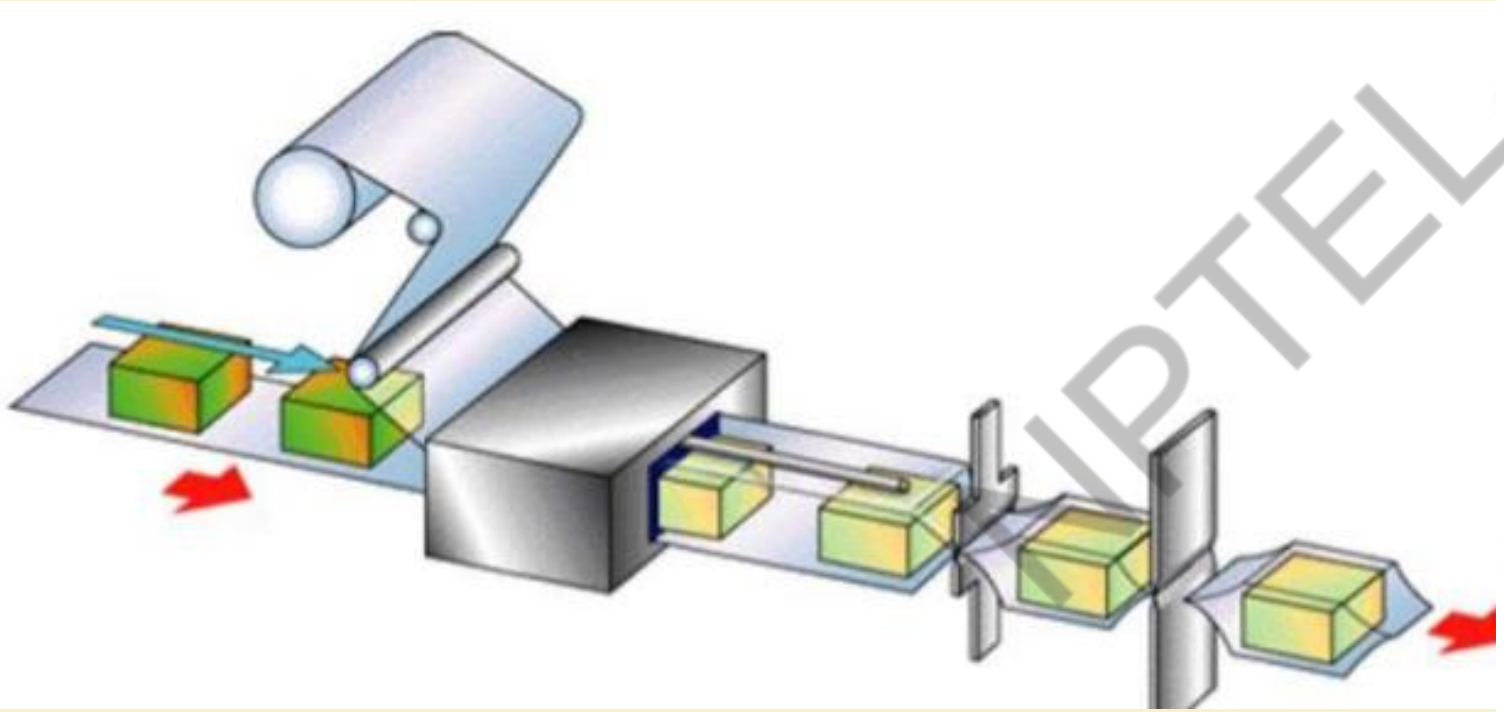


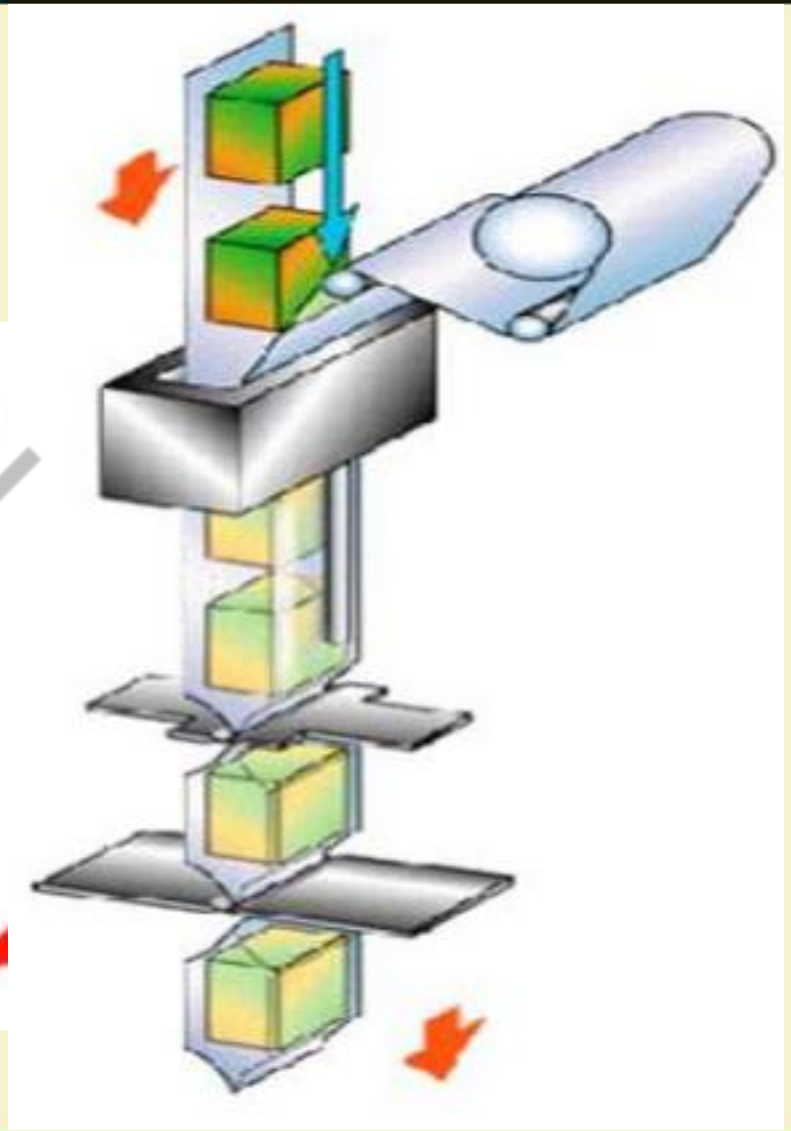
Vacuum Packaging machine



Form Fill seal machines:-

Horizontal





Vertical

Gas Flush Technique:-

- **Normally accomplished on a form fill – seal machine.**
- **Air replacement inside a package is performed by a continuous gas, by and large inert, stream.**
- **Atmosphere surrounding the food product is gradually flushed off.**
- Key factor is the speed of the machine.
- Process being continuous, finished product obtaining rate is very high.

Advantages of MAP:-

- Longer durability of perishable food / decrease of spoilage.
- Germ growth is reduced
- Form and texture of the product is retained.
- Natural colour of the product is preserved.
- Need to use preservative is greatly reduced.
- Shelf – life of the product is extended.
- Economics of the system depends on the extend of expansion of storage life of the product.

Disadvantages of MAP:-

- **Capital cost of gas packaging machinery.**
- **Cost of gases and packaging materials**
- **Cost of analytical equipments to monitor the quantity of correct gas mixtures**
- **Cost of instruments to ensure the quality of the product.**
- **Transport cost owing to increased package volume.**
- **Increased retail display space owing to increased package volume**
- **Potential danger due to growth of food-borne pathogens owing to abuse in temperature by the retailers as well as consumers**
- **Benefits of MAP is lost once the package is opened or gets leak.**

High O_2 MAP

- **High O_2 MAP atmosphere is where [O_2] > 70%. Mostly used for packaging RTE vegetables.**
- **Effective in inhibiting enzymatic browning. Microbial quality interms of reduction in yeast growth was observed.**
- Sensory quality is much superior compared to other gas mixtures and low O_2 MAP.

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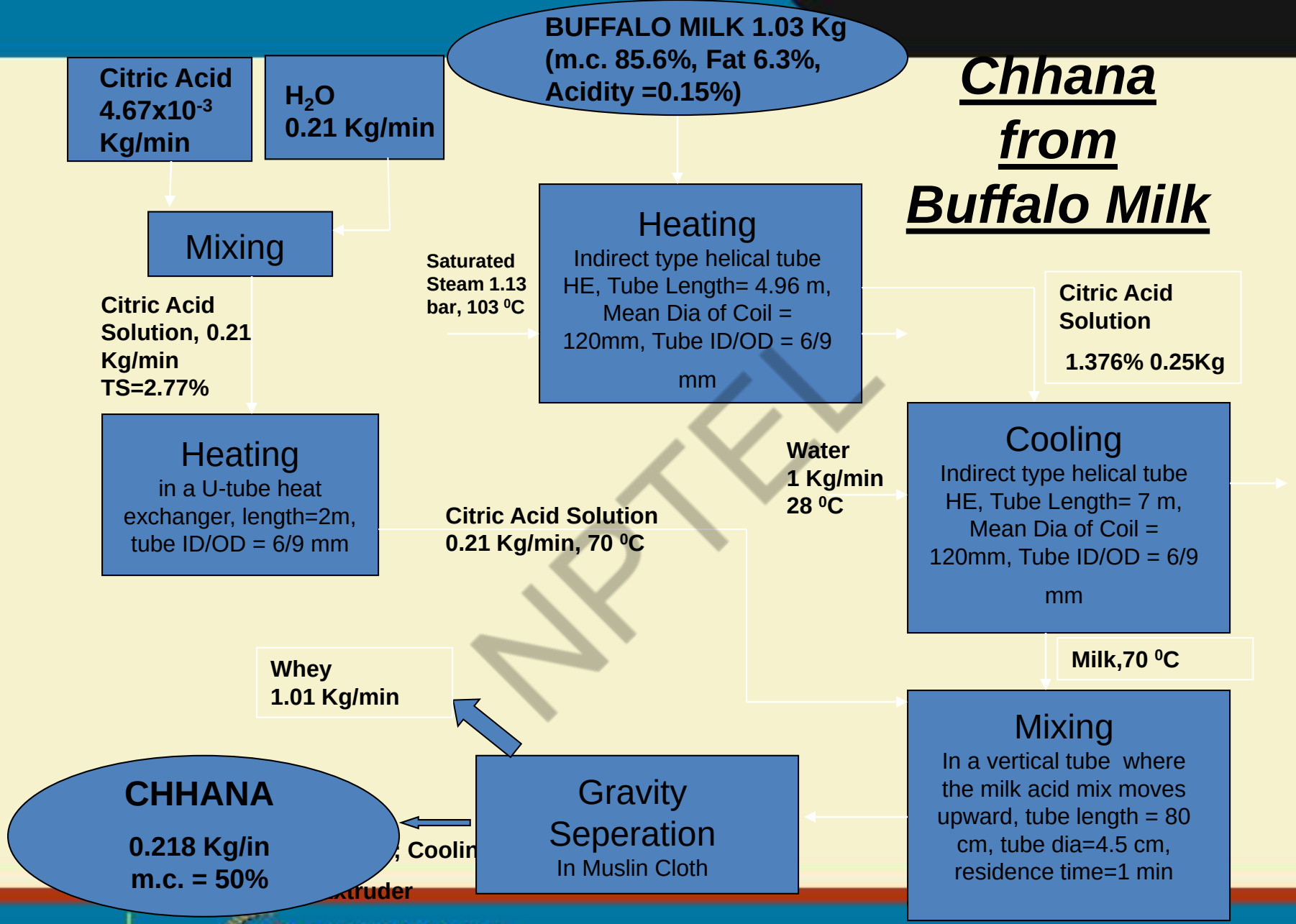
Lecture No. 60 : Flow Chart for Manufacturing Some Dairy and Food Products

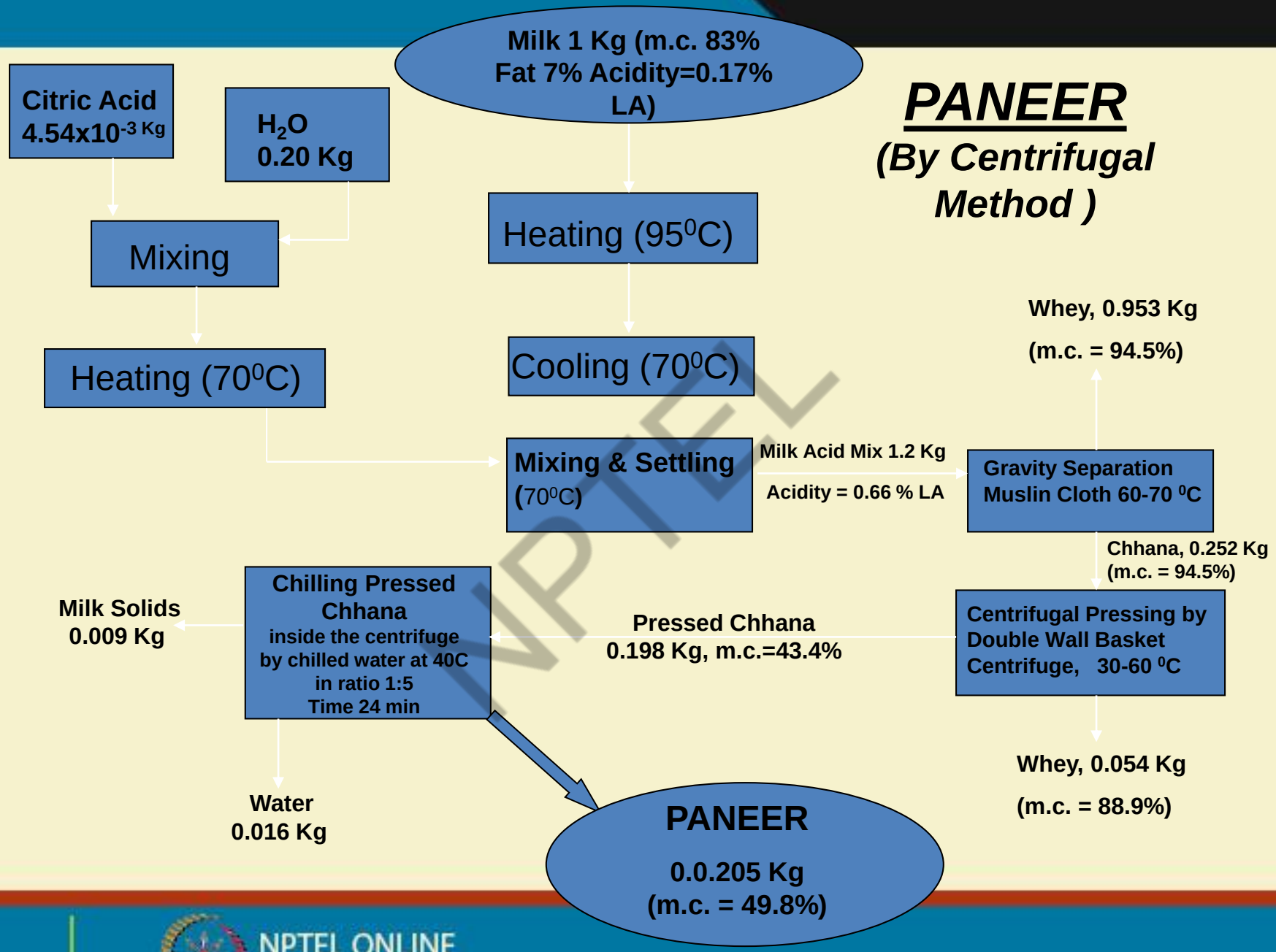
Flow Charts

Process & Material Flow

Chhana from Buffalo Milk

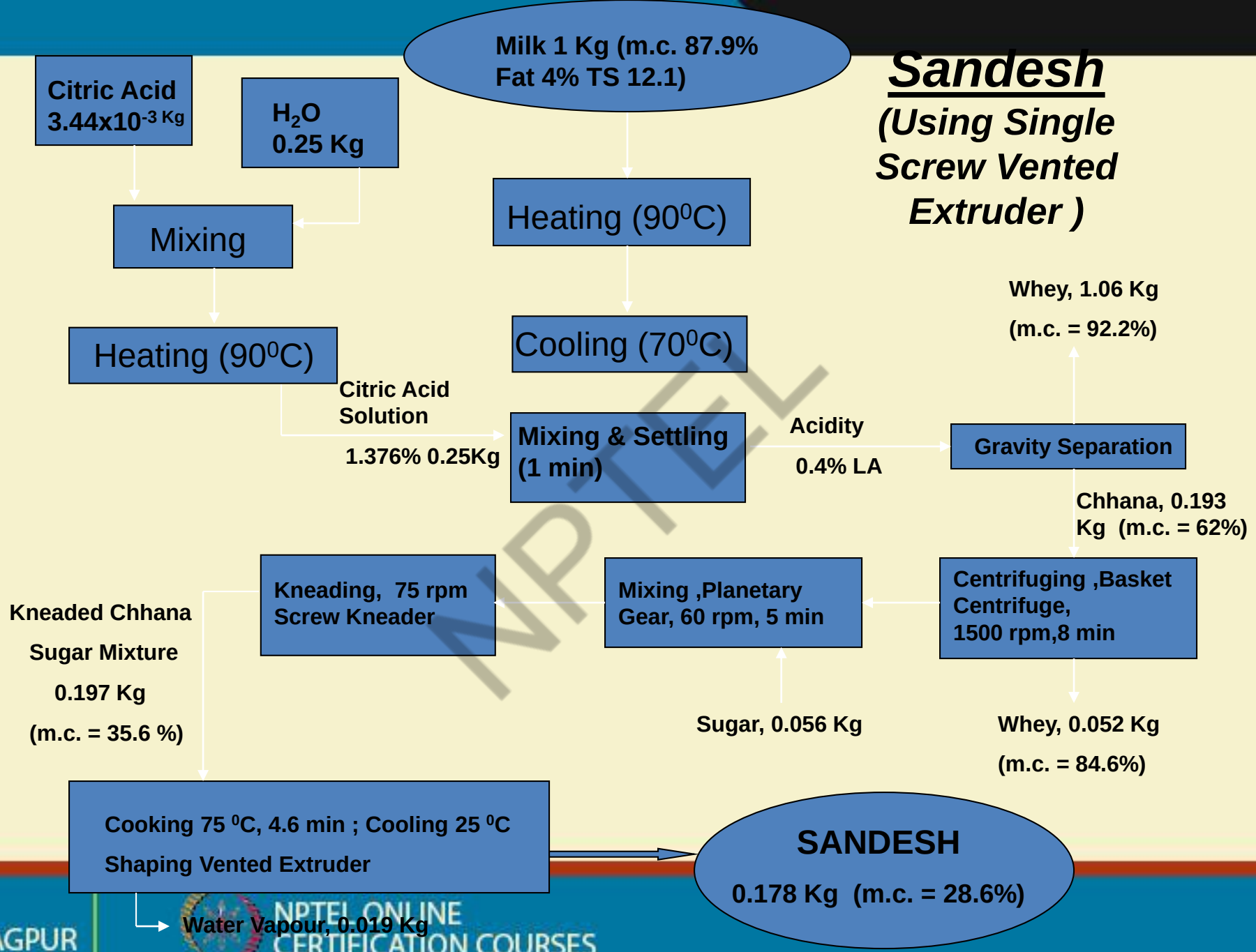


PANEER
(By Centrifugal Method)

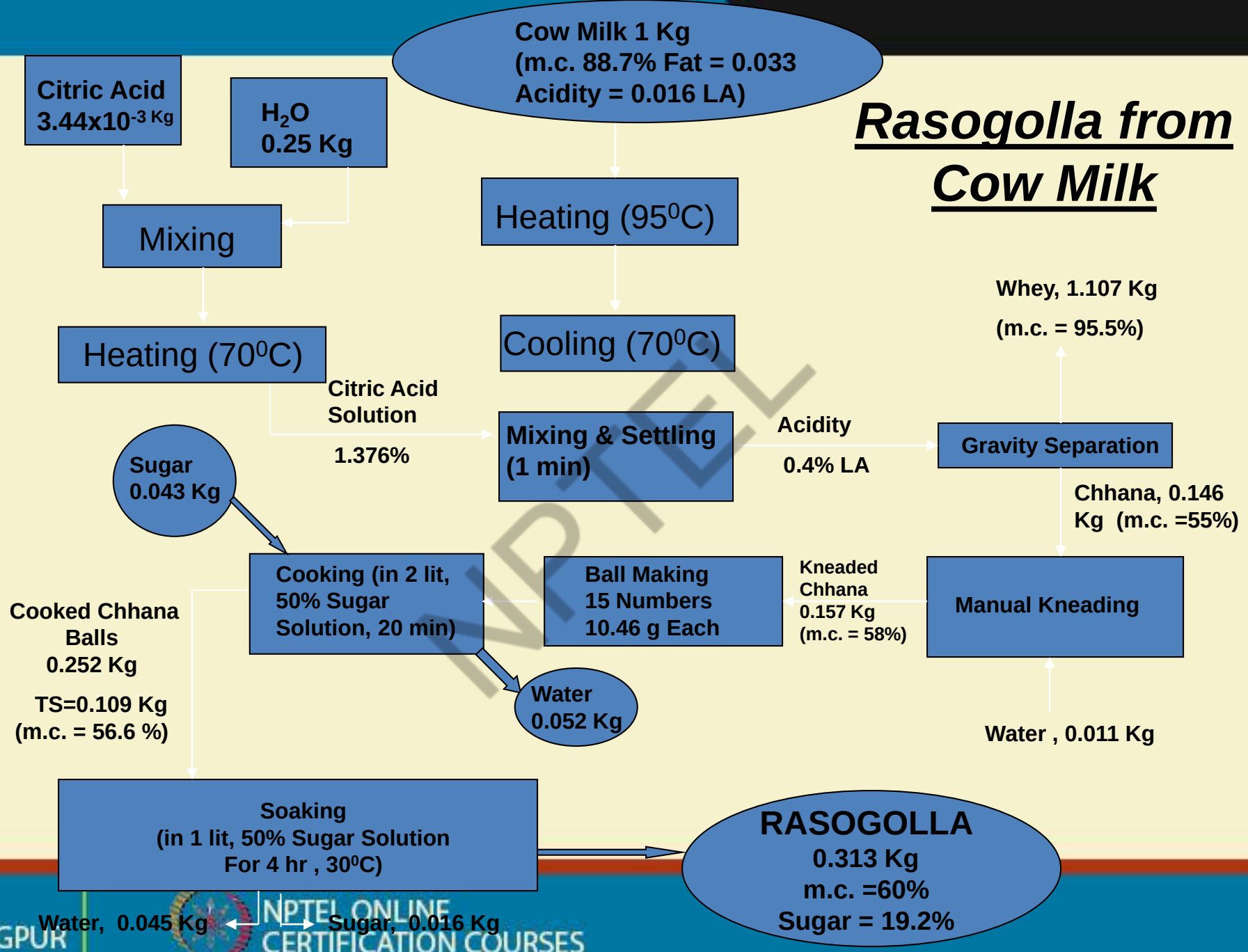


Sandesh

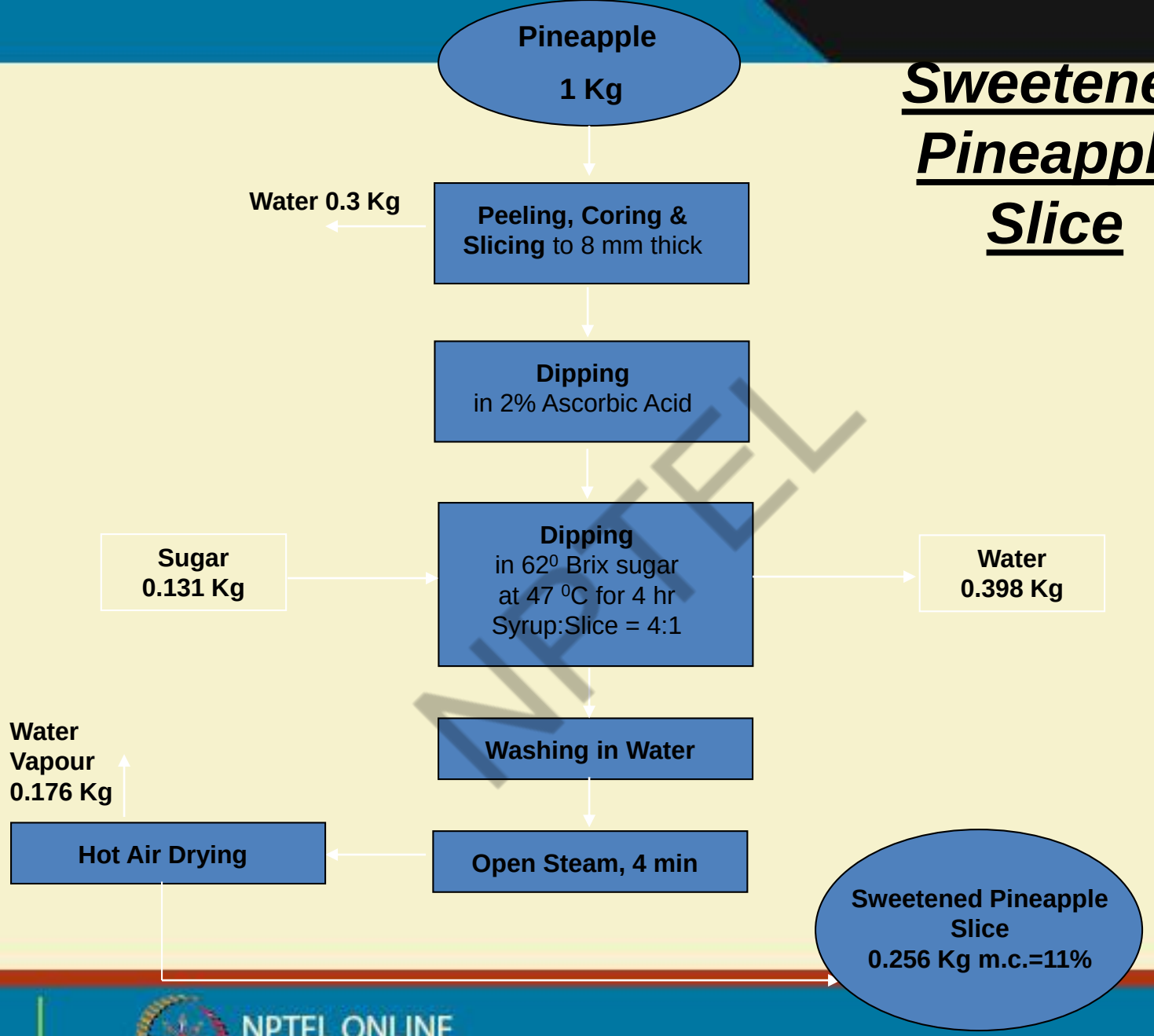
(Using Single Screw Vented Extruder)



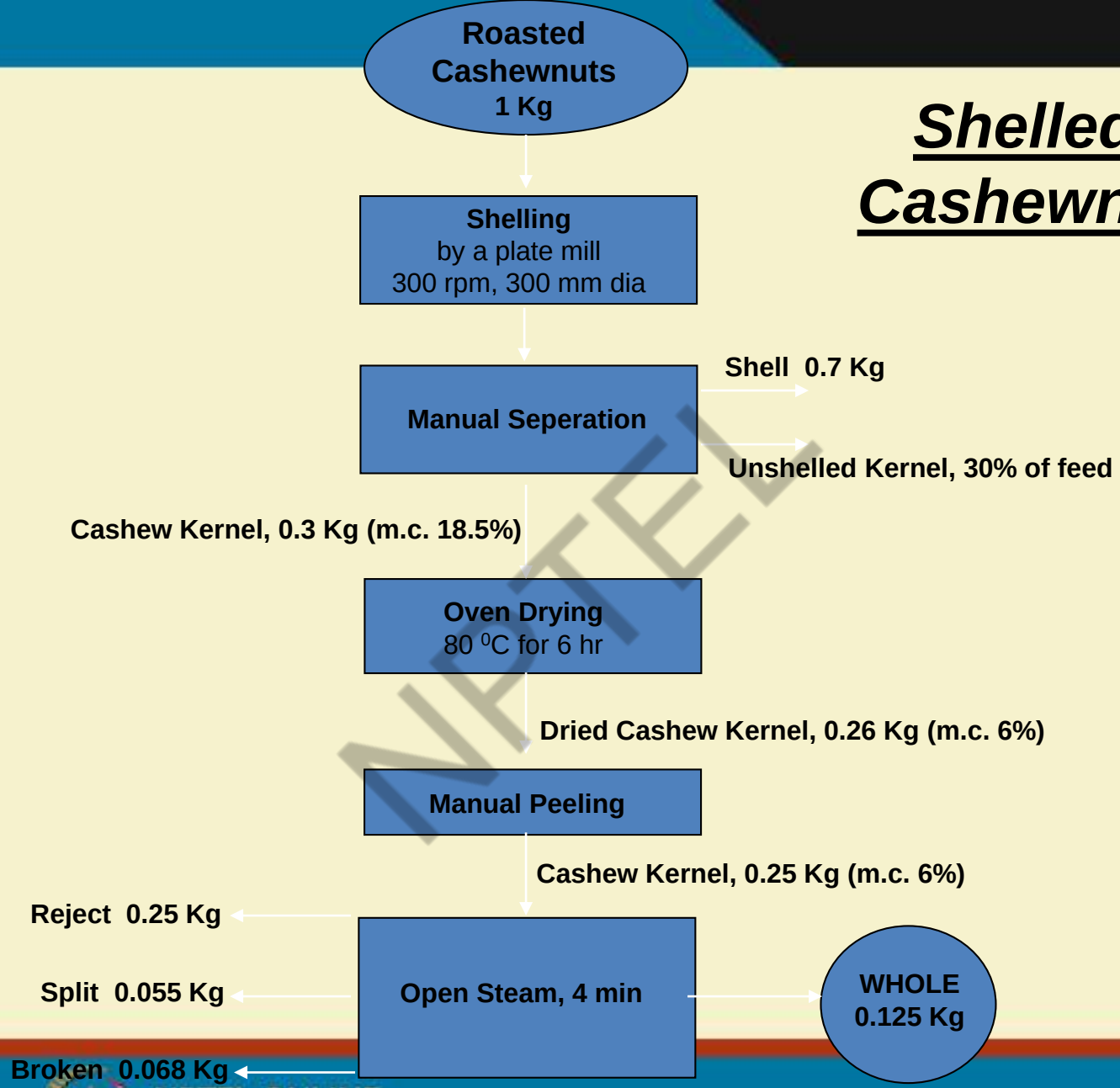
Rasogolla from Cow Milk



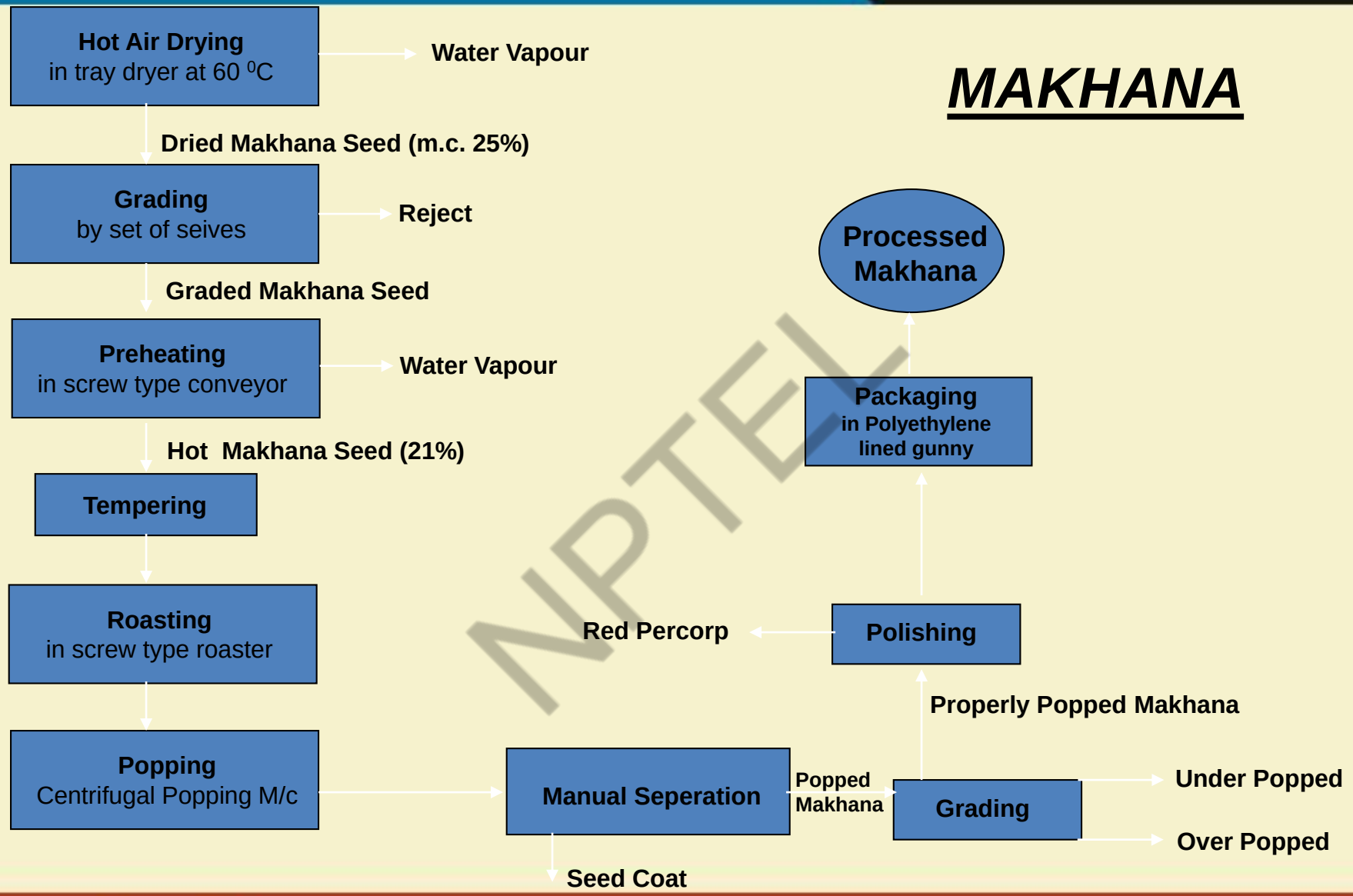
Sweetened Pineapple Slice



Shelled Cashewnut



MAKHANA



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