

AAVIN MILK FACTORY AMBATTUR

AAVIN INTERNSHIP REPORT (25/09/2023-09/10/2023)



(CHEMISTRY IN DAIRIES)

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TAMILNADU CO-OPERATIVE MILK PRODUCERS' FEDERATION LIMITED,
Joint Managing Directors' Office
29 & 30 Industrial Estate, Ambattur, Chennai - 600 098.

Ref.No.1277/HRD/2021

Date:10.10.2023

CERTIFICATE

This is to certify that Mr.SHRINIVAS.J II Year M.Sc (Chemistry) student of Sathyabama Institute of Science and Technology, Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600119. Internship Training in Tamil Nadu Cooperative Milk Internship Training in Tamil Nadu Cooperative Milk Producer's Federation Limited at Ambattur Dairy, Chennai-600098 from 25.09.2023 to 09.10.2023 (15 days) and completed the same satisfactorily.


10/10/2023
AGM(ADMIN)/HRD

INTRODUCTION :

Milk is nutrient rich food that provides a large number of nutrients relative to the calories consumed. Milk is delicious as a beverage and can be used as a base for other drink such as hot chocolate. The Milk of domesticated animals is also an important food source for humans. Most Milk consumed in Western countries from cows; other important sources include sheep, goats, water buffalo, and camels. Milk is essentially an emulsion of fat and protein in water, along with dissolved sugar, minerals (including calcium and phosphorus), and vitamins, particularly vitamin B complex.

Commercially processed cow's Milk is commonly enriched with **vitamins A and D**. Many Countries require pasteurization to protect against naturally occurring and artificially introduced microorganisms. Cooling further prevents spoilage (souring and curdling). Fat from whole Milk (about 3.5% fat content) can be removed in a separator to produce cream and leave lowfat Milk (1–2% fat) or skim Milk (0.5% fat). Milk is usually homogenized, forced under high pressure through small openings to distribute the fat evenly. It may also be condensed, evaporated, or dehydrated for preservation and ease of transport. Other dairy products include butter, cheese, and yogurt.

WORLDWIDE June 1 is the world Milk day as announced by Food and Agricultural Organization (FAO). Milk helps to children to promote the growth of their muscles, bones, teeth, and brain. Pediatricians and nutritionist agree that the balanced diet with a proportion of the necessary carbohydrate, and proteins, moreover, the high content of vitamin D in Milk is key component to Milk bone structure, bone recovery and bone health. In addition help to maintain the health of the teeth.

The dairy development was established in 1958 in Tamilnadu. The Administrative and statutory controls over all the Milk cooperatives in the state were transferred to the dairy development department on 1.8.1965. The commercial activities of the department such as Milk procurement, chilling, processing, packing and sale of Milk to the consumer etc., hitherto dealt with by the Tamilnadu Dairy Development Cooperation Limited, were transferred to the newly registered Tamilnadu Cooperative Milk Producers' Federation Limited, popularly known as "**Aavin**".

Chennai metro is having four dairies. Milk procurement, processing and distribution are being attended by the district unions in the respective areas. The cattle population in India is approximately 15% of total cattle population in the world. India stood at no.1 position in Milk production. Tamilnadu is one of the leading state in Milk production. The Milk production in Tamilnadu per day is 145.88 lakh Literers.

Functions of Cooperative Milk Producers Union:

1. Establishment of chilling centers
2. Formation of new Milk routes to collect Milk produced by the members of the societies.
3. Collection of Milk from societies, process and pack in modern dairy.
4. Supply of quality Milk.
5. Fixation Of procurement and prepacking of Milk.
6. Supply of inputs to the members of the societies. Nourishment of Milk Contains calories, proteins, carbohydrate, fat, saturated fat, cholesterol, vitamin A, vitamin C, foliate, calcium, magnesium, zinc, phosphorus, iron.

CHEMISTRY IN CLEANING:

Cleaning of Silo tanks, Tubs, Homogeniser is carried out by following steps

- #HOT WATER CLEANING
- # CAUSTIC SODA CLEANING
- #ACID CLEANING
- #RAW WATER CLEANING

CAUSTIC SODA (LYE) CLEANING(1%):

10KG of caustic soda is dissolved in 1000L of water and poured into the silo at 75°C and cleaned for 7-10mins.

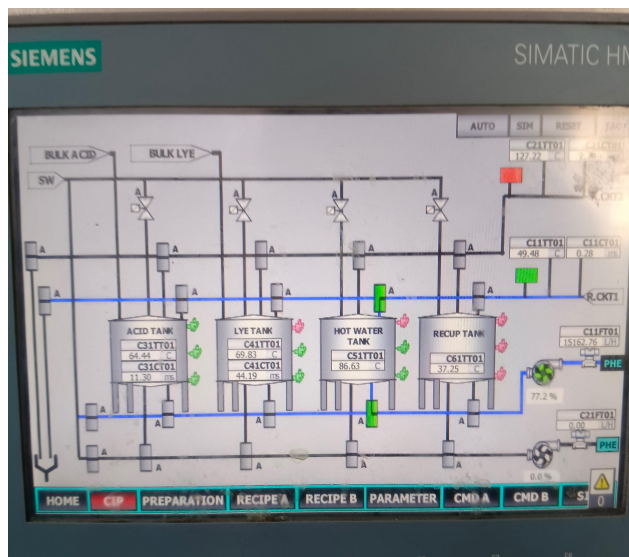
NaOH is specially used due to pH(7) which is more basic in nature which attacks the fat and protein residues on all type of dairy processing equipments.

ACID CLEANING (HNO₃)(0.6%) :

6KG of Nitric Acid is dissolved in 1000L of Water and at 65°C It is poured into the silo and cleaned upto 7-10 mins once in week.

HNO₃ is used to remove the scales inside the containers, To remove milk proteins and fat contamination, to passivate stainless steel containers.

It is followed by Raw water cleaning.



CHEMISTRY IN HYDROFLOW UNIT:

Used for softening of water.

Hardness of water is due to the presence of Ca, Mg ions.

Hardness of water can be reduced by following methods such as

1. Ion exchange Method
2. Reverse Osmosis Method
3. Salt free Method
4. Magnetic Method

ION EXCHANGE METHOD:

It consists of 3 layers of packing

Top layer-Filled with Resin which acts as Inlet

Middle layer-Filled with sand

Bottom layer-Filled with pebble stones which acts as outlet.

It is a 8hour process.

Resins used for Ion exchange Method in Aavin

1. Indion 225-Na
2. Thermax T 42 H

Both these resins are cation exchange resins that is strongly acidic.

Made up of cross-linked polystyrene and has gel like structure.

They contains Sulphonic acid Functional group.

Cleaning:

150kg of NaCl is dissolved in 900 litres of Water and poured into the inlet and kept for 1hour for the removal of ions for the resin bed.

It is then drained for 3 hours.

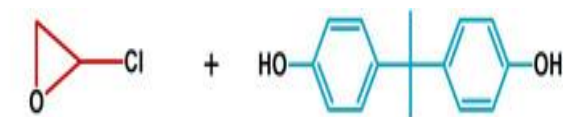
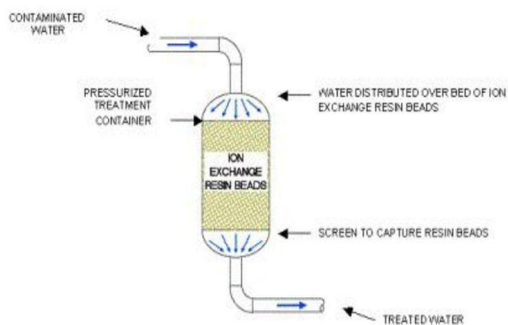
Use of Epoxy Paints:

Epoxy paints are used to prevent the corrosion of water containers, pipes, tanks etc.

The corrosion is caused due to presence of ion and impurities in water. Epoxy paints are made up of **POLYEPOXIDE** with **POLYAMINE HARDENER** which resists corrosion, turbulence, extreme temperatures.

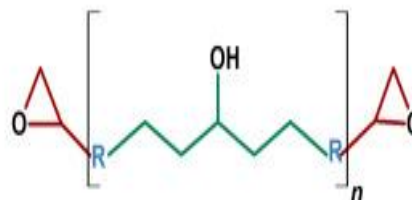
Common epoxy paints are made from Epichlorohydrin and Bisphenol'A'.

ION EXCHANGE PROCESS



Epichlorohydrin

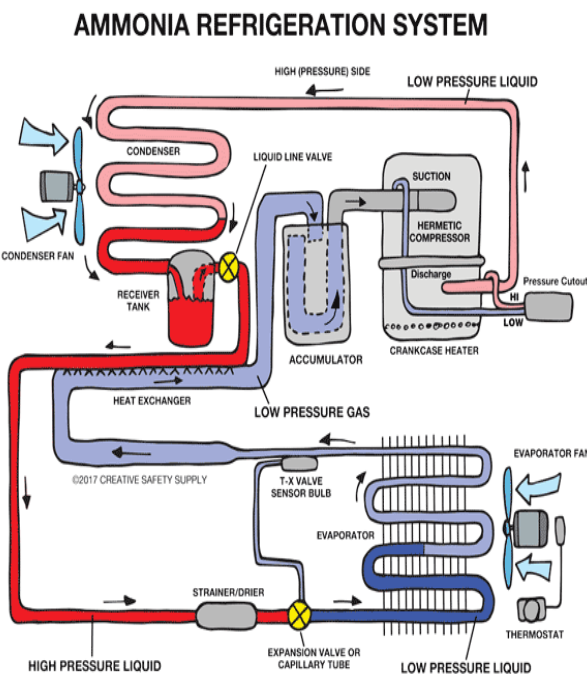
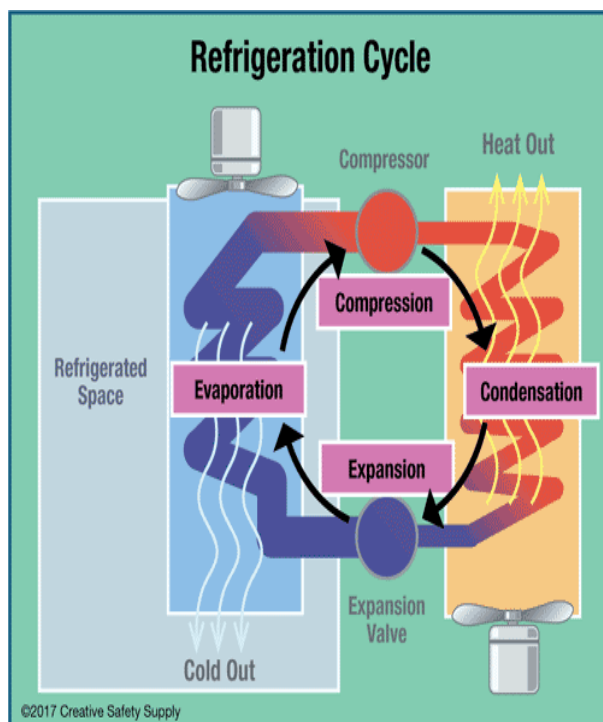
Bisphenol 'A'



where R =



CHEMISTRY IN REFRIGERATION SYSTEM:



USE OF AMMONIA IN REFRIGERATION UNIT:

AMMONIA (NH_3) is a colourless, Nonflammable liquid gas.

Anhydrous ammonia (99.98%) is used because it is cost effective, environmental friendly Nature.

In India, ammonia based vapour compression systems are more preferred mode of cooling milk in dairy industries.

Ammonia based systems are low pressure systems with ver less sophistication.

It has low boiling point.

It absorbs large amount of heat without any changes in temperature.

Ammonia is **3-10%** more effective than **CFC-CHLORO FLURO CARBON**.

It requires less electricity compared to CFC.

Ozone depletion potential of Ammonia is zero.

Anhydrous ammonia is illegal because it is a key ingredient in the production of **Methamphetamine**.



DIFFERENT VARIANTS OF AAVIN MILK:

There 6 different variants available in Aavin. They are,

#Magenta Colour (DIET) with 2.5% fat and 9% SNF.

#Sky Blue Colour (Toned Milk) with 3.5% fat and 8.5% SNF.

#Green Colour (Standardised Milk) with 4.5% fat and 8.5% SNF.

#Purple Colour (Delight Milk) with 3.5% fat and 8.5 %SNF(FORTIFIED).

#Orange Colour (Full Creamed Milk) with 6% fat and 9% SNF.

#Red Colour (Tea mate) with 6.5% fat and 9% SNF.



FORTIFIED MILK:

Process of adding vitamins and minerals in milk is called **Fortification**.

ADDITION OF **VITAMIN A** and **VITAMIN D2** in the milk in a appropriate amount.

It is a two-step process:

a) Preparing the pre-blend

b) Mixing the pre-blend with milk.

a) Preparing the pre-blend Based on batch size, fix the rate of addition of the premix. Ensure that once the bottle is opened it should be used completely.

Take one bottle of premix (lft.)

Heat premix to 45° C in water bath for 15 min

Prepare a pre-blend first by gradually mixing the pre-mix with small. amount of milk.

Stir continuously for 10-15 mins with a clean stainless steel rod

Rinse the premix bottle at least 3 times with the milk

Pour the pre-blend into the bulk tank before pasteurization of milk

Note:

Calculate the vitamin required according to the batch quantity to get the fortification level of Vitamin A: 900-1500 IU or 270-450 µg RE and Vitamin D: 200-300 IU or 5.0-7.5 µg per litre of milk.

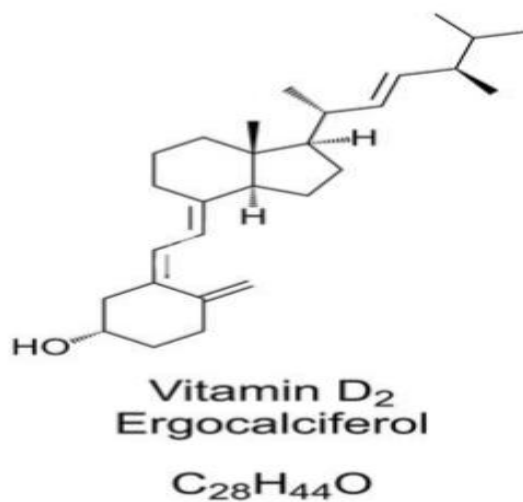
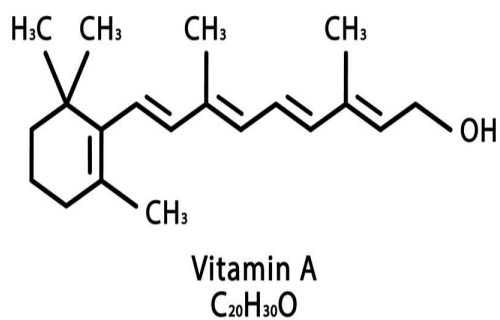
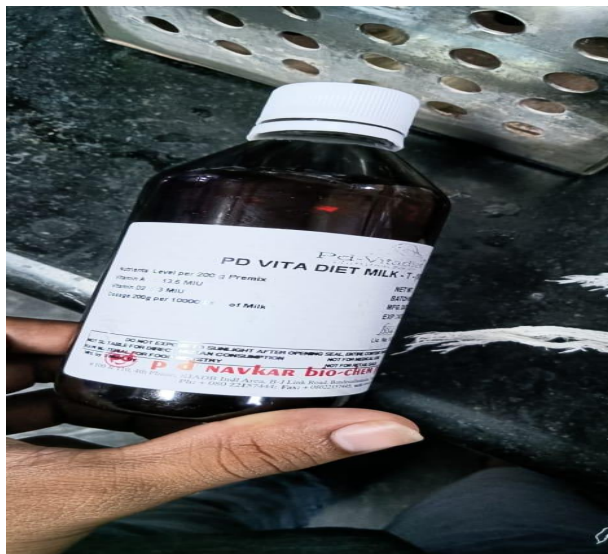
Take premix bottle to suit the batch size. The ratio is: for a batch of 50,000 litres of milk, add 1 litre of premix.

b) Mixing the pre-blend with milk

Batch mixing: Prepare a pre-blend first by mixing the pre-mix with small amount of milk. Before adding this pre-blend to bulk milk, mix it well with a stainless steel stirrer and then add it to bulk tank before pasteurization of milk.

Continuous mixing: It the process in which premix is added continuously into milk with the help of dozers. Maintain a constant flow rate of the pre- mix concentrate during continuous mixing.

VITAMIN SYRUP AND FORTIFIED DELIGHT MILK:



EFFLUENT TREATMENT PLANT (ETP):



CHEMISTRY IN EFFECTIVE TREATMENT PLANT:

ETP in which the waste water from the production plant is treated and released in to the environment.

It is carried out in following methods.

- # Collection of waste water (Inlet pH 5.5-6.9)
- #Fat removal
- #Buffer tank
- # UASB(UPFLOW ANAEROBIC SLUDGE BLANKET)(pH 7.3-8.7)
- #Aeration Tank
- #Clarification
- # Outlet treated Water (pH 7.0-8.0)

USES OF DAP AND UREA:

DI-AMMONIUM PHOSPHATE is rich in Nitrogen and Phosphorus.

UREA is rich in Nitrogen.

These are primary macronutrients and part of 18 essential plant nutrients.

These DAP and Urea are used to feed the microorganisms living in the sludge of waste Water which helps to breakdown the organic waste present in the waste Water.

These DAP and Urea are the primary fertilizers in farming.

Microbacteria is suggested by the by microbiologist for the ETP treatment.

These bacteria grow by breaking and feeding the sludge as food for it.



PRODUCTION AND EMISSION OF METHANE GAS:

Methane gas along with CO₂ and other gases are produced during the breaking down of organic waste inside the UASB tank by the microorganisms.

These microorganisms produce METHANE gas as major gas and which is collected and released into the atmosphere.



LABORATORY TESTS / QUALITY CONTROL TESTS FOR MILK:

PLATFORM TESTS:

1. TEMPERATURE

2. ORGANOLEPTIC

CHEMICAL ANALYSIS

3. CLOT ON BOILING TEST

4. ACIDITY

5..FAT TEST

6.SNF TEST

7.HOMOGENISATION EFFICIENCY

8.PHOSPHATASE TEST

9.KEEPING QUALITY TEST

10.MBR TEST

11.COLIFORM TEST

12.STANDARD PLATE COUNT TEST

13.ANIBIOTIC RESIUDUE TEST

ADULTERATION TESTS:

14.UREA DETECTION

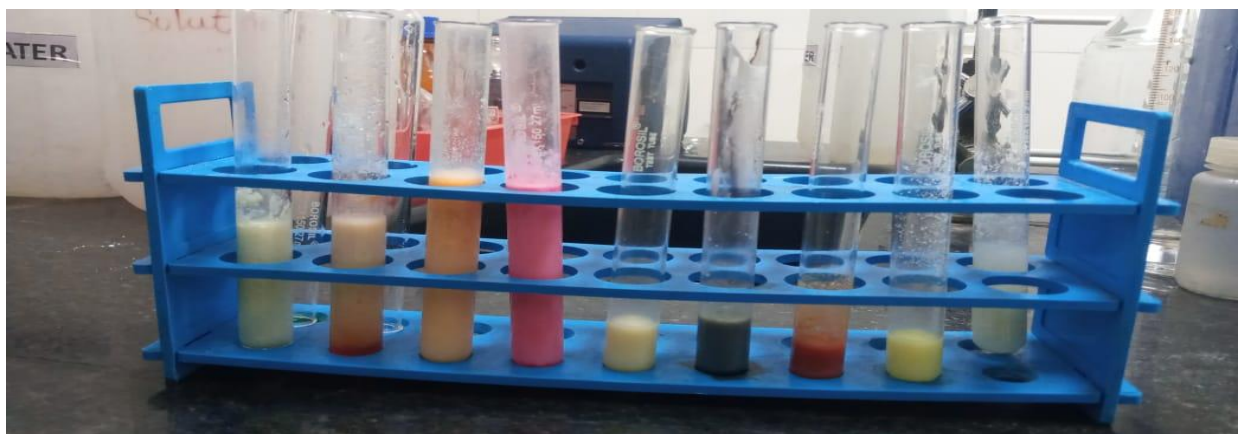
15.NEUTRALIZER TEST

16.STARCH CERAL FLOURS DETECTION TEST

17.SUGAR AND GLUCOSE TEST

19. SALT DETECTION

18.HYDROGEN PEROXIDE TEST



THE TAMILNADU CO-OP. MILK PRODUCERS FEDERATION LTD.
AAVIN AMBATTUR CHENNAI 600 098

QUALITY CONTROL TESTS FOR MILK

PLATFORM TEST

1. TEMPERATURE
2. ORGANOLEPTIC

CHEMICAL ANALYSIS

3. CLOT ON BOILING TEST
4. ACIDITY
5. FAT TEST
6. SNF TEST
7. HOMOGENISATION EFFICIENCY
8. PHOSPHATASE TEST

MICROBIAL ANALYSIS

9. KEEPING QUALITY TEST
10. MBR TEST
11. COLIFORM TEST
12. STANDARD PLATE COUNT TEST
13. ANIBIOTIC RESIUDUE TEST

ADULTERATION TEST

14. UREA DETECTION
15. NEUTRALIZER TEST
16. STARCH CERAL FLOURS DETECTION TEST
17. SUGAR AND GLUCOSE TEST
18. HYDROGEN PEROXIDE TEST
19. SALT DETECTION

METHYLENE BLUE REDUCTION TEST:

PROCEDURE:

Methylene Blue (MB) solution is prepared by dissolving 1 tablet of standard methylene blue tablet in 200 ml of cold sterile distilled water in a sterile flask. Allow to stand for several hours and ensure the complete dissolution of the tablet and further diluted with 600ml of cold sterile distilled water and keep this mixture as stock solution.

Take 10ml of milk in a sterilized test tube.

Add 1 ml of Methylene blue solution to get a concentration of 1 part of dye to 3,00,000 parts of milk.

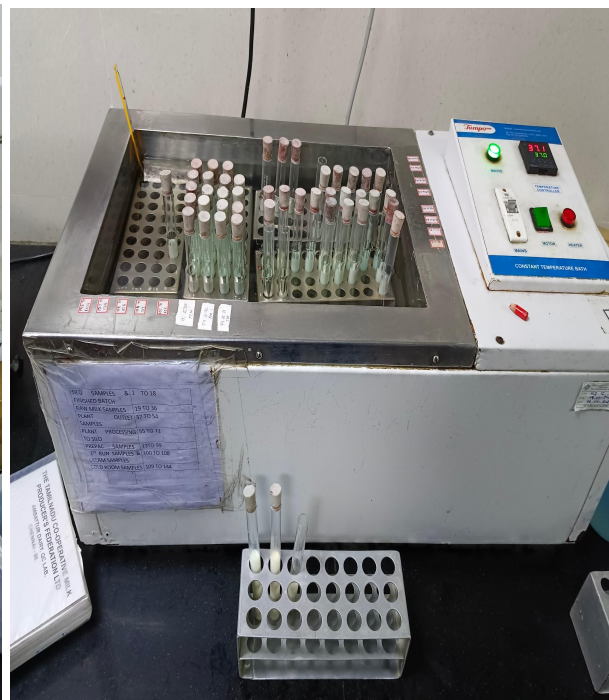
Plug with a sterilized cork.

Invert the tube to mix the contents and incubate at 37°C in a water bath.

The colour of milk in the tubes is examined first 10 minutes and then after every half an hour and the time required for complete decolourisation is noted.

INTERFERENCE :

The difference between the initial time and final time is the MBR time.



PHOSPHATASE TEST:

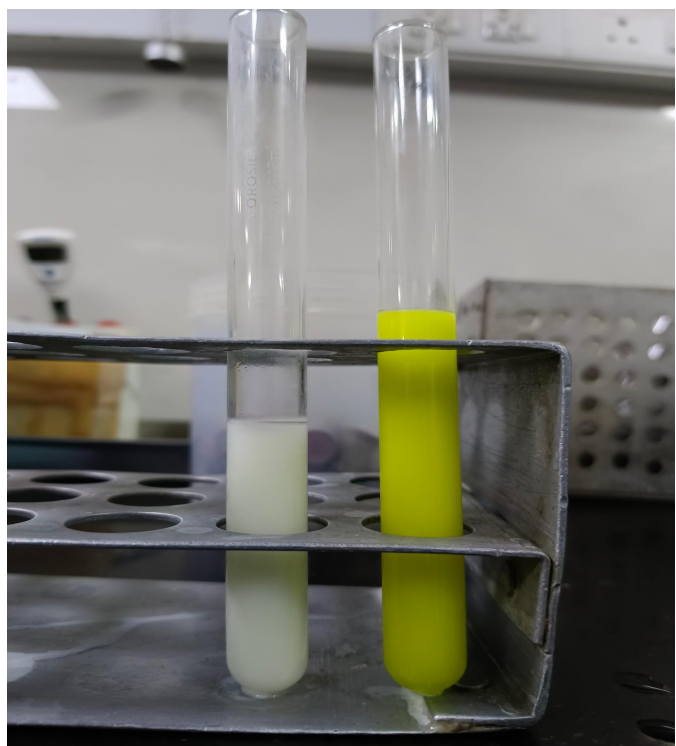
PROCEDURE:

Buffer Substrate :

- Weigh 3.5g of sodium carbonate and 1.5g of sodium bicarbonate dissolve in one litre of distilled water and sterilize. This serves as buffer. With this add 1.5g of Para Nitro Phenyl disodium Ortho Phosphate. This serves as substrate.
- Transfer 5ml of the Buffer substrate solution to a clean dry test tube using a pipette.
- Add 1ml of milk sample and close the tube with stopper.
- Mix the content by inverting the test tube
- Incubate the test tube for exactly 30 minutes at 37°C.
- Note the colour at the end of 30 minutes.

INTERPRETATION :

- If the colour of the sample shows yellow it indicates that the pasteurization inadequate.
- Compare this with a negative control using boiled milk.



PASTEURIZATION AND HOMOGENISATION:

PASTEURIZATION is a process that heats milk to a specific temperature for a set amount of time to kill harmful bacteria. This makes milk safe to drink and extends its shelf life.

Heating to a higher temperature, 72°C-78°C, and holding for 15 seconds (and yet higher temperatures for shorter periods of time).

HOMOGENISATION is a process that breaks up milk fat globules and disperses them evenly throughout milk. This process prevents milk from separating and gives it a more homogeneous texture. In AAVIN the cream separated milk is mixed with butter and milk solids in an appropriate amount to get the target fat % of milk. Process is maintained at 80°C.

DETERMINATION OF HOMOGENISATION EFFICIENCY:

PROCEDURE:

- Take 100 ml of milk sample and bring the temperature to 20°C ±1°C.
- Pour the well mixed 50 ml milk sample into the centrifuge tube.
- Place the tube in the centrifuge and centrifuge at 1500 RPM for 10 minutes.
- Remove the top fat layer using spatula and insert the pipette to the bottom of the centrifuge tube by closing the sucking end of the pipette
- Take out 10.75 ml of milk sample from the bottom of the tube and estimate the fat content.

INTERPRETATION :

Homogenisation Efficiency = $\frac{\text{Fat in the bottom layer}}{\text{Fat in the milk sample}} \times 100$

STANDARDS:

Minimum 70%

DETERMINATION OF MILK FAT BY GERBER METHOD:

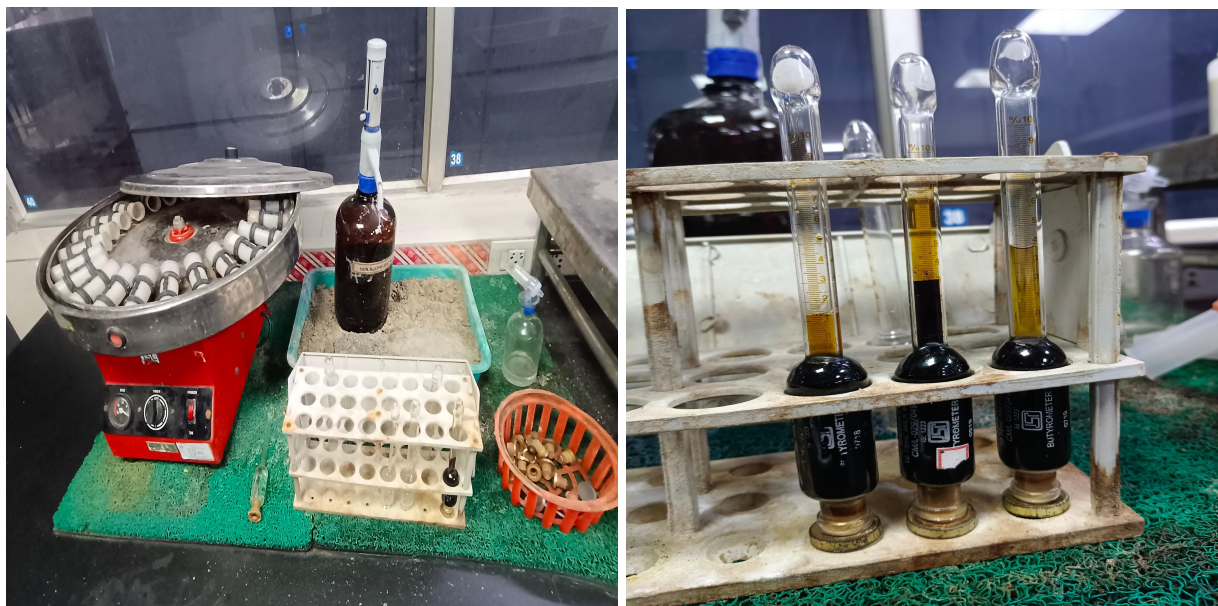
PROCEDURE:

- Take 10ml of Gerber acid in a Milk butyrometer.
- Add 10.75ml of milk sample along the sides of Butyrometer.
- Add 1ml of amyl alcohol.

- Close the neck with the stopper.
- Mix the contents thoroughly until the curd has been dissolved.
- Place the butyrometer in a centrifuge for centrifugation at 1100 rpm for 5 minutes.
- Take out the butyrometer and place it in the water bath $65^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and keep it for 5 minutes.

INTERPRETATION

- The scale reading that corresponds to the lowest point of fat meniscus and the surface of separation of fat and acid gives the percentage of fat.



DETERMINE THE PERCENTAGE OF SNF IN MILK BY **LACTOMETER** , **MILKOSCAN** and **LACTOSCREEN**:

PROCEDURE:

. Adjust the temperature of the milk sample to 84cF.

Mix the milk gently by pouring several times from one bottle to another, avoiding incorporation of air.

Fill the Lactometer cylinder with the milk sample.

Allow the Lactometer to float freely on the milk without touching the sides of the cylinder. Ensure some quantity of milk overflows from the cylinder when lactometer is inserted.

Allow the Lactometer to come to stationary position and then take the Lactometer reading.

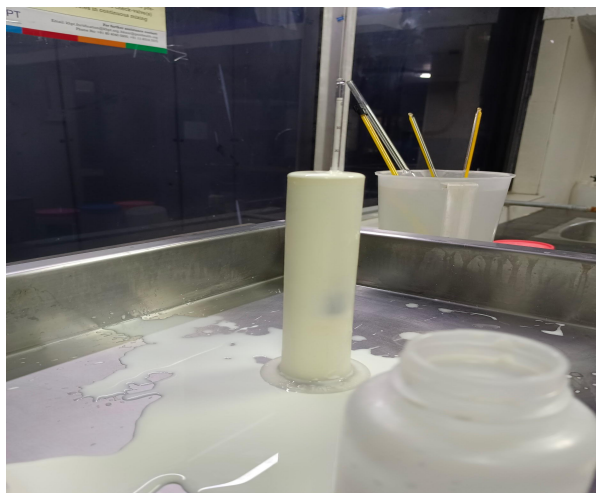
INTERPRETATION: MODIFIED RICHMONDS FORMULA

$$\text{SNF}\% = \text{CLR}/4 + (0.2 \times F) + 0.36$$

- CLR-Corrected Lactometer Reading

F-Fat percentage in milk sample

Substituting the Corrected Lactometer Reading and the Fat % in the formula, the SNF content of the milk can be found out.



Time	Sample ID	Fat % m/m	Solid non fat % m/m	Protein % m/m	Lactose % m/m	Solids % m/m	Acidity % lactic acid	pH
9/26/2023 12:57:06 PM	SILO 6 FCM	6.22	9.06	3.75	5.11	15.33	0.172	6.38
9/26/2023 12:31:47 PM	DELITE 3A	3.53	8.46	3.50	4.75	11.95	0.137	6.53
9/26/2023 12:30:31 PM	FCM 9A	5.88	8.71	3.59	4.92	14.63	0.154	6.48
9/26/2023 12:29:19 PM	SM 2A	4.55	8.34	3.44	4.70	12.89	0.138	6.53
9/26/2023 12:24:50 PM	TM 7A	3.06	8.42	3.47	4.75	11.45	0.137	6.52
9/26/2023 12:05:10 PM	SILO 5 SM	4.68	8.38	3.46	4.72	13.06	0.147	6.45
9/26/2023 11:34:45 AM	SM 5B	4.56	8.34	3.45	4.70	12.89	0.140	6.52

Product	All in one-R
Fat	4.42 % m/m
Solid non fat	8.26 % m/m
Protein	3.41 % m/m
Lactose	4.56 % m/m
Solids	12.65 % m/m
Acidity	0.139 % lactic acid
pH	6.49
Casein	2.79 % m/m
Density	1.03 g/ml
True Protein	3.36 % m/m
Freezing point depression	523.6 mOsm
Citric Acid/Citrate	0.18 % m/m



SWAB TEST:

SWAB:

Swabbing involves the microbiological testing of food preparation surfaces, equipment and utensils using various swab techniques to find out if pathogens are present.

SWAB CONTACT SURFACE METHOD:

Swab consist of a column wool wound round at the end of the metal wire. The swab test consist of applying a sterile swab clipped in a saline solution over a measured surface such as pipe lines, valves, inside the storage tank etc.

Procedure:

Swab is collected after cleaning the surface and the sample is noted where it is taken from.

The collected swab is stored in the saline solution in the test tubes.

Methyl broth is prepared in the autoclave machine and UTG stored in test tubes separately.

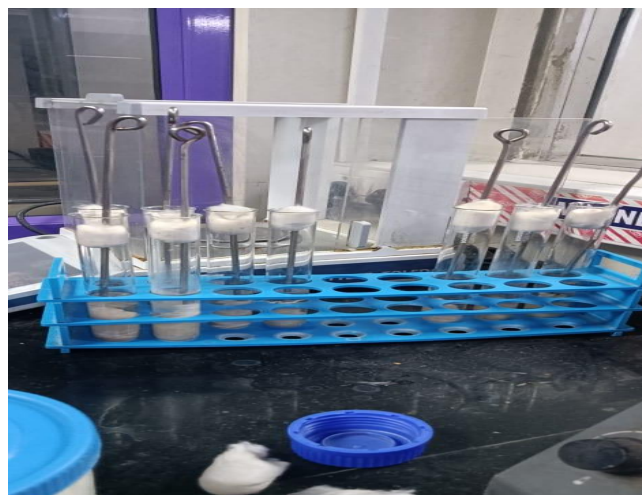
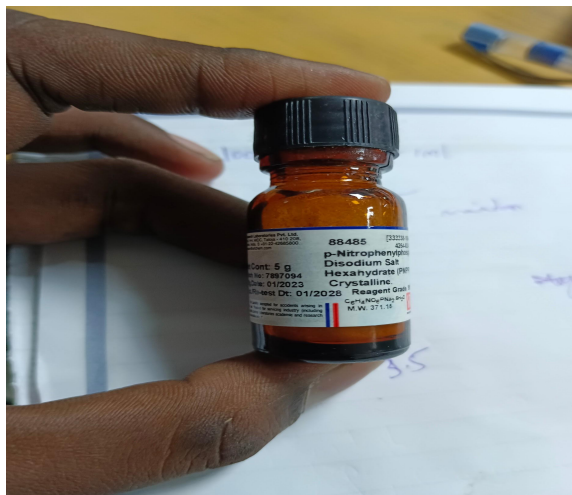
Add 2 drops of saline solution in the methyl broth and incubate it for 24 hrs.

Note the test tubes using numbers or code to identify the swab collected area.

Interference:

If the methyl broth remains in the same color It indicates there is no bacteria present in the surface area and the area is cleaned well.

If the color of the methyl broth changes into yellow colour then there is bacteria present in the surface area and that test tube is traced and the area is cleaned well again.



DETERMINATION OF HARDNESS:

Total hardness may be defined as the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate in milligrams per litre. The amount of hardness equivalent to the total alkalinity is called "carbonate hardness". The amount of hardness in excess of total alkalinity is called "non-carbonate hardness". In common usage, water is classified as soft, if it contains less than 75 ppm of hardness as calcium carbonate.

Reagents required:

Standard EDTA solution, 0.01M: Dissolve 0.3723 g Ethylenediamine tetraacetic acid disodium salt extra pure in 100 ml. in distilled water.

Ammonia buffer solution: Add 1 ml of Ammonia buffer solution in the sample.

Eriochrome Black T: Dissolve 0.5 g of EBT in 100 mL in distilled water.

Procedure:

Take 20 ml of the sample in a conical flask.

Add 1 ml of the Ammonia buffer solution.

Add 2 drops of the Eriochrome Black T indicator solution.

Titrate the contents with EDTA with continuous stirring.

The last few drops may be added at 3-5 seconds intervals.

At the end point color changes from wine red to blue.

Observation:

In this titration, the color changes from wine red to blue sharply at the end-point.



ADULTERATION TESTS:

1.SUGAR:

Take 5ml of milk in the test tube.

Add .1ml of conc. HCl.

Add 0.1g of resorcinol powder and mix thoroughly. Place the test tube in boiling water bath for 5 mins.

Withdraw the tube and observe the color.

Appearance of deep red color indicates presence of sucrose or ketose sugar.

2.STARCH:

Take 5 ml of milk in a test tube.

Bring to boiling condition and allow test tube to cool to room temperature.

Add 1-2 drop iodine solution to test tube dissolve 1.3 gm of iodine and 1.5 gm of potassium iodine in sufficient distilled water and make up to 100 ml.

Development of blue color indicates the presence of starch which disappears when the sample is boiling and appears on cooling.

3.UREA:

Take 5 ml of milk in a test tube.

Add 5 ml dimethyl amino benzaldehyde and dissolve 1.6 gm of p- dimethyl amino benzaldehyde in 100 ml of 10 percentage HCl.

Distinct yellow color is observed in milk containing added urea shows a slight yellow color due to the presence of natural urea.

4.SALT(NaCl):

Take 2 ml of milk in a test tube.

Add 1 ml of 5 percentage potassium chromate.

Add 2 ml of 0.1 N silver nitrate.

Appearance of yellow color indicates presence of dissolved chloride.

5.MOLTO DEXTRIN:

Take 5 ml of milk in a test tube and add equal vol of 10 percent acetic acid the milk will curd.

Filter it and take 1 ml of filtrate in a test tube and add a few drops of oro

Appearance of brown color indicates the presence of molto dextrin.

6.NEUTRALISERS:

Rosa acid test for the presence of carbonate.

Take 5 ml of milk in a tube and add an equal vol of 95 percent alcohol.

Add red color indicates the presence of alkali.

Normal milk shows only a brownish color

HYDROGEN PEROXIDE:

Take 10 ml of milk in a test tube.

Add 5 drops of 2 percent phenylene diamine hydrochloride.

Mix thoroughly and observe the color.

Development of an intense blue color shows the presence of hydrogen peroxide.

FORMALDEHYDE:

Take about 10 ml of milk in a test tube.

Add 0.5 ml of ferric chloride solution.

Add carefully about 1 ml of conc H_2SO_4 .

Down the side of the test tube in such a way that it forms a separate layer at the bottom of the test tube without with the milk.

Development of violet or blue color at the junction of two liquids indicates the presence of formaldehyde.

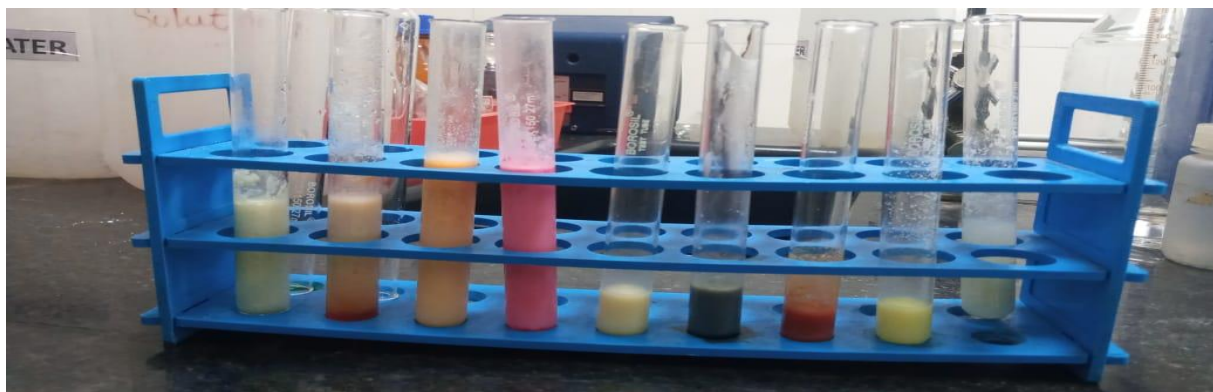
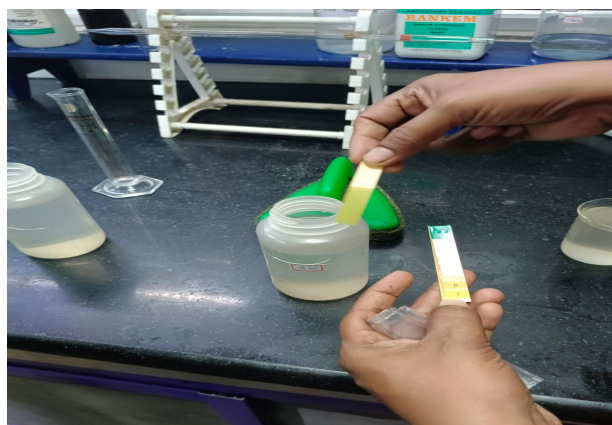
AMMONIUM SULPHATE:

Take 1 ml of milk and add 0.5 ml of 2 percent sodium hydroxide

Add 0.5 ml of 2 percent sodium hypo chloride.

Add 0.1 ml of phenol solution and heat for 20 mins in a boiling water bath.

Bluish color turns deep blue indicates presence of ammonium sulphate.

**pH TESTS FOR VARIOUS WATER SAMPLES:**

DECLARATION

I Shrinivas.J , hereby declare that this industrial training report entitled Chemistry in Dairies is submitted on partial fulfillment of the requirements of the degree of M.Sc(Chemistry) in my original record of work carried out by me during the industrial training of TAMILNADU CO-OPERATIVE MILK PRODUCER'S FEDERATION LIMITED (AAVIN) from 25/09/2023 to 09/10/2023.

Place:

Date:

Name and Signature of Student