GreenariA
Go Green, Learn Green
An Agricultural Monthly e-Magazine
Volume 02, Issue 06, 2024
ISSN: 2584-153X
Article ID: G-24-0620

CARE AND MANAGEMENT OF DAIRY EQUIPMENTS

Pawan Kumar[1*] and Karan Mahar[2]
[1]PhD scholar, Indian Veterinary Research Institute, Izatnagar*
[2]PhD scholar, National Dairy Research Institute, Karnal
***e-mail:** pawankumawat249@gmail.com*

INTRODUCTION

Care and management of dairy equipment is necessary for proper working and maintaining hygienic condition of dairy equipment. It is also an important factor for maintaining optimum performance and production of dairy farm. The expected useful life of dairy equipment is 8 year, implying a depreciation of 12.5% per annum. We can easily extend their useful life by 30-35%. IDMC (Indian dairy machinery company) limited was established in Anand (Gujarat), 1978 to manufacture dairy equipment and components and to contribute in moderating their prices. Many Indian companies manufacture dairy equipment such as Delaval Pvt. Ltd., GEA Farm Technologies Pvt. Ltd., Mahindra & Mahindra Ltd., Alfa Laval India Pvt. Ltd., Vansun Technologies Pvt. Ltd. and Sumangalam Dairy Farm Solutions (India) Pvt. Ltd con. The most commonly used dairy farm equipments are:

Milking equipments: Milking machines, bucket, pipelines, robotic milking systems, etc.

Feeding Systems: Automatic feeders, TMR (Total Mixed Ration) mixers, feed troughs

Health Monitoring Devices: Activity monitors, rumination sensors, temperature probes etc.

Manure Management Tools: Manure spreaders, slurry tanks, composting systems etc.

Cooling Systems: Fans, misters, sprinklers, fogger, cooling pads etc.

Calf Rearing Equipment: Calf hutches, milk replacers, automatic calf feeders etc.

Fencing and Containment: Electric fences, gates, cattle pens etc.

Data Management Software: Data management software, monitoring devices sensors etc.

OBJECTIVE OF MAINTENANCE OF DAIRY FARM EQUIPMENT:

• Reduce cost of maintenance and repair

• Increase the certainty of daily production target.

• Increase the farm efficiency and improve the farm production efficiency.

• Increase the overall productivity of dairy farm.

• Reduces the risk of unaccepted machinery failure.

COMMON TYPE OF APPROACHES FOR DAIRY EQUIPMENT MAINTENANCE

1. Preventive maintenance- In this approach equipment maintenance is conducted to keep equipment in working condition. This is concern with daily basis maintenance, periodic inspection, diagnosis of equipment condition, and to measure deterioration of equipment. Here's a comprehensive guide to preventive maintenance of dairy equipment:

• **Create a Maintenance Schedule:** Develop a preventive maintenance schedule outlining routine tasks, such as inspections, lubrication, cleaning, and calibration, for each piece of

dairy equipment. Schedule maintenance activities based on manufacturer recommendations, usage patterns, and equipment criticality.

• **Inspect Regularly:** Conduct regular inspections of all dairy equipment to identify signs of wear, damage, or malfunction. Inspect moving parts, seals, connections, electrical components, and safety features. Address any issues promptly to prevent further damage.

• **Lubricate Moving Parts:** Proper lubrication of moving parts is essential for reducing friction, wear, and noise in dairy equipment. Use food-grade lubricants recommended by the equipment manufacturer and follow lubrication schedules to maintain smooth operation.

• **Clean and Sanitize:** Clean and sanitize dairy equipment regularly to remove debris, bacteria, and contaminants that can compromise product quality and safety. Use approved cleaning agents and follow proper sanitation procedures to maintain hygiene standards.

• **Calibrate Sensors and Meters:** Calibrate sensors, meters, and measuring devices periodically to ensure accurate readings and consistent performance. Follow manufacturer instructions for calibration procedures and frequency to maintain precision.

• **Replace Wear Parts:** Replace worn or damaged parts, such as seals, gaskets, belts, and filters, according to the manufacturer's recommendations or when signs of wear are observed.

• **Monitor Performance:** Monitor the performance of dairy equipment regularly, including temperature, pressure, speed, and other relevant parameters. Keep records of performance data and compare them to baseline values to detect any deviations.

• **Train Operators:** Provide training to equipment operators on proper operation, maintenance procedures, safety precautions, and troubleshooting techniques. Empower operators to identify and address minor issues before they escalate into major problems.

• **Document Maintenance Activities:** Maintain detailed records of all preventive maintenance activities, including dates, tasks performed, and any issues encountered. Use these records to track equipment history, identify recurring problems, and improve maintenance practices.

• **Schedule Professional Service:** For complex equipment or specialized maintenance tasks, schedule periodic service visits by qualified technicians or service providers.

2. Predictive maintenance - Predictive maintenance is an advanced approach that utilizes data analytics and machine learning algorithms to predict when equipment is likely to fail so that maintenance can be performed just in time to prevent the failure from occurring. Here's how predictive maintenance can be applied to dairy equipment:

• **Data Collection**: Collect data from various sensors, meters, and monitoring devices installed on dairy equipment. These sensors can measure parameters such as temperature, pressure, vibration, and electrical currents, providing insights into the health and performance of the equipment.

• **Data Analysis:** Use advanced analytics techniques, including statistical analysis and machine learning algorithms, to analyze the collected data. Identify patterns, trends, and anomalies that may indicate potential issues or failure modes in the equipment.

• **Condition Monitoring**: Continuously monitor the condition of dairy equipment in real time using sensor data and predictive models. Set up automated alerts or notifications to flag potential issues or abnormalities detected by the predictive maintenance system.

• **Maintenance Planning:** Use the insights generated by the predictive maintenance system to optimize maintenance schedules and prioritize maintenance activities. Perform maintenance tasks proactively, scheduling them during planned downtime periods to minimize disruptions to dairy operations.

3. Corrective maintenance – Corrective maintenance approach conducted to get equipment working again so that this approach also known as repair approach. In this approach the reason for equipment failure is identified and action is taken to reduce the frequency of future failure.

• Identify the Issue: When a piece of dairy equipment malfunctions or exhibits abnormal behavior, promptly identify the problem. Engage operators and maintenance personnel to gather information about the symptoms, circumstances, and potential causes of the issue.

• Diagnosis: Conduct a thorough diagnosis to determine the root cause of the equipment malfunction. Use troubleshooting techniques, diagnostic tools, and equipment manuals to isolate the problem and identify any faulty components or systems.

• Repair or Replacement: Based on the diagnosis, proceed with the necessary repair or replacement of defective parts or components. Follow manufacturer guidelines, technical specifications, and safety procedures when performing repairs to ensure proper functionality and compliance with standards.

• **Testing and Verification:** After completing the repair or replacement, test the equipment to verify that the issue has been resolved and that it operates correctly. Conduct functional tests, performance checks, and safety inspections to ensure that the equipment meets operational requirements and safety standards.

• **Root Cause Analysis:** Perform a root cause analysis to identify underlying factors contributing to the equipment malfunction. Explore potential systemic issues, operational errors, or maintenance deficiencies that may have led to the problem. Implement corrective actions to address root causes and prevent recurrence.

COMMON MAINTENANCE PROBLEMS AND THEIR RESOLUTION

Wear and Tear: Dairy equipment undergoes regular use, leading to wear and tear of components such as seals, gaskets, bearings, and belts. Over time, this can result in reduced functionality, leaks, and equipment failure.

Mitigation: Replace and correct the wear parts.

Corrosion: Exposure to moisture, chemicals, and acidic substances in dairy processing environments can cause corrosion of metal parts and surfaces. Corrosion weakens equipment structures, compromises hygiene standards, and increases the risk of contamination.

Mitigation: Through proper maintenance and surface treatment.

Scaling and Deposits: Hard water containing minerals like calcium and magnesium can cause scaling and deposits on surfaces, pipes, and heating elements within dairy equipment.

Scale buildup restricts flow, reduces heat transfer efficiency, and impairs equipment performance. Mitigation: Regular descaling and cleaning are necessary to prevent these issues.

Leakage: Seals, fittings, valves, and joints in dairy equipment may develop leaks over time due to wear, corrosion, or improper installation. Leakage can lead to product loss, contamination risks, safety hazards, and environmental concerns.

Mitigation: Prompt detection and repair of leaks are essential to maintain equipment integrity and prevent operational disruptions.

Clogging and Blockages: Dairy equipment, such as pumps, filters, and pipelines, may experience clogging and blockages caused by debris, sediment, or product buildup. This can impede flow rates, reduce processing efficiency, and increase the risk of contamination.

Mitigation: Regular cleaning, flushing, and maintenance of filtration systems are necessary to prevent blockages.

Electrical Issues: Electrical components, such as motors, switches, relays, and control panels, may experience malfunctions, short circuits, or breakdowns due to wiring faults, voltage fluctuations, or component degradation.

Mitigation: Electrical problems can disrupt equipment operation, pose safety risks, and requires skilled troubleshooting and repair by qualified personnel.

Lubrication Issues: Moving parts and mechanical components in dairy equipment require proper lubrication to minimize friction, wear, and heat generation. Inadequate lubrication or the use of incorrect lubricants can lead to premature component failure, increased energy consumption, and operational inefficiencies.

Mitigation: Regular lubrication maintenance is essential to ensure smooth equipment operation and longevity.

Calibration Drift: Instruments, sensors, and measuring devices used in dairy equipment must be calibrated regularly to maintain accuracy and reliability. Calibration drift, caused by environmental factors, ageing, or misuse, can lead to inaccurate readings, process deviations, and quality control issues.

Mitigation: Scheduled calibration and verification procedures are necessary to uphold measurement accuracy and regulatory compliance.

Testing of dairy equipment: With the time period the milking machine efficiency and other equipment quality gradually deteriorate that generally goes un-noticed by the farmer that's why it is advisable to test the system at least twice a year by skilled person.

Milking equipment in hygiene point of view: Maintain dome shaped neck milking vessels for milking because open buckets are not hygienic to use. There are more chances of dust and dirt entering into it. After use of milk vessels, they should be washed first with hot water containing soda followed by sanitizer (Ranocid@10ml in10 lit water). After cleaning, it should be sun dried and kept inverted.

TYPES OF DAIRY EQUIPMENT CLEANING

1. Physical cleaning of dairy equipment

Physical cleaning of dairy equipment involves several key steps to ensure thorough removal of soil, residues, and contaminants. Here are the common types of physical cleaning methods used:

• **Pre-rinsing:** Before initiating the cleaning process, equipment surfaces are pre-rinsed with water to remove loose soil, debris, and product residues. This initial rinsing helps prevent the accumulation of soil during subsequent cleaning steps.

• **Manual Cleaning:** Manual cleaning involves the use of brushes, scrubbers, sponges, and cloths to manually scrub equipment surfaces. Food-grade cleaning agents or detergents are applied to facilitate the removal of stubborn residues, grease, and deposits. Manual cleaning is especially more effective for intricate areas where automated methods may not reach.

• **CIP (Clean-in-Place) Systems**: Clean-in-place systems are automated systems designed to clean equipment in situ without disassembly. These systems utilize pumps, spray balls, and circulating cleaning solutions to flush, scrub, and sanitize equipment surfaces. CIP systems are commonly used for pipelines, tanks, and closed systems where manual cleaning is impractical or labor-intensive.

• **Pressure Washing:** Pressure washing involves the use of high-pressure water jets to dislodge and remove soil, residues, and contaminants from equipment surfaces. Pressure washing is effective for large equipment, exterior surfaces, and outdoor installations where manual cleaning may be challenging.

• **Foam Cleaning:** Foam cleaning is a method where foaming agents or detergents are applied to equipment surfaces to create a foam layer. The foam adheres to the surfaces, allowing the cleaning agents to penetrate and dissolve soil and residues effectively. Foam cleaning is suitable for vertical surfaces, irregular shapes, and areas requiring prolonged contact with cleaning agents.

• **Steam Cleaning:** Steam cleaning utilizes high-temperature steam to disinfect and remove soil and residues from equipment surfaces. Steam effectively sanitizes surfaces by killing bacteria, mold, and other microorganisms. Steam cleaning is commonly used for equipment components that can withstand high temperatures and moisture, such as stainless steel surfaces.

• **Scraping and Scraping Tools:** Scraping involves the use of scraping tools, such as scrapers or spatulas, to manually remove adherent soil, residues, or scale from equipment surfaces. Scraping is often used as a preliminary step before applying cleaning agents or performing other cleaning methods.

• **Ultrasonic Cleaning:** Ultrasonic cleaning employs ultrasonic waves to create high-frequency vibrations in a cleaning solution. These vibrations generate microscopic bubbles that implode on equipment surfaces, dislodging and removing soil, residues, and contaminants. Ultrasonic cleaning is effective for cleaning small parts, components, and intricate surfaces.

2. Chemical cleaning of dairy equipment

It involves the use of specific cleaning chemicals to remove organic residues, mineral deposits, biofilms, and microbial contaminants from equipments surfaces. Here are some common types of chemicals used in dairy equipment cleaning:

• **Alkaline Cleaners:** Alkaline cleaners, also known as caustic cleaners, are used to remove organic residues such as fats, proteins, and sugars from surfaces. They work by saponifying fats and breaking down proteinaceous soils. Alkaline cleaners are

effective for cleaning stainless steel, glass, and plastic surfaces. Sodium hydroxide (NaOH) and potassium hydroxide (KOH) are common ingredients in alkaline cleaning formulations.

• **Acid Cleaners:** Acid cleaners are used to remove mineral deposits, scale, and inorganic residues from surfaces and equipment. They work by dissolving mineral salts such as calcium carbonate, calcium sulfate, and magnesium carbonate. Acid cleaners are particularly useful for descaling equipment like heat exchangers, pasteurizers, and evaporators. Common acids used include phosphoric acid, citric acid, nitric acid, and hydrochloric acid.

• **Chlorine-Based Cleaners:** Chlorine-based cleaners, such as chlorine bleach (sodium hypochlorite) or chlorine dioxide, are used for disinfection and sanitization purposes. They help eliminate microbial contaminants, including bacteria, yeasts, molds, and viruses. Chlorine-based cleaners are often used as part of a CIP (Clean-in-Place) system to sanitize equipment surfaces.

• **Oxygen-Based Cleaners:** Oxygen-based cleaners, such as hydrogen peroxide or peracetic acid, are used for both cleaning and disinfection purposes. They release oxygen radicals that break down organic matter and provide antimicrobial activity against a wide range of pathogens. Oxygen-based cleaners are effective at low temperatures and are suitable for cleaning heat-sensitive equipment.

• **Enzymatic Cleaners:** Enzymatic cleaners contain enzymes (e.g., proteases, amylases, lipases) that target specific types of organic soils, including proteins, starches, and fats. They are particularly useful for removing biofilms, proteinaceous residues, and complex organic soils. Enzymatic cleaners are often used as pre-soaks or in manual cleaning processes.

• **Detergents:** Detergents are surfactant-based cleaning agents that help lift and suspend soil from surfaces, allowing them to be rinsed away. They are typically used in combination with alkaline, acid, or enzymatic cleaners to enhance cleaning effectiveness. Detergents help reduce surface tension and improve wetting, penetration, and soil removal.

• **Sanitizers:** Sanitizers are chemical agents that reduce microbial populations on surfaces to safe levels. Sanitizers can be chlorine-based, iodine-based, quaternary ammonium compounds (quats), or hydrogen peroxide-based, depending on the specific application requirements and regulatory standards.

3. Sterile cleaning of dairy equipments

It's essential to follow standardized cleaning and sterilization protocols, validate cleaning processes, and regularly monitor equipment hygiene to ensure the production of safe and high-quality dairy products.

• **Steam Sterilization:** Steam sterilization involves exposing dairy equipment to high-temperature steam to kill microorganisms and sterilize surfaces. This method is commonly used for heat-resistant equipment and components that can withstand high temperatures. Steam can be applied by directing steam into the equipment long enough for product contact surfaces to be heated to at least 100°C.

• **Dry Heat Sterilization:** Dry heat sterilization involves exposing dairy equipment to high temperatures in a dry environment to kill microorganisms. This method is suitable for heat-resistant equipment and components that cannot be sterilized using moist heat

methods. Dry heat sterilization is effective for decontaminating surfaces and equipment.

• **Chemical Sterilization:** Chemical sterilization involves treating dairy equipment with sterilizing agents such as chlorine-based sanitizers, peracetic acid, hydrogen peroxide, or ozone. Chlorine, in solutions of sodium or calcium hypochlorite, is the most widely used of the chemical sterilant. For proper microbiological sanitation the chlorine solution used in dairy-cleaning operations should contain between, 50 and 300 ppm available chlorine. 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. Chemical sterilization may be used in combination with other cleaning methods for enhanced microbial control.

• **Ultraviolet (UV) Sterilization:** UV sterilization utilizes ultraviolet light to destroy microorganisms by damaging their DNA. UV sterilization systems can be installed in dairy processing equipment or facilities to disinfect surfaces, air, and water. UV sterilization is effective against bacteria, viruses, yeasts, and molds and is often used as a supplementary sterilization method.

The cleaning cycle in a dairy comprises the following stages:

• **Recovery of product residues by scraping, drainage and expulsion with water or compressed air:** All product residues should be recovered from the production line at the end of the run. Time must be allowed for the product to drain from tank walls and pipes. Surfaces coated with solid residues. Before cleaning starts, the remaining milk is forced out of the production lines with water. Wherever possible, the milk in the piping systems is blown or flushed with water to collecting tanks.

• **Pre-rinsing with water to remove loose dirt:** Pre-rinsing should always be carried out immediately after the production run. Otherwise, the milk residues will dry and stick to the surfaces, making them harder to clean. Milk fat residues are more easily flushed out if the pre-rinsing water is warm, but the temperature should not exceed 55 °C, to avoid coagulation of proteins. Pre-rinsing must continue until the water leaving the system is clear, as any loose dirt left will increase detergent consumption.

• **Cleaning with detergent:** The dirt on heated surfaces is normally washed off with alkaline and acid detergents, in that order or the reverse order, with intermediate water flushing, whereas cold surfaces are normally cleaned with alkalis and only occasionally with an acid solution. The detergent must also be capable of dispersing dirt and encapsulating the suspended particles to prevent flocculation. The most commonly used are sodium triphosphate and complex phosphate compounds.

CONCLUSION

Effective care, maintenance, and management of dairy equipment are essential for the sustainable and efficient operation of dairy farms. Implementing proper maintenance practices not only ensures equipment longevity but also contributes to cost savings, improved productivity, and reduced operational risks, ultimately benefiting the dairy industry as a whole.