AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 04 Issue: 06 June 2023 Article No: 11

Environmental Impact of Dairy Waste: Waste Lifecycle Assessment

Deepali Chandwani[1], Anjali Juyal[2] and Hemu Rathore[3]
[1]M.Sc. Research Scholar, FSN Department, CCAS, MPUAT, Udaipur
[2]Guest Faculty, RMCS department, CCAS, MPUAT, Udaipur
[3]Professor and HOD, RMCS department, CCAS, MPUA, Udaipur

SUMMARY

Demand for dairy products is rising globally, which encourages the growth of dairy sector and waste accumulation. Whey, dairy sludge, and wastewater (processing, cleaning, and sanitary) are produced in significant proportions. They contain both organic and inorganic components, have high nutritional concentrations, and have high biological oxygen demand (BOD) and chemical oxygen demand. (COD). The dairy industry is one of the most polluting of the food industries because of its significant water use. The dairy sector in India is expected to grow quickly as a result of the country's increasing milk consumption, and waste generation and related environmental concerns are also being given greater focus. The ecosystem, atmosphere, and the soil are all severely impacted by the rising amount of wastewater from the dairy industry. The dairy industry needs a kind of wastewater management system to reduce the negative consequences of effluent.

INTRODUCTION

Growing dairy product demand worldwide promotes the development of the dairy sector and the build-up of waste. Significant amounts of whey, dairy sludge, and wastewater (processing, cleaning, and sanitary) are produced. They have high nutritional concentrations, comprise both organic and inorganic components, and have high biological oxygen demand (BOD) and chemical oxygen demand (COD). Additionally, a variety of detergents that are acidic or alkaline as well as additional sterilizing agents might be present. The dairy industry degrades the quality of the land, the air, and the water. Due to its extensive water use, the dairy sector is one of the most polluting of all food industries. One of the main industries contributing to water contamination is dairy. Given the rising milk demand, the dairy industry in India is predicted to expand quickly, and waste creation and associated environmental issues are also given more importance. When released to the surface of the land or water, poorly treated wastewater with high levels of contaminants produced by poor design, operation, or treatment systems causes significant environmental hazards. The dairy business may perform a number of activities, such as pasteurizing cream, cheese, milk powder, etc. The water used in processing milk is one of the biggest waste products for the dairy industry. Minerals and organic milk products in significant quantities can be found in the milk after the water has been removed. Caustic wastewater is produced as a result of plant cleaning.

Sources of Wastewater

Wastes generated during the manufacture of dairy products include milk solids, although they do so in diluted form and at varying quantities. These substances are almost always present in the waste emitted from operations. The wastes generated by the dairy industry include the following:

1. Routine cleaning and washing of any product residue in the tank, trucks, cans, pipelines, tanks, and other equipment is done following each processing cycle.
2. Leaks, overflows, freezing-on, boiling over, and careless handling are the main causes of spills.
3. Processing losses in automatic packing equipment include splashing and container breakage.
4. The washing and sanitising solution contains detergents and other substances, which are then disposed of as garbage.

Effects of Wastewater on Environment

Dairy sector wastewater output is among the most polluting agents, both in terms of volume and specific characteristics. Between 0.2 to 10 litres of effluent are generated for every litre of pasteurised milk.Effluents from dairy processing are sporadically generated, and their flow rates are very variable.The volume, concentration, and composition of the effluents produced by the dairy industry depend on a number of factors, including the type of product being processed, the production programme, operating procedures, the

design of the processing plant, the level of water management, and ultimately, the amount of water conserved.The effluent from dairy operations comprises considerable levels of inorganic salts and milk components like Casein in addition to detergents and sanitizers used for cleaning.

Their high biological oxygen demand (BOD) and chemical oxygen demand are mostly caused by all of these componentswhich is much higher than the Indian Standard Institute (ISI), now Bureau of Indian Standard (BIS), specified limits for the discharge of industrial effluents, as these wastes are typically released to the nearby stream or land without any prior treatment, it is reported to cause serious pollution issues.Due to the quick decomposition of dairy effluents and the immediate decrease in the dissolved oxygen level of the receiving streams, anaerobic conditions are created, which cause the production of potent unpleasant odours as a result of undesirable conditions. The receiving water turns into a breeding ground for mosquitoes and flies that spread diseases including dengue fever,chikungunya, malaria and yellow fever.

In addition, it has been shown that some fish and algae species become toxic when exposed to dairy wastes at greater levels. It has been shown that the sewage casein precipitation, which further breaks down into a vile-smelling, black sludge, is toxic to fish in some dilutions. Dairy effluent contains soluble organics, suspended solids, and trace organics. In addition to other things, they promote eutrophication, increase gas release, add colour or turbidity, and produces repulsive taste and aroma.

Effects on Atmosphere

Gaseous emissions

Various emissions may be released into the atmosphere as a result of manufacturing activities. Boiler stacks emit carbon dioxide, sulphur oxides, and nitrogen oxides into the atmosphere. At wastewater irrigation locations, nitrous oxide (N_2O) is released from the soil, whereas methane emission from anaerobic waste treatment systems is plausible. The consequences of carbon dioxide, methane, and nitrous oxide emissions will probably need to be considered in the future because they are three important greenhouse gases.

Dust/ Odours

Particulate pollution can be released through boiler stacks, powder dryers, and other equipment. Particle material losses could additionally originate from other production processes. When particle emissions are too high, dust and powder may cause harm to neighbouring structures in addition to being undesirable. Visual pollution also includes factory smoke and steam plumes. The release of offensive odours must be considered in industrial processing areas. Several waste treatment plants have a propensity to emit unpleasant odours.

Effects on Land

Nutrients (nitrogen and phosphorus)

The primary means of nutrient removal in soil-based treatment systems include:

- Plant consumption and incorporation into animal products.
- Groundwater losses (leaching)
- Soil adsorption and immobilisation;
- Losses to the Environment

Plants are capable of absorbing 500 kg of nitrogen per hectare per year. The amount of phosphorus is around 30 kg. If animals consume this pasture , up to 90% of the nitrogen and phosphate in it are recycled. Through denitrification and the volatilization of ammonia from dung and urine patches, nitrogen is lost to the environment. During the denitrification process, microorganisms transform nitrate into either nitrous oxide or dinitrogen gas. When a suitable organic carbon source is accessible for energy in anoxic (i.e., when there is not enough oxygen) environments, this occurs. Denitrification rates in wastewater irrigation locations might be rather high.

Some irrigation facilities may have nitrogen losses to the groundwater, primarily in the form of nitrate, depending on how much nitrogen is removed by other techniques. The primary barrier to the disposal of nitrogen-containing wastes in soils is often nitrate pollution of groundwaters that are afterwards used as water sources for people or cattle. Adopting common drinking water regulations in these circumstances is typical. Leaching of phosphorus into groundwater generally does not pose a threat because of the high retention and immobilisation of phosphates in soils.

Sodium and other minerals

Sodium, potassium, calcium, and magnesium are all immobilised by soils and occupy the cation exchange sites on soil colloids and clays.

CONCLUSION

Dairy farms require some kind of wastewater management system. A variety of site-specific factors, including the herd size, proximity to streams, gullies, and underground aquifers, climate, soil type, and labour availability, should be taken into account when deciding on the optimal approach for a certain farm. In most cases, pond systems are superior than continuous application systems. However, there are some circumstances when continuously applied systems that are well-managed and built could be just as suited as pond systems. They frequently perform a better job of preserving the environment and enabling farmers to benefit from the fertiliser and water value of the effluent.

REFERENCES

Cammarota MC, Freire DMG. 2006. A review on hydrolytic enzymes in the treatment of wastewater with high oil and grease content. *Bioresource Technology*. **97**:2195–210

Chatzipaschali A, Stamatis AG. 2012. Biotechnological utilization with a focus on anaerobic treatment of cheese whey: current status and prospects. *Energies*. **5**:3492–525.

Cristian O. 2010. Characteristics of the untreated wastewater produced by food industry. *Analele Universităţii din Oradea, Fascicula: Protecţia Mediului*. **15**:709–14.

Dhall P, Siddiqi T.O., Ahmad A, Kumar R, Kumar A. 2012. Restructuring BOD: COD ratio of dairy milk industrial wastewaters in BOD analysis by formulating a specific microbial seed. *Scientific World Journal*. 105712.

Gannoun H, Khelifi E, Bouallagui H, Touhami Y, Hamdi M. 2008. Ecological clarification of cheese whey prior to anaerobic digestion in upflow anaerobic filter. *Bioresource Technology*. **99**:6105–11.

Janczukowicz W, Zieliński M, Dębowski M. 2008. Biodegradability evaluation of dairy effluents originated in selected sections of dairy production. *Bioresource Technology*. **99**:4199–205.

Milani, FX., Nutter, D., Thoma, G. 2011. Environmental impacts of dairy processing and products. *Journal of Dairy Science*. **94** (9): 4243-4254

Omil F, Garrido JM, Arrojo B, Méndez R. 2003. Anaerobic filter reactor performance for the treatment of complex dairy wastewater at industrial scale. *Water Research*. **37**:4099–108.

Raghunath, BV., Punnagaiarasi, A., Rajarajan, G., Irshad, A., Elango, A., Kumar, MG. 2016. Impact of dairy effluent on environment. *Research Gate*.

Rahman MS, Islam MA, Habib S, Sarker J. 2013. Measuring biodegradability of industrial wastewater by a low-cost differential respirometer. *Research Journal of Engineering Sciences.* **2**:1–4.

Sarkar B, Chakrabarti PP, Vijaykumar A, Kale V. 2006. Wastewater treatment in dairy industries – possibility of reuse. *Desalination*.**195**:141–52.

World Wild Life. Dairy Industries. Retrieved from https://www.worldwildlife.org/industries/dairy#:~:text=Dairy%20cows%20and%20their%20manure,prairies%2C%20wetlands%2C%20and%20forests on 25/10/22.