Waste Characteristics of Dairy Industry and its Treatment

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INTRODUCTION

Industries producing dairy products involves processing raw milk into consumer milk,

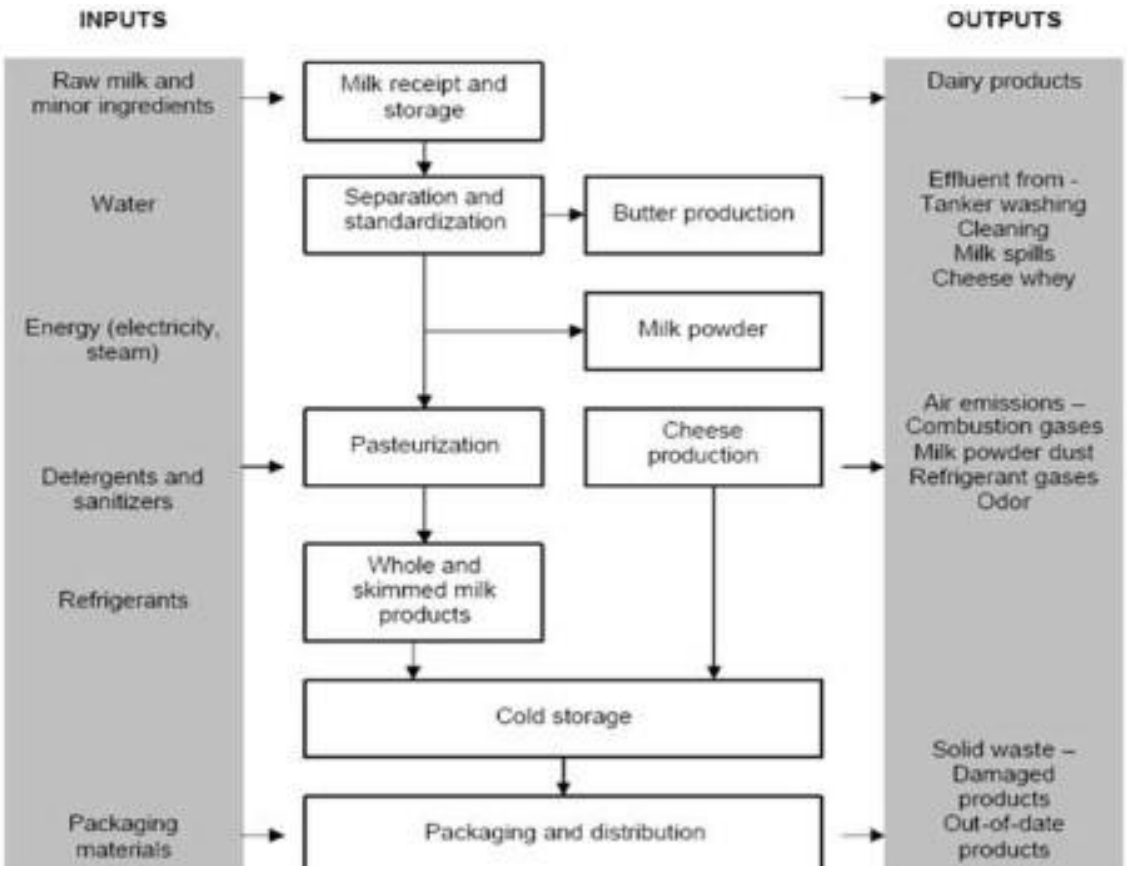
ice-cream, butter, cheese and yogurt.

Processes involved in the manufacturing are chilling, pasteurization, homogenization, condensing, etc.

Diary industries have shown tremendous growth in size and number in most countries of the world.

Wastewater discharged by these industries is characterized by high COD, BOD, nutrients, organic and inorganic contents. If it is discharged directly into streams without proper treatment can severely pollute receiving water bodies.

FLOW CHART OF DIARY PROCESSING ACTIVITIES:



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SOURCES OF WASTEWATER:

Dairy Processes	Sources of Waste
Milk receiving and storage	Spills from storage tank Foaming Poor drainage of tankers
Pasteurization	Deposits on surface of heating equipment Recovery of downgraded product Cleaning operations
Homogenisation	Cleaning operations Liquid leaks
Clarification	Pipe leaks Foaming

https://vertassets.blob.core.windows.net/image/a7184538/a7184538-c0e7-420f-b9fd-e6fbe7c5d934/dairyplant.jpg

CHARACTERISTICS OF WASTEWATER:

- Biochemical Oxygen Demand (BOD): 0.8 to 2.5 kilogram per metric ton(kg/t) of milk in the untreated effluent.
- Chemical Oxygen Demand (COD): 1.5 times the BOD level.
- Total Suspended Solids (TSS): 100-1,000 milligrams per liter(mg/l).

Total Dissolved Solids (TDS): Nitrogen (about 6% of the BOD level)

Phosphorous (10-100 mg/l).

- It often generates odour and in some cases, dust which need to be controlled.
- It may contain pathogens from contaminated materials or production processes.

COMPOSITION OF THE WASTEWATER OF DIARY INDUSTRIES:

Table 1: Characteristics of dairy industry wastewaters (composition in mg/l, except pH)

Waste Type	COD	BOD	PH	TSS	TS	References
Milk & Dairy Products factory	10251.2	4840.6	8.34	5802.6		Onet Cristian,2010
Dairy effluent	1900-2700	1200-1800	7.2-8.8	500-740	900-1350	U. B. Deshannavar, et al 2012
Arab Dairy Factory	3383 ± 1345	1941± 864	7.9 ± 1.2	831 ± 392		A. Tawfik et. al,2007
Dairy waste water	2,500- 3,000	1,300-1,600	7.2-7.5	72,000-80,000	8,000-10,000	Javed Iqbal Qazi et. al,
Dairy effluent (CPCB 1993)	1120-3360	320-1750	5.6-8	28-1900		Kusum Lata, et. al, Biogas forum,1999
Whey	71526	20000	4.1	22050	56782	Deshpande D.P. et. al, 2012
Bhandara Co-operative dairy industry wastewater	1400 to 2500	800 to 1000	7.1-8.2	1045 to 1800	1100 to 1600	Monali Gotmare* et al.,2011
Cheese Whey pressed	80,000-90,000	120,000-135,000	6	8000-11000		Rana Kabbout, et al.,2011
Aavin dairy industry washwater	2500-3300		6.4 -7.1	630-730	1300-1400	Sathyamoorthy G.L, et al.,2012
Dairy industry wastewater	2100	1040	7-8	1200	2500	A. Arumugam

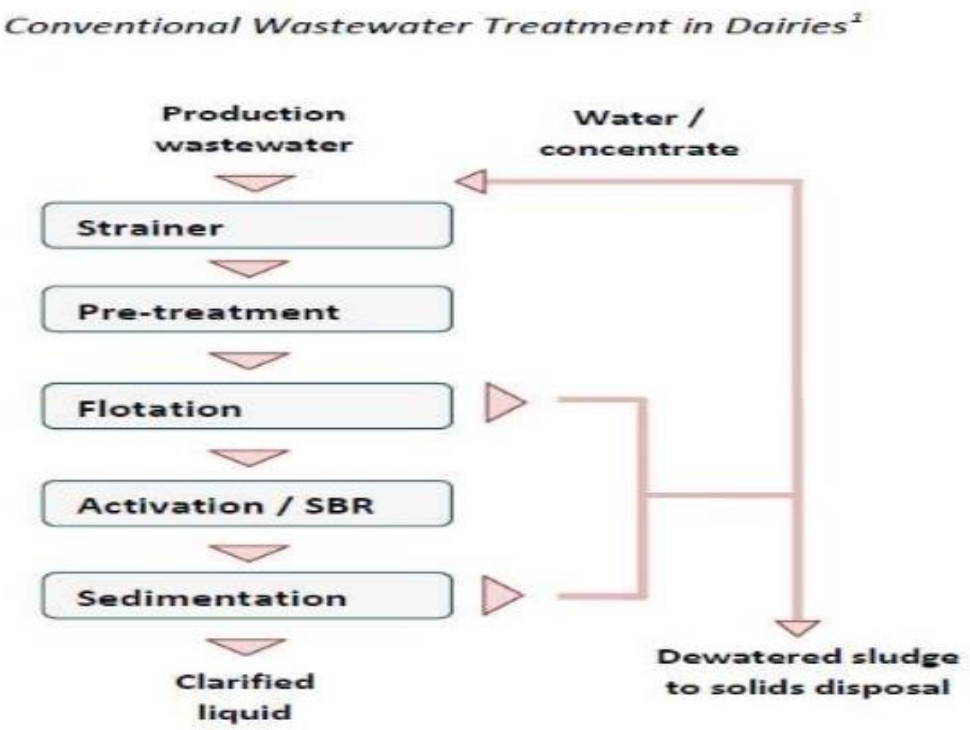
https://inpressco.com/wp-content/uploads/2013/11/Paper31611-1615.pdf

WASTEWATER TREATMENT PROCESSES

The dairy industry generates on an average 3.0-4.0 liters of wastewater per liter of milk processed.
Dairy wastewater is highly biodegradable, they can be effectively treated with biological wastewater treatment systems.

Wastewater treatment process is based on five steps:

- Screening
- Oil and grease separation in a tank
- Flow equalization in a tank
- An activated Sludge Process (Aerobic Process)
- Tertiary Treatment



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SCREENING:

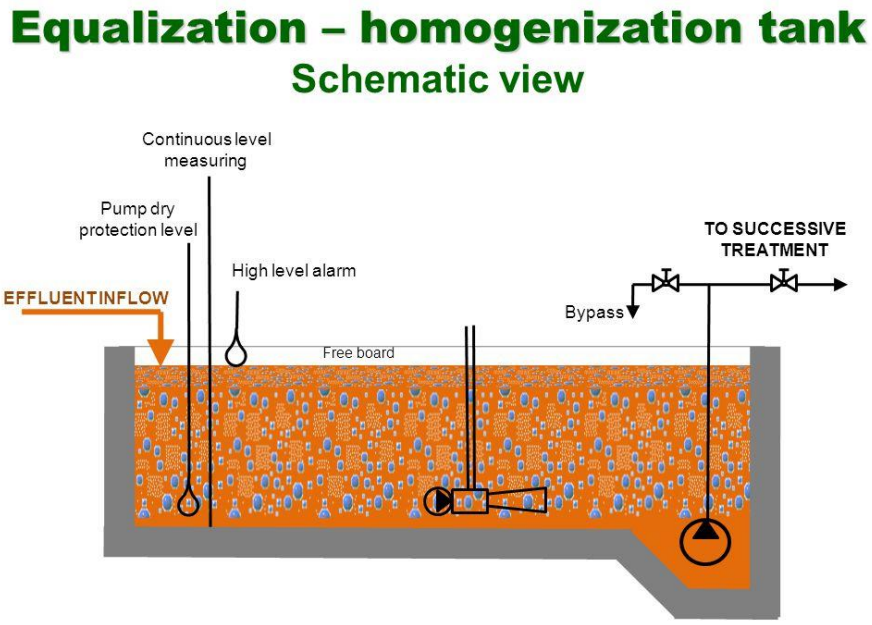
This process screens out coarse or heavy solids that could damage process pumps.

OIL AND GREASE SEPARATION:

- **Floatation:** Floatation removes oil and grease, separates physical solids and decrease BOD associated with the physical solids. This treatment separates pollutants by removing solids due to their lower density, where they can be concentrated and then skimmed off.

FLOW EQUILIZATION:

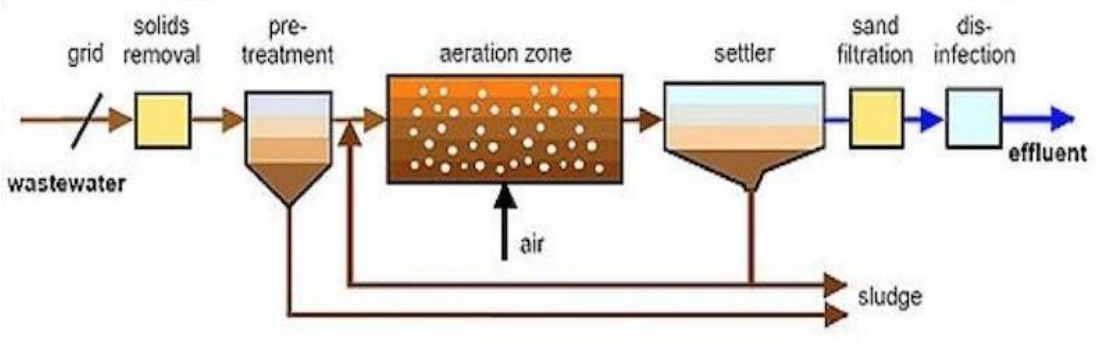
Flow equalization tank are designed to accommodate the variable flow into the tank and output a steady state condition that would flow into the treatment plant, which optimizes the efficiency of the treatment process. Equalization reduces hydraulic overloads and the possibility of flow-variation shock loads. Mixing increases the effectiveness of equalization.



http://slideplayer.com/3453785/12/images/13/Equalization+%E2%80%93+homogenization+tank+Schematic+view.jpg

ACTIVATED SLUDGE PROCESS:

- Primary wastewater mixed with bacteria-rich (activated) sludge and air or oxygen is pumped into the mixture.
- Promotes bacterial growth and decomposition of organic matter.
- Last step is a settling tank where sludge settles out and then the treated wastewater moves on for tertiary treatment.
- Some settled sludge is used to inoculate incoming primary effluent.
- BOD removal is approximately 85%.
- Microbial removal by activated sludge:
  80-99% removal of bacteria (sunlight, temperature, antagonistic microorganism, predation by ciliated protozoans, competition from other bacteria, adsorption to sludge solids).
  90-99% removal of viruses (mostly through solids settling, but also bacterial antiviral products and predation).

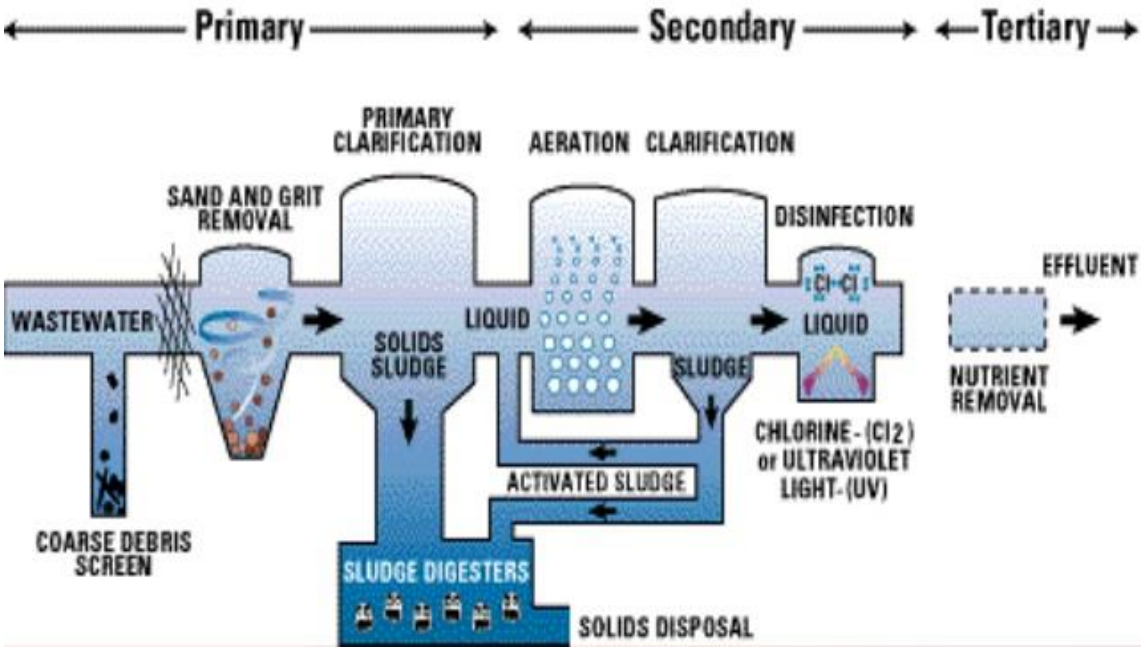


https://www.aboutcivil.org/sites/default/files/2017-12/types-activated-sludge.jpg

TERTIARY TREATMENT:

Tertiary treatment involves a series of additional steps to further reduce organics, turbidity, N, P, metals and pathogens. This is for wastewater that may impact recreational areas, will be used for irrigation, or will be used for drinking water.

- **Coagulation:** Chemicals such as lime or polyelectrolytes are used to help coagulate and agglomerate smaller particles into larger particles, thereby increasing their density and associated settling rates. This method focuses on removing suspended solids.
- **Filtration:** Water moves through filter beds and screens which removes substances. This method results in reduction of suspended solids or oil and grease.
- **Carbon Adsorption:** Carbon removes refractory organic compounds. It also removes ethers lignin and tannins.
- **UV Disinfection:** UV contains energy that is absorbed in the DNA of micro-organisms, disrupting reproductions at the cellular level. It mainly removes micro-organisms such as coliform bacteria, viruses, protozoa.



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STANDARDS FOR EFFLUENTS DISCHARGE:

PARAMETER	MAXIMUM VALUE (mg/l)	
	WORLD BANK REPORT	CPCB, INDIA
pH	6-9	6.5-8.5
BOD_5	50	100 (based on BOD_5)
COD	250	-
Total Suspended Solids	50	150
Oil & Grease	10	10
Total Nitrogen	10	-
Total Phosphoruus	2	-
Temperature Increase	$< = 3^0$ C	-
Coliform Bacteria	400 Most Probable Number / 100 ml	-

https://www.researchgate.net/profile/Bharati_Shete/publication/260631762/figure/download/tbl1/AS:669658520752132@1536670441522/Minimal-standards-for-discharge-of-effluents-from-the-dairy-industry.png

WASTE MINIMISATION

- Reducing use of water.
- Reducing use of chemicals or substitution of mineral salts – for example potassium in place of sodium compounds.
- Recycling water and chemicals.
- Recovery and reuse of product from first reuse.
- Recovering and reusing spilled raw materials and products.

http://www.handybinwaste.com.au/library/images/mini_chart.gif

REDUCE REUSE AND RECYCLE

- Many dairy products have technologies in place for recovering wastewater and reuse in the dairy plant.
- Reuse and recycling can considerably decrease the volume of mains water required to operate the plant.
- Reuse and recycling reduce the cost of both mains water and wastewater disposal.
- Fats, milk solids and minerals can also be recovered from wastewater and recycled – either at the dairy plant or offsite.
- Cleaning chemicals can also be recovered and reused on site.

https://p3w6d7a3.stackpathcdn.com/wp-content/uploads/2017/08/reduce-reuse-recycle.jpg

CONCLUSION

Diary industries have shown tremendous growth in size and number in most countries of the world. The dairy industry generates on an average 3.0-4.0 liters of wastewater per liter of milk processed. Reuse and recycling can considerably decrease the volume of mains water required to operate the plant and reduce the cost of both mains water and wastewater disposal.

If we devise such a method which reduces the cost of treatment and provide some of the by-product, in line. The owners themselves think of applying the same in the industry, ultimately minimize the losses to be developed to the ecosystem which is helpful in protecting the environment. Thereby I propose of using coir as a media the cheapest and readily available material in a fixed film bed reactor.

REFERENCES

- **International Journal of Current Engineering and Technology.**
  https://inpressco.com/wp-content/uploads/2013/11/Paper31611-1615.pdf

- **Water Technology and Industries Water Management**.
  https://www.watertechonline.com/wastewater/article/15545760/what-are-process-controls-for-treating-wastewater-in-the-dairy-industry

- **Environmental Issues in Dairy Processing.**
  Written by J.W. Barnett, S. L. Robertson and J. M. Russell, Environment Portfolio, New Zealand Dairy Research Institute, Palmerston North.
  https://www.researchgate.net/publication/286182856_Dairy_industry_wastewater_sources_characteristics_its_effects_on_environment

- **Utilization and treatment of Dairy effluent through biogas generation.**
  Bhumesh Singh Bhadouria, Sai. V. S, International Journal of Environmental Sciences Volume 1, No. 7, 2011.
  http://www.ipublishing.co.in/ijesarticles/ten/articles/volone/EIJES2109.pdf