STUDY OF DAIRY WASTEWATER TREATMENT BY USING CONSTRUCTED WETLAND

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ABSTRACT

Dairy industries have shown tremendous growth in size and number in most countries of the world. These industries discharge wastewater which is characterized by high chemical oxygen demand, biological oxygen demand, nutrients, and organic and inorganic contents. Such wastewaters, if discharged without proper treatment, severely pollute receiving water bodies. In this article, the various recent advancements in the treatment of dairy wastewater have been discussed and stress is given on the lowest cost of the best possible treatment. The objective of the research was to evaluate the performance of a laboratory-scale biological treatment unit for dairy-industry wastewater and to determine the kinetic parameters. The quality of wastewater decides the line of treatment. The study undertaken involved the characterization of wastewater and the dairy waste is selected for this purpose. Constructed wetlands treat the sewage water using highly effective and ecologically sound, design principles that use plants, microbes, sunlight and gravity to transform wastewater into gardens and reusable water. There for we use constructed wetland for treating the dairy waste water to convey the best result and pollution free climate.The quality of wastewater decides the line of treatment. The study undertaken involved the characterization of wastewater and the dairy waste is selected for this purpose. Constructed wetlands treat the sewage water using highly effective and ecologically sound, design principles that use plants, microbe

Keywords:* *Dairy Wastewater, Characterization Of Wastewater, Laboratory-Scale Biological Treatment, Ecofriendly And Low Cost Treatment Method, Constructed Wetland , Development Of Society, Cleanliness, Etc.

I INTRODUCTION

1.1 Dairy Wastewater

The dairy industry wastewaters are primarily generated from the cleaning and washing operations in the milk processing plants. It is estimated that about 2 % of the total milk processed is wasted into drains. Dairy wastewaters are characterized by high Biological-Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), Dissolved Oxygen (DO) concentrations, and generally contain fats, nutrients, lactose, as well as detergents and sanitizing agents. Dairy effluents decompose rapidly and deplete the dissolved oxygen level of the receiving streams immediately resulting in anaerobic conditions and release of strong foul odour due to nuisance conditions. The receiving water becomes breeding place for flies and mosquitoes carrying malaria and other dangerous diseases like dengue fever, yellow fever, chicken guniya.

It is also reported that higher concentration of dairy wastes are toxic to certain varieties of fish and algae. The casein precipitation from waste which decomposes further into a highly odorous black sludge at certain dilutions the dairy waste is found to be toxic to fish also. Dairy effluent contains soluble organics, suspended, solids, trace organics. They decrease do, promote release of gases, cause taste and odour, impart colour or turbidity, promote eutrophication. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater cause serious environmental problems. Moreover, the Indian government has imposed very strict rules and regulations for the effluent discharge to protect the environment. Thus, appropriate treatment methods are required so as to meet the effluent discharge standards.

1.2 Wastewater Generation and Characteristics

Dairy industries are involved in the manufacturing of various types of milk products such as fluid milk, butter, cheese, yogurt, condensed milk, flavored milk, milk powder, ice cream, etc. Typical by-products obtained include buttermilk, whey, and their derivatives. A chain of operations involving receiving and storing of raw materials, processing of raw materials into finished products, packaging and storing of finished products, and a group of other ancillary operations (e.g., heat transfer and cleaning) are examples of some of the great variety of operations performed in the dairy industries. The initial operations such as homogenization, standardization, clarification, separation, and pasteurization are common to most plants and products. Clarification (removal of suspended matter) and separation (removal of cream for milk standardization to desired butterfat content), generally, are accomplished by specially designed large centrifuges.

Drying, condensing, etc. are also used in dairy industries for the production of various products. In the dairy industry, some amount of wastewater gets produced during starting, equilibrating, stopping, and rinsing of the processing units (flushing water, first rinse water, etc.). However, a majority of wastewater gets produced during cleaning operations, especially between product changes when different types of products are produced in a specific production unit and clean-up operations. The dairy industry is one of the most polluting of industries, not only in terms of the volume of effluent generated, but also in terms of its characteristics as well.

Dairy effluent contains soluble organics, suspended solids, trace organics. All these components contribute largely towards their high Biological Oxygen Demand (BODS) and Chemical Oxygen Demand (COD).The characteristics of a dairy effluent contain Temperature, Color, pH (6.5-8.0), DO, BOD, COD, Dissolved solids suspended solids, chlorides sulphate, oil & grease. The waste water of dairy contains large quantities of milk constituents such as casein, inorganic salts, besides detergents and sanitizers used for washing. It has high sodium content from the use of caustic soda for cleaning. Typical Characteristic of dairy industry waste water reported by various authors. Figure 1.1 explains in detail the units involved in milk processing industries and shows the flowchart of Effluent generation from various units.

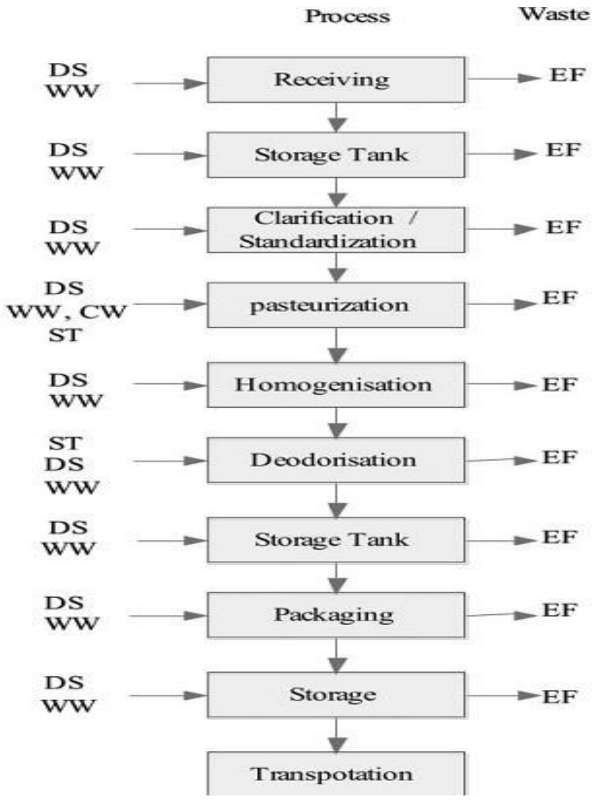

Fig. No. 1.1:- Effluent Generation From Various Units of Milk Processing. DS-detergents and sanitizing agents, WW-wash water, ST-steam, CW-cooling water.(Sources: Comparative Study of Various Treatments For Dairy Industry Wastewater Mrs. Bharati S. Shete, Dr. N. P. Shinkar)

1.3 Dairy Wastewater Treatment

Common techniques for treating dairy industry wastewaters include grease traps, oil water separators for separation of floatable solids, equalization of flow, and clarifiers to remove SS. Biological treatment consists of the aerobic and anaerobic process. Sometimes anaerobic treatment followed by aerobic treatment is employed for the reduction of soluble organic matter (BOD) and Biological Nutrient Removal (BNR) is employed for the reduction of nitrogen and phosphorus. Aerobic biological treatment involves microbial degradation and oxidation of waste in the presence of oxygen. Conventional treatment of dairy wastewater by aerobic processes includes processes such as activated sludge, trickling filters, aerated lagoons, or a combination of these. But there are more advanced techniques which will be beneficial to us by providing energy generation and Reuse and energy conservation have become the words of the day and anaerobic processes have emerged with a new potential so we study here some of the anaerobic processes studied by different scientists.

Table no. 1.1:- Comparison of advantages and disadvantages of aerobic and aerobic treatment of dairy industry waste waters.(Sources: Comparative Study of Various Treatments For Dairy Industry Wastewater Mrs. Bharati S. Shete, Dr. N. P. Shinkar).

FACTORS	AEROBIC PROCESS	ANAEROBIC PROCESS
Reactors	Aerated lagoons, oxidation ditches, Stabilization ponds, Trickling filters and Biological discs	UASB, Anaerobic filter, Upflow packed bed reactor, CSTR, Down flow fixed-film reactor, Buoyant Filter Bioreactor,
Reactor size	Aerated lagoons, oxidation ditches, Stabilization ponds, Trickling filters and Biological discs requires larger land area but SBR needs comparatively lower area.	Smaller reactor size is required.
Effluent Quality	Excellent effluent quality in terms of COD, BOD and nutrient removal is achieved.	Effluent quality in terms of COD is fair but further treatment is required. Nutrient removal is very poor.
Energy	High energy is required.	These processes produce energy in the form of methane.
Biomass yield	In comparison to anaerobic process, 6-8 times greater biomass is produced	Lower biomass is produced.
Loading rate	Maximum 9000 g COD/m3 d is reported in literature.	Very high Loading rate of 31 kg COD/m3 d has been reported. This is the reason for smaller reactor volume and lesser area.
Oil and grease removal	These do not cause serious problems in aerobic processes (Komatsu et al., 1991).	Fats in wastewater shows the inhibitory action during anaerobic treatment of dairy wastewaters
Shock loading	Excellent performance in this regard.	Anaerobic processes showed not good responses to this shock loading.
Alkalinity addition	No need.	There is need for alkalinity addition to maintain the pH because pH changes during the digestion of lactose.

II. WETLANDS

Wetlands are transitional areas between land and water. The boundaries between wetlands and uplands or deep water are therefore not always distinct. The term “wetlands” encompasses a broad range of wet environments, including marshes, bogs, swamps, wet meadows, tidal wetlands, floodplains, and ribbon (riparian) wetlands along stream channels. All wetlands - natural or constructed, fresh-water or salt - have one characteristic in common: the presence of surface or near-surface water, at least periodically. In most wetlands, hydrologic conditions are such that the substrate is saturated long enough during the growing season to create oxygen-poor conditions in the substrate.

The lack of oxygen creates reducing. (oxygen-poor) conditions within the substrate and limits the vegetation to those species that are adapted to low-oxygen environments. The hydrology of wetlands is generally one of slow flows and either shallow waters or saturated substrates. The slow flows and shallow water depths allow sediments to settle as the water passes through the wetland. The slow flows also provide prolonged contact times between the water and the surfaces within the wetland. The complex mass of organic and inorganic materials and the diverse opportunities for gas/water interchanges foster a diverse community of microorganisms that break down or trans-form a wide variety of substances. Most wetlands support a dense growth of vascular plants adapted to saturated conditions.

This vegetation slows the water, creates microenvironments within the water column, and provides attachment sites for the microbial community. The litter that accumulates as plants die back in the fall creates additional material and exchange sites, and provides a source of carbon, nitrogen, and phosphorous to fuel microbial processes.

2.1. Wetland Functions and Values

Wetlands provide a number of functions and values. (Wetland functions are the inherent processes occurring in wetlands; wetland values are the attributes of wetlands that society perceives as beneficial.) While not all wetlands provide all functions and values, most wetlands provide several. Under appropriate circumstances. constructed wetlands can provide:

1.Water quality improvement

2.Flood storage and the resynchronization of storm rainfall and surface runoff

3.Cycling of nutrients and other materials

4.Habitat for fish- and wildlife

5.Passive recreation, such as bird watching and photography

6.Active recreation, such as hunting

7.Education and research

8.Aesthetics and landscape enhancement.

2.2. Components of Constructed Wetlands

A constructed wetland consists of a properly-designed basin that contains water, a substrate, and, most commonly, vascular plants. These components can be manipulated in constructing a wetland. Other important components of wetlands, such as the communities of microbes and aquatic invertebrates, develop naturally.

2.2.1. Water

Wetlands are likely to form where landforms direct surface water to shallow basins and where a relatively impermeable subsurface layer prevents the surface water from seeping into the ground. These conditions can be created to construct a wetland. A wetland can be built almost anywhere in the landscape by shaping the land surface to collect surface water and by sealing the basin to retain the water. Hydrology is the most important design factor in constructed wetlands because it links all of the functions in a wetland and because it is often the primary factor in the success or failure of a constructed wetland. While the hydrology of constructed wetlands is

 ISBN: 978-93-86171-12-2

not greatly different than that of other surface and near-surface waters, it does differ in several important respects:

1.Small changes in hydrology can have fairly significant effects on a wetland and its treatment effectiveness

2.Because of the large surface area of the water and its shallow depth, a wetland system interacts strongly with the atmosphere through rainfall and evapotranspiration (the combined loss of water by evaporation from the water surface and loss through transpiration by plants).

3.The density of vegetation of a wetland strongly affects its hydrology, first, by obstructing flow paths as the water finds its sinuous way through the network of stems, leaves, roots, and rhizomes and, second, by blocking exposure to wind and sun.

Substrates used to construct wetlands include soil, sand, gravel, rock, and organic materials such as compost. Sediments and litter then accumulate in the wetland because of the low water velocities and high productivity typical of wetlands. The substrates, sediments, and litter are important for several reasons:

1.They support many of the living organisms in wetlands.

2.Substrate permeability affects the movement of water through the wetland.

3.Many chemical and biological (especially microbial) transformations take place within the substrates.

4.Substrates provide storage for many contaminant.

5.The accumulation of litter increases the amount of organic matter in the wetland. Organic matter provides sites for material exchange and microbial attachment, and is a source of carbon, the energy source that drives some of the important biological reactions in wetlands.

The physical and chemical characteristics of soils and other substrates are altered when they are flooded. In a saturated substrate, water replaces the atmospheric gases in the pore spaces and microbial metabolism consumes the available oxygen. Since oxygen is consumed more rapidly than it can be replaced by diffusion from the atmosphere, substrates become anoxic (without oxygen). This reducing environment is important in the removal of pollutants such as nitrogen and metals.

2.2.2. Vegetation

Both Vascular Plants (the higher plants) and Non-Vascular Plants (algae) are important in constructed wetlands. Photosynthesis by algae increases the dissolved oxygen content of the water which in turn affects nutrient and metal. Constructed wetlands attract waterfowl and wading birds, including mallards, green-winged teal, wood ducks, moorhens, green and great blue herons, and bitterns. Snipe, red-winged blackbirds, marsh wrens, bank swallows, red-tailed hawks, and Northern harriers feed and/or nest wetlands.

2.2.3. Constructed wetlands media

Hydraulic conductivity according to the time of media

1. Coarse gravel, high permeability: of the order of 10-2 m/s
2. Gravel, good permeability: of the order of 10-4 m/s
3. Fine to medium sand, poor permeability: of the order of 10-5 m/s
4. Loamy sand, permeable with difficulty: of the order of 10-6 m/s

5. Fine-particulate clay, very poor permeability: of the order of 10-8 m/s

Depending on the kind of plants used, hydraulic conductivity increases with time as old rhizome channels remain open after the rhizomes decayed thereby creating a series of pores through the bed. They can develop in any significant quantity after three to five years.

2.2.4. Gravel rocks and crushed stones

The media used in Subsurface Flow Constructed Wetlands (SSFCW) is fundamental; it is crucial that the gravel or sand be clean, washed and without impurities. When available, volcanic rock is the best medium but other materials such as limestone, river rocks, recycled concrete and recycled crushed glass to desired diameter are also being used. The gravel is the growth medium for microorganisms, works as a sieve and determines hydraulic residence time.

2.2.5. Aesthetics and landscape enhancement

While wetlands are primarily treatment systems, they provide intangible benefits by increasing the aesthetics of the site and enhancing the landscape. Visually, wetlands are unusually rich environments. By introducing the element of water to the landscape, constructed wetlands, as much as natural wetlands. Add diversity to the landscape. The complexity of shape, color, size, and interspersion of plants, and the variety in the sweep and curve of the edges of landforms all add to the aesthetic quality of the wetlands. Constructed wetlands can be built with curving shapes that follow the natural contours of the site, and some wetlands for water treatment are' indistinguishable, at first glance, from natural wetlands.

1.Vascular plants contribute to the treatment of wastewater and runoff in a number of ways: they stabilize substrates and limit channelized flow.

2.They slow water velocities, allowing suspended materials to settle.

3.They take up carbon, nutrients, and trace elements and incorporate them into plant tissues.

4.They transfer gases between the atmosphere and the sediments.

5.Leakage of oxygen from subsurface plant structures creates oxygenated microsites within the substrate.

6.Their stem and root systems provide sites for microbial attachment.

7.They create litter when they die and decay.

Constructed wetlands are usually planted with emergent vegetation (non-woody plants that grow with their roots in the substrate and their stems and leaves emerging from the water surface). Common emergent used in constructed wetlands include bulrushes, cattails, reeds, and a number of broad-leaved species.

2.2.6. Microorganisms

A fundamental characteristic of wetlands is that their functions are largely regulated by microorganisms and their metabolism (Wetzel 1993). Microorganisms include bacteria, yeasts, fungi, protozoa, rind algae. The microbial biomass is a major sink for organic carbon and many nutrients. Microbial activity:

1.Transforms a great number of organic and inorganic substances into innocuous or insoluble substances.

2.Alters the reduction/oxidation (redox) conditions of the substrate and thus affects the processing capacity of the wetland.

3.It is involved in the recycling of nutrients. Some microbial transformations are Aerobic (that is, they require free oxygen) while others are Anaerobic (they take place in the absence of free oxygen). Many bacterial species are facultative anaerobes, that is, they are capable of functioning under both aerobic and anaerobic conditions in response to changing environmental conditions. Microbial populations adjust to changes in the water delivered to them. Populations of microbes can expand quickly when presented with suitable energy-containing materials. When environmental conditions are no longer suitable, many microorganisms become dormant and can remain dormant for years (Hilton 1993). The microbial community of a constructed wetland can be affected by toxic substances, such as pesticides and heavy metals, and care must be taken to prevent such chemicals from being introduced at damaging concentrations.

2.2.7. Animals

Constructed wetlands provide habitat for a rich diversity of invertebrates and vertebrates. Invertebrate animals, such as insects and worms. contribute to the treatment process by fragmenting detritus and consuming organic matter. The larvae of many insects are aquatic and consume significant amounts of material during their larval stages, which may last for several years. Invertebrates also fill a number of ecological roles; for instance, dragonfly nymphs are important predators of mosquito larvae. Although invertebrates are the most important animals as far as water quality improvement is concerned, constructed wetlands also attract a variety of amphibians, turtles, birds, and mammals.

III.CONSTRUCTED WETLANDS AS TREATMENT SYSTEMS

A constructed wetland is a shallow basin filled with some sort of substrate, usually soil or gravel, and planted with vegetation tolerant of saturated conditions. Water is introduced at one end and flows over the surface or through the substrate, and is discharged at the other end through a weir or other structure which controls the depth of the water in the wetland.

3.1. How wetlands improve water quality

A wetland is a complex assemblage of Water, Substrate, Plants (vascular and algae), Litter (primarily fallen plant material), Invertebrates (mostly insect larvae and worms). and an Array of Microorganisms (most importantly bacteria). The mechanisms that are available to improve water quality are therefore numerous and often interrelated. These mechanisms include:

1.Settling of suspended particulate matter.

2.Filtration and chemical precipitation through contact of the water with the substrate and litter.

3.Chemical transformation.

4.Adsorption and ion exchange on the surfaces of plants, substrate, sediment, and litter.

5.Breakdown and transformation of pollutants by microorganisms and plants.

6.Uptake and transformation of nutrients by microorganisms and plants.

7.Predation and natural die-off of pathogens.

The most effective treatment wetlands are those that foster these mechanisms. The specifics for the various types of wastewater and runoff are discussed in the wastewater-specific volumes.

3.2. Advantages of Constructed Wetlands

Constructed wetlands are a cost-effective and technically feasible approach to treating waste-water and runoff for several reasons:

Wetlands can be less expensive to build than other treatment options.

1.Operation and maintenance expenses (energy and supplies) are low.

2.Operation and maintenance require only periodic, rather than continuous, on-site labor.

3.Wetlands are able to tolerate fluctuations in flow.

4.They facilitate water reuse and recycling.

There are more advantages in addition:

1.They provide habitat for many wetland organisms.

2.They can be built to fit harmoniously into the landscape.

3.They provide numerous benefits in addition to water quality improvement, such as wildlife habitat and the aesthetic enhancement of open spaces.

4.They are an environmentally-sensitive approach that is viewed with favor by the general public.

3.3. Limitations of Constructed Wetlands

There are limitations associated with the use of constructed wetlands:

1.They generally require larger land areas than do conventional wastewater treatment systerns. Wetland treatment may be economical relative to other options only where land is available and affordable.

2.Performance may be less consistent than in conventional treatment. Wetland treatment efficiencies may vary ‘seasonally in response to changing environmental conditions, including rainfall and drought. While the average performance over the year may be acceptable, wetland treatment cannot be relied upon if effluent quality must meet stringent discharge standards at all times.

3.The biological components are sensitive to toxic chemicals, such as ammonia and pesticides.

4.Flushes of pollutants or surges in water flow may temporarily reduce treatment effectiveness.

5.They require minimum amount water if they are to survive. While wetlands can tolerate temporary drawdown, they cannot withstand complete drying.

3.4. Types of Constructed Wetlands

There are several types of constructed wetlands: surface flow wetlands, subsurface flow wetlands, and hybrid systems that incorporate surface and subsurface flow wetlands. Constructed wetland systems can also be combined with conventional treatment technologies. The types of constructed wetlands appropriate for domestic wastewater, agricultural wastewater, coal mine drainage, and storm water runoff are discussed in the wastewater-specific volumes.

3.4.1. Surface flow wetlands

A Surface Flow (SF) wetland consists of a shallow basin, soil or other medium to support the roots of vegetation, and a water control structure that maintains a shallow depth of water. The water surface is above the substrate. SF wetlands look much like natural marshes and can provide wildlife habitat and aesthetic benefits as well as water treatment. In SF wetlands, the near-surface layer is aerobic while the deeper waters and substrate are usually anaerobic. Storm water wetlands and wetlands built to treat mine drainage and agricultural runoff are usually SF wetlands. SF wetlands are sometimes called free water surface wetlands or, if they are for mine drainage, aerobic wetlands. The advantages of SF wetlands are that their capital and operating costs are low, and that their construction, operation, and maintenance are straightforward. Fig. no. 1.3 shows the Surface flow constructed wetland used for treatment waste water. The main disadvantage of SF systems is that they generally require a larger land area than other systems.

3.4.2. Subsurface flow wetlands

A Sub-Surface flow (SSF) wetland consists of a sealed basin with a porous substrate of rock or gravel. The water level is designed to remain below the top of the substrate. In most of the systems in the United States, the flow path is horizontal, although some European systems use vertical flow paths. SSF systems are called by several names. Including vegetated submerged bed, root zone method, microbial rock reed filter, and plant-rock filter systems. Because of the hydraulic constraints imposed by the substrate, SSF wetlands are best suited to wastewaters with relatively low solids concentrations and under relatively uniform flow conditions. SSF wetlands have most frequently been used to reduce 5-day biochemical oxygen demand (BOD5) from domestic wastewaters. The advantages cited for SSF wetlands are greater cold tolerance, minimization of pest and odor problems, and, possibly, greater assimilation potential per unit of land area than in SF systems.

It has been claimed that the porous medium provides greater surface area for treatment contact than is found in SF wetlands, so that the treatment responses should be faster for SSF wetlands which can, therefore, be smaller than a SF system designed for the same volume of wastewater. Since the water surface is not exposed, public access problems are minimal. Several SSF systems are operating in parks. With public access encouraged. The disadvantages of SSF wetlands are that they are more expensive to construct, on a unit basis than SF wetlands. Because of cost, SSF wetlands are often used for small flows. In Fig. no. 1.4 subsurface flow constructed wetlands used for treatment waste water have been shown. SSF wetlands may be more difficult to regulate than SF wetlands, and maintenance and repair costs are generally higher than for SF wetlands. A number of systems have had problems with clogging and unintended surface flows.

3.4.3. Vertical flow SSF constructed wetland

Sewage water is pumped at regular intervals (every 2 to 6 hours, depending on design and treatment levels sought) through a network of pipes laid on top of a bed filled with gravel-type media of generally 3 different granulometries through which the water percolates. Vertical Flow CWs generally require 2/3 of the space of an horizontal flowCW and can raise treatment quality in certain parameters yet they are less passive systems as they rely on a controlled source of energy.

3.4.4. Horizontal flow SSF constructed wetland

Sewage effluent fills the space between the gravel and circulates horizontally, naturally, each time water comes into the system. There is no external energy dependency (and therefore no contribution to pollution output).

IV. WINTER AND SUMMER OPERATION

Wetlands continue to function during cold weather. Physical processes, such as sedimentation. Continue regardless of temperature, providing that the water does not freeze. Many of the reactions take place within the wetland substrate, where decomposition and microbial activity generate enough heat to keep the subsurface layers from freezing. Water treatment will continue under ice. To create space for under-ice flow, water levels can be raised in anticipation of freeze, then dropped once a cover of ice has formed.

Rates of microbial decomposition slow as temperatures drop and the wetland may need to be made larger to accommodate the slower reaction rates. For agricultural wetlands, which rely on microbial activity to break down organic wastes, it may be prudent to store the wastewater in the pretreatment unit during the cold months for treatment during the warm months. The high flows that are common in winter and spring because of snowmelt, spring rains, and high groundwater tables can move water so quickly through a wetland. that there is not enough retention time for adequate treatment. Because removal rates are much higher during warm weather, the agricultural wetland can often be smaller than if the water were treated year-round. Wetlands lose large amounts of water in the summer through evapotranspiration. The adequacy of flow in the summer must be considered since it will affect water levels in the wetland and the amount of wetland effluent available for recycling (if this is part of the design). A supple-mental source of water may be required to maintain adequate moisture in the wetland.

V. CONSTRUCTED WETLAND FOR WASTEWATER TREATMENT

Constructed Wetlands (CWs) are engineered systems that have been designed and constructed to utilize the natural processes involving wetland vegetation, soils, and the associated microbial assemblages to assist in treating wastewaters. They are designed to take advantage of many of the same processes that occur in natural wetlands, but do so within a more controlled environment. CWs for wastewater treatment may be classified according to the life form of the dominating macrophyte, into systems with free-floating, floating leaved, rooted emergent and submerged macrophytes. Further division could be made according to the wetland hydrology (free water surface and subsurface systems) and subsurface flow CWs could be classified according to the flow direction (horizontal and vertical. A simple scheme for various types of constructed wetlands water 2010.

The major characteristics of various types of constructed wetlands for wastewater. treatment. H = horizontal, V = vertical. The first experiments aimed at the possibility of wastewater treatment by wetland plants were undertaken by Käthe Seidel in Germany in the early 1950s at the Max Planck Institute in Plön. Seidel then carried out numerous experiments aimed at the use of wetland plants for treatment of various types of wastewater, including phenol wastewaters, dairy wastewaters or livestock wastewater. Most of her experiments were carried out in constructed wetlands with either Horizontal (HF CWs) or Horizontal Flow Subsurface flow Constructed Wetland Vertical Flow (VF CWs) subsurface flow, but the first fully constructed wetland was built with Free Water Surface (FWS) in the Netherlands in 1967. However, FWS CWs did not spread substantially in Europe where subsurface flow constructed wetlands prevailed in the 1980s and 1990s. In North America, FWS CWs started with the ecological engineering of natural wetlands for wastewater treatment at the end of the 1960s and beginning of the 1970s. This treatment technology was adopted in North America not only for municipal wastewaters but all kinds of wastewaters. Subsurface flow technology spread more slowly in North America but, at present, thousands of CWs of this type are in operation. Various types of constructed wetlands may be combined in order to achieve higher treatment effect, especially for nitrogen. Hybrid systems comprise most frequently VF and HF systems arranged in a staged manner but, in general, all types of constructed wetlands could be combined in order to achieve more complex treatment efficiency.

VI. BIOLOGICAL TREATMENT OF DAIRY WASTE WATER USING ACTIVATED SLUDGE

The objective of the researched by Ambreen Lateef , Mohmaad Nawaj, Shazia Iliyas (2013) was to evaluate the performance of a laboratory-scale biological treatment unit for dairy-industry wastewater and to determine the kinetic parameters for the activated sludge process. A laboratory-scale treatment unit comprising an aeration tank and final clarifier was used for this purpose. The treatment unit was operated continuously for three months by varying the hydraulic retention times from 2 to 12 days. The biological oxygen demand (BOD) of the influent and effluent and the mixed liquor suspended solids of the aeration tank were determined at various detention times to generate data for the kinetic coefficients. The kinetic coefficients k (maximum substrate utilization rate), Ks (half velocity constant), Y (cell yield coefficient), and Kd (decay coefficient) were found to be 4.46 day 1, 534 mg/l, 0.714, and 0.038 day 1, respectively, based on the BOD. These coefficients may be used for the design of activated sludge process facilities for dairy wastewater.

Biological treatment processes offer a cost effective method to remove organic compounds and nitrogen from the wastewater. Treatment designs are continually evolving to provide greater treatment efficiency, at a lower cost. Biological wastewater

treatment is the primary method of preparing food processing wastewater flows for return to the environment. Increasing industry wastewater loads on existing plants and more stringent government discharge requirements have put considerable pressure on the food-processing industry to refine and understand better the design and management of biological wastewater treatment processes. Dairy wastewater is generally treated using biological methods such as activated sludge process, aerated lagoons, trickling filters, sequencing batch reactor, up flow anaerobic sludge blanket reactor, anaerobic filters, etc. Biological methods, like activated sludge process, are invariably employed for the secondary treatment of a large number of industrial wastewater. Knowledge of the microbial kinetics and determination of the kinetic coefficients for a particular wastewater are, therefore, imperative for the rational design of treatment facilities.

VII. ROOT ZONE METHOD FOR DAIRY WASTE WATER

(By Ashwani Dubey and Omprakash Sahu gives the root zone method for dairy waste water treatment)

The consumption of large volumes of water and the generation of organic compounds as liquid effluents are major environmental problems in milk processing industry. The volume of freshwater required by this industry can be significantly reduced by recovering the intrinsic water present in dairy industry. This amount of freshwater will depend on the process technology. In recent years, the environmental effects of industrial activities have increased considerably, and current perspectives indicate that the trend for this problem is to be worsening. In this regard study is to treat the waste water generated from the dairy industry by a new technique called Root zone method. Physico-chemical and organic parameters of water samples of the dairy were examined to determine the quality and extent of pollution. By which the pH, COD, BOD, TDS, Turbidity, Hardness, Alkalinity, Electrical conductivity are reduced.

Waste water is generated in milk processing unit, mostly in pasteurization, homogenization of fluid milk and the production of dairy products such as butter, cheese, milk powder etc. Most of the milk processing unit use “clean in place” (CIP) system which pumps cleaning solutions through all equipment in this order water rinse; caustic solution (sodium hydroxide) wash, water rinse, acid solution (phosphoric or Nitric acid) wash, water rinse, and sodium hypo-chlorite disinfectant. These chemicals eventually become a part of waste water.

It is one of the largest sources of industrial effluents in many countries like (Europe and India). A typical European dairy factory generates approximately 50m3 waste water daily with considerable concentration of organic matter (fat, protein and carbohydrates) and nutrients mainly (Nitrogen and phosphorous) originating from the milk and the milk products.

VIII.WASTEWATER MANAGEMENT IN DAIRY INDUSTRY, POLLUTION ABATEMENT AND PREVENTIVE ATTITUDE.

Increase in demand for milk and their products many dairies of different sizes have come up in different places. The dairy industry involves processing raw milk into products such as consumer milk, butter, cheese, yogurt, condensed milk, dried milk (milk powder), and ice cream, using processes such as chilling, pasteurization, and homogenization. The typical by-products of milk are buttermilk, whey, and their derivatives. The effluents are generated from milk processing through milk spillage, drippings, washing of cans, tankers bottles, utensil, and equipment’s and floors. The dairy industry generate on an average 2.5-3.0 litres of wastewater per litre of milk processed. Generally this wastewater contains large quantities of fat, casein, lactose, and inorganic salts, besides detergents, sanitizers etc. used for washing. These all contribute largely towards their high biological oxygen demand (BOD), chemical oxygen demand (COD) and oil and grease much higher than the permissible limits. Among the biological treatments trickling filter and activated sludge process involve more economy high power requirement, more chemical consumption and large area requirement. Use of a dairy wastewater for irrigation after primary treatment in an aerated lagoon may also be good for the disposal of dairy wastes.

IX. WASTEWATER TREATMENT WETLAND – A CASE STUDY

Lovisa Lagerblad the scientist events the study on waste water treatment wetland in 2010.

Water is a prerequisite for life on earth. Without adequate water sanitation several hazardous health and environmental consequences will follow. In many developing countries the fast urbanization rate is putting a great stress on the, if even existing, poorly developed treatment systems. A sustainable way for wastewater treatment, with or without additional purification, is the use of natural wetlands.

A new wastewater treatment plant is constructed in Ja-Ela, a suburb to Colombo, Sri Lanka. The area is of great interest due to its many industries and highways. The river Dandugam Oya is today working as a recipient for treated wastewater. Dandugam Oya is suffering from pollution and the performed studies show that the nutrient level is high and the oxygen level is very low. This may cause eutrophication and fish death, which earlier has been observed in Negombo Lagoon. A small wetland (≈5 ha) is today located between the river and the wastewater outfall, and this study has focused on its treatment capacity. The wetland vegetation stands for a potential treatment, but the vegetation is not the only reason to wetland removal efficiencies. The major mechanisms for pollutant removal in wetlands include both bacterial transformations and chemical processes including adsorption, precipitation and sedimentation. In these processes wetland characteristics such as size, depth and retention time are important. It was observed that the levels of pathogens coming from the old wastewater treatment plant were exceeding the recommended levels. Coliforms can be removed through adaptation to gravel and submersed plant parts biofilms. The studied wetland was not useful for this treatment purpose, mainly because its retention time was too short. For the same reason a large nutrient treatment is not to be expected, which demands the retention time to be fairly long because the nitrate molecules and the denitrification bacteria need time to interact.

X. CONCLUSION

1.The removal efficiency of TSS, COD and BOD in modified root zone treatment system (MRZTS) is found to be well within the limits.

2.Removal efficiency increases with the increase in retention time.

3.Comparison of the conventional STP, conventional RZTS with modified RZTS indicates that the modified RTZS perform best in the removal of TSS, BOD.

4.The removal efficiency through MRZTS is found to be low.

5.Growth of plants in root zone treatment system is very fast because of large availability of nutrients in domestic sewage.

6.Technical equipment requires minimal supervision

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