Treatment Of Dairy Waste Water From Salem Aavin Using Natural Coagulants

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ABSTRACT

The dairy industry is generally considered to be largest source of food processing. These industries wastewater is characterized by high COD, BOD, nutrients etc. Such wastewater is to be treated natural coagulants and then tests are to be carried to check the water characteristics like BOD, COD, pH and turbidity, etc. These natural coagulants, when used for treatment of waters with low-to-medium turbidity range (50–500 NTU), are comparable to their chemical counterparts in terms of treatment efficiency. Their application for industrial wastewater treatment is still at their infancy, though they are technically promising as coagulant for dyeing effluent as afforded by Yoshida intermolecular interactions. These natural coagulants function by means of adsorption mechanism followed by charge neutralization or polymeric bridging effect. Frequently studied plant-based coagulants include Nirmaliseeds (Strychnospotatorum), Moringaoleifera, Tannin and Cactus. For variation of doses of these natural coagulants the reduction of solids takes place. There is not much change in pH and conductivity due to natural coagulants. The efficiency of Cicerarietinum is more compared to other three; this depends on the protein content which is present in the natural coagulant. The increase of dosage causes the increase of turbidity.

Keywords: Treatment, Dairy Waste Water, Salem Aavin, Natural Coagulants

1.INTRODUCTION

1.1 General

The dairy industry is generally considered to be the largest source of food processing wastewater in many countries. With increase in demand for milk and milk products, many dairies of different sizes have come up in different places. These dairies collect the milk from the produces, and then either simply bottle it for marketing, or produce different milk foods according to their capacities. Large quantity of wastewater originates due to their different operations. The organic substances in the wastes comes either in the form in which they were present in milk, or in a degraded form due to their processing. As such, the dairy wastes, through biodegradable, are very strong in nature. The production of drinking water from most raw water sources involves coagulant use at a coagulation/flocculation stage to remove turbidity in the form of suspended and colloidal material. Many coagulants and flocculants are widely used in conventional water treatment processes. These materials can be classified into inorganic coagulants (e.g. aluminium and ferric salts) and synthetic organic polymers (e.g. polyacryl amide derivatives and polyethylene imine). Aluminium salts are cheap and are the most widely used coagulants in water and wastewater treatment all over the world. Regarding the application of synthetic polymers, the presence of residual monomers is undesirable because of their neurotoxicity and strong carcinogenic properties. In recent years there has been considerable interest in the development of usage of natural coagulants which can be produced or extracted from microorganisms, animal or plant tissues. These coagulants should be biodegradable and are presumed to be safe for human health. In addition, natural coagulants produce readily biodegradable and less voluminous sludge that amounts only 20– 30% that of alum treated counterpart. Water from all sources must have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity, McConnachie et al. For the treatment of surface water, some traditional chemicals are used during the treatment of surface water at its various steps. Commonly used chemicals for various treatment units are synthetic organic and inorganic substances. In most of the cases, these are expensive since they are required in higher dose and do not show cost effectiveness.

1.2 Dairy Wastewaters

The dairy industry generates large quantities of wastewater, as per litre of processed milk, 0.2 to 10 L of wastewater are produced. Dairy wastewaters contain high concentrations of organic matter (e.g. fat, milk, protein, lactose, lactic acid), minerals and detergents. Typical dairy wastewater characteristics include 4000-59000 mg/L COD, 70-800 mg/L TSS, 100-1400 mg/L TN and 25-450mg/L TP. Dairy wastewaters are mainly generated by the milk processing units where the pasteurization, homogenization of fluid milk are processed. Large amounts of wastewaters are also created from the production of dairy products such as butter, cheese, milk powder etc. Large volume of water are used in cleaning processing units, resulting in wastewater which also contains detergent, sanitizers, base, salts and organic matter, depending upon sources. Differences in production widely change the volume and strength of the wastewater. Thus, effluent characteristics rely on the production of wastewater volume per unit (litres waste water/kg product), concentration (mg/L), and weight of waste generated per unit of g waste/kg product .

1.3. Characteristics Of Wastewater

In dairy, wastewater is often discharged intermittently. The nature and composition of wastes depends on type of products produced and processing capacity of the plants. Dairy cleaning waters may also contain a variety of sterilizing agents and various acid and alkaline detergents. Thus, the pH of the wastewaters can vary significantly depending on the cleaning strategy employed. Dairy wastewaters are characterized by high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) concentrations. Chemical oxygen demand (COD), which is normally about 1.5 times the BOD level, It also contains total solids, total dissolved solids, nitrogen and phosphorous. Important indicators for the quantification of organic load of dairy plant effluents are biological oxygen demand (BOD), chemical oxygen demand (COD), the ratio of COD to BOD indicates the biodegradability of organic materials under aerobic or anaerobic condition.

2.DAIRY WASTE

Due to highly biodegradable nature of dairy wastewater its treatment requires urgent attention but as such treatment is not a big issue. Biological treatment technologies can readily treat the dairy wastewater. The final effluent can be readily used for irrigation and sludge itself becomes a good fertilizer. If waste is disposed in water bodies or ground BOD becomes the major concern. It may lead to anaerobic conditions and related problems. The BOD is in a range of 1000 to 2000 mg/L (1) obviously, Biological threatening is required for it. The Biological treatment may be Activated sludge process, Trickling filter, aerated lagoon or oxidation pond. However anaerobic process is also found to be successful. Dairy waste water is an area, already quite exposed.

2.1 Dairy Technology (Milk Process Technique)

Milk treatment is the preparation of raw milk including heat treatment as a precondition for milk processing. The treatment of milk is done in the preparation room. It is a first process in any dairy plant. The milk processing is the quality oriented activity of manufacturing, packing of dairy based products on the basis of treated milk. Product and process involved in dairy: Many dairies restrict themselves bottling pasteurized milk and making ghee from scoured milk. The dairy industry is characterized by the multitude of products and therefore production lines. Plants can have as few as one or two production lines or all of them (pasteurized milk, cheese, butter, etc.). In few dairies where supply of milk is larger, butter, condensed milk, powdered milk, ice cream, panner, shrikhand, milk powder, yoghurt, cheese etc. are also produced. However the production of skimmed and toned milk and cheese making has the increasing demand in India.

2.1.1 Milk Processes

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. According to 'Treatment of dairy waste water using aerobic biodegradation and coagulation' 87.43 per cent reduction of COD at 640ml/min was close to 87.05 per cent removal of COD at rate 320ml/min of aeration which were obtained at the end of 72 hours, so optimum dosage was taken as 320ml/min as rate of aeration. Odour removal was around 70 to 80 per cent.

2.2 Characterization Of Dairy Wastewater

Dairy wastewater does not require segregated treatment. All analysis and treatment is done for composite wastewater. Garb samples are collected from balancing tank of the wastewater treatment facility and are analyzed for various parameters. Table. 1 shows Characteristics of dairy industry wastewaters

This is done so as

- To decide the type of treatment required by the wastewater.
- To estimate the pollution effects of wastewater.
- To compare the same with standards given in IS codes.

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). Dairy wastes are white in colour and usually slightly alkaline in nature and become acidic quite rapidly due to the fermentation of milk sugar to lactic acid. The suspended matter content of milk waste is considerable mainly due to fine curd found in cheese waste. The pollution effect of dairy waste is attributed to the immediate and high oxygen demand. Decomposition of casein leading to the formation of heavy. Black sludge's and strong butyric acid odors and characterize milk waste pollution. 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. It depends largely on the quantity of milk processed and type of product manufactured. 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.

Table 1: Characteristics of dairy industry wastewaters

Waste Type	COD	BOD	PH	TSS	TS
Milk & Dairy Products factory	10251.2	4840.6	8.34	5802.6	
Dairy effluent	1900-2700	1200-1800	7.2-8.8	500-740	900-1350
Dairy waste water	2,500-3,000	1,300-1,600	7.2-7.5	72,000-80,000	8,000-10,000
Aavin dairy industry waste water	2100	1040	7-8	1200	2500

2.3 Physical Characters Of Waste Water

- Temperature
- Colour
- Hydrogen Ion Concentration (Ph)
- Turbidity
- Salinity
- Electrical Conductivity
- Total Dissolved Solids (Tds)

2.4 Chemical Characters

- Alkalinity
- Free Carbon Dioxide
- Total Carbon Dioxide
- Chloride
- Dissolved Oxygen (Do)
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Total Hardness
- Calcium
- Magnesium
- Ammonical Nitrogen (Nh4 - N)
- Nitrite Nitrogen (No2 - N)
- Nitrate Nitrogen (No3 - N)
- Total Ortho Phosphate (Top)
- Acid Hydrolyzable Phosphate (Ahp)
- Total Phosphate (Tp)
- Organic Phosphate (Op)
- Protein
- Carbohydrate
- Fats
- Sulfate

2.5 Effluent Characterization

The effluent grab samples are collected at the same time while collecting the raw wastewater samples and are characterized for various parameters. This is done so as:

- To determine the efficiency of treatment facility.
- To compare the effluent characteristics with IS permissible limits.
- To decide the suitable method of disposal of final effluent.
- To examine the scope of reuse of final effluent.

2.6 Environmental Effects Of Effluents

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. It generates about 0.2–10 litres of effluent per litre of processed milk with an average generation of about 2.5 litres of wastewater per litre of the milk processed. Dairy processing effluents are generated in an intermittent way and the flow rates of these effluents change significantly. The volume, concentration, and composition of the effluents arising in dairy industry are dependent on the type of product being processed, the production program, operating methods, design of the processing plant, the degree of water management being applied, and subsequently the amount of water being conserved. These dairy industries generate different types of waste including: wastewater from the production line (cleaning of equipment and pipes) cooling water, domestic wastewater, the acid whey and sweet. Due to this the quality and quantity of the product content in the dairy wastewater at a given time changes with the application of another technological cycle in the processing line. The sweet whey form the most polluting effluent by its biochemical composition rich in organic matter (lactose, protein, phosphorus, nitrates, nitrogen) and is from 60 to 80 times more polluting than domestic sewage. The waste water of dairy contains large quantities of milk constituents such as casein, inorganic salts, besides detergents and sanitizers used for washing. All these components contribute largely towards their high biological oxygen demand (BODS) and chemical oxygen demand (COD). Which is much higher than the specified limits of Indian standard institute (ISI), now Bureau of Indian standard (BIS), for the discharge of industrial effluents; As these wastes are generally released to the nearby stream or land without any prior treatment are reported to cause serious pollution problems. Dairy effluents decompose rapidly and deplete the dissolved oxygen level of the receiving streams immediately resulting in anaerobic conditions and release of strong foul odors 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 odor, impart color or turbidity, promote eutrophication. The main environmental problems related to milk production affect the pollution of water, air and biodiversity. They often cause a growth of algae and bacteria that consume oxygen in the water and eventually suffocate the rivers leading to the gradual disappearance of fish. Hence the need to treat dairy effluents by various processes.

3.COAGULATION

3.1 General

Due to the lack of proper water treatment systems in these rural or underdeveloped communities, the bestimmediate option is to use simple and relatively costeffectivepoint-of-use (POU) technologies such as coagulation. Coagulation is an essential process in the treatment of both surface water and industrial wastewater. Its application includes removal of dissolved chemical species and turbidity from water via addition of conventional chemical-based coagulants, namely, alum (AlCl3), ferric chloride(FeCl3) and polyaluminium chloride (PAC).While the effectiveness of these chemicals as coagulants is well-recognized, there are, nonetheless, disadvantages associated with usage of these coagulants such as ineffectiveness in low-temperature water, relatively high procurement costs, detrimental effects on human health, production of large sludge volumes and the fact that they significantly affect Ph of treated water. Water quality is of concern to everyone. Quality is the acceptability of the water for uses like drinking, cooking bathing, and laundering. Most municipally treated water is safe and generally of good quality. You may have concerns regarding taste, odors, clarity even hardness. Water from private or community wells can be contaminated. Contaminated water may have off-tastes, odors, or visible particles. However, some dangerous contaminants in water are not easy to detect. Accurate water testing is needed to determine safety and quality. Water testing may be done by private testing labs, county and state health laboratories, departments of health, and some local environmental consulting companies.

- Large seasonal variation in raw water quality e.g. turbidity.
- Water treatment chemicals are imported with scarce foreign currency.
- High cost of water treatment chemicals which constitute in between 35% to 70% of recurrent expenditure.
- Inadequate supply of chemicals for water treatment.
- Inadequate laboratory facilities to monitor process performances required to operate the plants, Inadequate funding, Low revenue base.
- Water supply considered as a social commodity rather than an economic resource inadequate skilled manpower, Poor operational and maintenance schedules, Adoption of inappropriate technology.
- Inadequate supply to meet growing demand Under dosing of chemicals leading supply of poor quality water.

3.1.1. Problems Are Due To Use Of Chemicals In Water Treatment

- Aluminum has also been indicated to be a causative agent in neurological diseases such Foreign exchange problem as pre-senile dementia.
- There is a fear that ingestion of aluminum ions may induce Alzheimer's disease.
- Sludge produced is voluminous and non biodegradable after treatment and therefore poses disposal problems leading to increase cost of treatment.
- The costs of these chemicals have been increasing at an alarming rate in developing countries.

3.2 The Coagulation Process

Coagulation and flocculation are the processes used to remove the particles responsible for turbidity and colour. The colloidal particles present in wastewaters generally carry a negative electrical charge. Their diameter may range between 10-4 to 10-6 mm. These particles are surrounded by an electrical double layer (due to attachment of positively charged ions from the ambient solution) and thus inhibit the close approach of each other. They remain finely divided and don't agglomerate. Due to their low specific gravity, they don't settle out. Coagulation is accomplished by the addition of ions having the opposite charge to that of the colloidal particles. In coagulation, a coagulant (generally positively charged) is added which causes compression of the double layer and thus the neutralization of the electrostatic surface potential of the particles. The resulting destabilized particles stick sufficiently together when contact is made. Rapid mixing (a few seconds) is important at this stage to obtain uniform dispersion of the chemical and to increase the opportunity for particle-to-particle contact. Flocculation, which follows coagulation, consists of slow gentle stirring. During flocculation, the microscopic coagulated particles aggregate with each other to form larger flocs. These flocs then are able to aggregate with suspended polluting matter. These flocs are large enough to settle rapidly under the influence of gravity, and may be removed from suspension by filtration. Aluminum and iron salts are commonly used as chemical coagulants. They form insoluble material i.e. aluminium and ferric hydroxides when they react with calcium and manganese hydrogen carbonates, which are almost always present in water. The formation of the insoluble hydroxides depends on the pH. Whereas turbidity is best removed within a pH range of 5.7 to 8.0, color removal is generally obtained at pH range of about 4.4 to 6.0. Alum (aluminium sulphate) is most widely used chemical coagulant whereas ferric chloride, potash alum, ammonia alum, ferrous sulphate are also some of the chemical coagulants which are not extensively used.

3.3 Natural Based Coagulants And Coagulation Mechanisms

Polymeric coagulants can be cationic, anionic ornonionic, in which the former two are collectively termed as polyelectrolyte. Many studies concerning natural coagulants referred to them as'polyelectrolytes' even though many of these studies did not actually conduct in-depth chemical characterization to determine their ionic activity. As such, this term should be used carefully, and be applied only after ionic activity is determined to be present in the coagulant. Natural coagulants are mostly either polysaccharides or proteins. In many cases, even though polymers labelled as non-ionic are not necessarily absent of charged interactions, as there may be interactions between the polymer and a solvent within a solution environment as the polymer may contain partially charged groups including –OHalong its chain. It is imperative to fully grasp the underlying coagulation mechanisms associated with these natural coagulants so that complete understanding of their usage can be realized. Aggregation of Particulates in a solution can occurvia four classic coagulation mechanisms: (a) double layer compression; (b) sweep flocculation; (c)adsorption and charge neutralization; and (d)adsorption and inter particle bridging. The presence of salts [or suitable coagulants] can cause compression of the double layer which destabilizes the particulates. Sweep flocculation occurs when a coagulant encapsulates suspended particulates in a soft colloidal floc. Adsorption and charge neutralization refer to the sorption of two particulates with oppositely charged ions while inter particle bridging occurs when a coagulant provides a polymeric chain which sorbs particulates. Polymeric coagulants are generally associated with mechanisms(c) and (d) as their long-chained structures (especially polymers with high molecular weights) greatly increase the number of unoccupied adsorption sites. It appears that these two mechanisms provide underlying principles to the inner workings of plant based coagulants as well and they are the focus of discussion in the following sections. The existence of background electrolytes in aqueous medium can f acilitate the coagulating effect of polymeric coagulants since there is lesser electrostatic repulsion between particles. Although many plant-based coagulants have been reported, only four types are generally well-known within the scientific community, namely, Nirmali seeds (Strychnospotatorum), Moringaoleifera, Tannin and Cactus.

3.4 Coagulants For Optimal Wastewater Treatment From Environmental

Coagulants are a key component for any treatment program that handles suspend solids, as they consolidate those particles for easy and thorough removal. But, if you aren't using the right type or amount of coagulants you could be wasting money on chemicals, non-compliance fees, and surcharges that are higher than they need to be because your system isn't running efficiently. That's where Beckart Environmental can help. We offer a complete line of chemical wastewater treatment products, including coagulants, and we have a highly trained staff of technicians that can assess what type and quantity of coagulant best serves your needs. We have decades of experience optimizing chemical treatment plans for many industries including metal finishing, machining, painting & coating, printing & corrugated, granite processing, stone fabrication, food processing, and more. Over the years we've used that experience to create a high quality line of proprietary coagulant blends that are formulated to be both affordable and low sludge producing, Beckart Blends. The sedimentation process can be quickened by adding coagulants to the water. Coagulation with extracts from natural and renewable vegetation has been widely practiced since recorded time. There is a variety of natural coagulants used around the world, depending on the availability. Extracts from the seeds of Moringa oleifera can be used, the trees of which are widely present in Africa, the Middle East and the Indian subcontinent. Strychnos potato rum, also known as clearing nuts or the nirmali tree, is found in India to treat water. Prickly pear cactus is prevalent and traditionally used in Latin America. There are also reports of other natural coagulants being used, such as fava beans. Coagulants contain significant quantities of water-soluble proteins which carry an overall positive charge when in solution. The proteins bind to the predominantly negatively charged particles that cause turbidity (e.g. sand, silt, clay).Coagulation happens when the positively and negatively charged particles are chemically attracted together. They can then accumulate (flocculation) to form larger and heavier particles (flocs). The flocs can be settled out or removed by filtration. Bacteria and viruses can attach themselves to the suspended particles in water that cause turbidity. Therefore, reducing turbidity levels through coagulation may also improve the microbiological quality of water.

4.MATERIALS AND METHODS

4.1 Materials

Few materials were used in this study such as water, natural coagulants (M.Oleifera, Okra andC.Procera), alum and clay materials. The detail descriptions of those coagulants are as given below. There are three natural coagulants used in this present study. They are namely seeds of MoringaOlifera, Okra gum and dry flowers of Calotropisprocera.

4.1.1. M.Oleifera

Plant species - Genus Moringa Family- Moringaceae. Common Name- Drum stick (Golden shower)Moringa oleifera, known as Moringa, is native to north India but is now found throughout the tropics. It grows fast and reaches up to 12m. The bark is grey and thick and looks like cork, peeling inpatches. Moringa is full of nutrients and vitamins and is good in your food as well as in the food of your animals. Moringa helps to clean dirty water and is a useful source of medecines.

4.1.2.Okra

Plant species – A.esculentus Family- MavacaeCommon Name- lady's finger or Gumbo OkraAbelmoschusesculentus L. (Moench), is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. This crop is suitable for cultivation as a garden crop as well as on large commercial farms. Okra gum is soluble in cold water. It is used in the food industry as a good emulsifying and foam stabilizing agent. In the range of studied, it is observed that whatever the volume of gumbo mucilage, the turbidity decreases when the P^H increases. The reduction in turbidity is significant when the volume of mucilage used, confirming the preceding results. The mucilage, from its sticky nature, contains polymer molecules.

4.1.3. Calotropisprocera- Plant Species – C.Procera

Family- Aclepiadaceae Common Name- calotrope Calotropisprocera are abundantly available inhe tropics, mostly planted as ornamental shrubs. Calotropisprocera have been reported to containcalotropin, a very active non- toxic proteolyticenzyme used in curdling milk protein in traditional cheese - making in Nigeria. Also the use of C. procera latex for enzyme purification, a simple method based on recipitation for the cope with the high costs due to declining revenues and funding. The inability of local supplies to satisfy the demand due to competing uses for imported chemicals. The use of alum as a coagulant in the treatment of water increases the aluminium concentration. A high concentration of aluminium is also of concern because of its adverse effects on health. Aluminium intake into the body has been linked with several neuropathological diseases including percentile dementia and Alzheimer's disease. There is also the problem of reaction of alum with natural alkalinity present in water leading to reduction of pH and a low efficiency in coagulation of cold waters. Under-dosing of chemicals so as to meet the increasing water demand leading to production of poor quality drinking water. Using alum as well as other metallic salt coagulants produces large sludge volumes which are also non- biodegradable. Ferric salts and synthetic polymers have also been used as coagulants but with limited success because of the same disadvantages manifested in the use of aluminium salts.

4.1.4 Nirmali Seeds

S. potatorum (nirmali) is a moderate-sized tree found in Southern and central parts of India, Sri Lanka and Burma, used predominantly as a traditional medicinal extract. Sanskrit writings from India reported that the seeds were used to clarify turbid surface water over4000 years ago which indicated that they were the first reported plant-based coagulant used for water treatment. Most studies concerning its use as coagulant seem to be limited within the Indian subcontinent. Nirmali seed extracts are anionicpolyelectrolytes that destabilize particles in water by means of inter particle bridging. Previous studies have established that the seed extracts also contain lipids, carbohydrates and alkaloids containing the –COOH and free –OH surface groups which enhance the extracts' coagulation capability. A mixture of polysaccharide fraction extracted from S. Potatorum seeds contained galactomannan and galactan capable of reducing up to 80% turbidity of kaolin solution. In all cases, the galactomannans are made up of a main chain of 1,4-linked d-mannopyranosyl residues bearing terminal d-galactopyranosyl units linked at the 0–6 position of some mannose residues. Although the specific coagulation mechanism associated within rmali seed extracts has not been extensively investigated, one can surmise that the presence of copious amount of –OH groups along chains of galactomannan and galactan provides weakly butabundant adsorption sites that ultimately lead to the fore said coagulant inter particle bridging effect. Since both ionic (–COO−H+) and comparatively non-ionic (galactomannan) groups or substances are suggested to be present in the extract, the author deems that its designation as 'anionicpolyelectrolytes' is premature, as there are no identified studies that provide detailed elucidation of its coagulation mechanisms and percentage composition of the extract. As such, further studies are required in this aspect.

4.1.5 Tannin

Tannin is a general name given to large polyphenolcompounds obtained from natural materials, for example, the organic extract from bark and wood of trees such as Acacia, Castanea, or Schinopsis. It is a polymer with molecular weights ranging from hundreds to tens of thousands and traditionally used as a tanning agent in the leather industry. There have been conflicting reports on the effect of tannin on human health and its portrayal in this negative light may have limited its application as natural coagulant for water treatment. The tannin used in their study is extracted from valonia, which is obtained from the corn cup of the oak that grows in Asia Minor. They conclude that tannin is an excellent substitute to chemical coagulants. The effectiveness of tannin as a natural coagulant for water treatment is influenced by the chemical structure of tannins that have been extracted from plant and degree of tannin modification. The presence of phenolic groups in tannin clearly indicates its anionic nature since it is a good hydrogen donor. Fig.1 illustrates the schematic representation of basic tannin structure in aqueous solution and possible molecular interactions that induce coagulation. It is common knowledge that phenolic groups can easily deprotonate to form phenoxide which is stabilized via resonance. This deprotonation is attributed to delocalization of electrons within the aromatic ring which increases the electron density of the oxygen atom. This provides an indication that the more phenolic groups are available in a tannin structure, the more effective its coagulation capability. An interesting study on application of a commercial tannin containing both amine and phenonic groups for water treatment suggests that their tannin is cationic in nature since there is a single tertiary amine group per monomer.

4.1.6 Cactus

Application of cacti species for water treatment is rather recent compared to other natural coagulants such as nirmali or M. oleifera. The most commonly studied cactus genus for water treatment is Opuntia which is colloquially known as 'nopal' in Mexico or'prickly pear' in North America. This cactus type has long been associated with its medicinal properties and dietary food sources. Besides Opuntia, other cactus species including Cactus latifaria have also been successfully used as natural coagulants. The high coagulation capability of Opuntia is most likely attributed to the presence of mucilage which is aviscous and complex carbohydrate stored in cactus inner and outer pads that has great water retention capacity. Previous studies have established thatmucilage in cactus Opuntia contains carbohydrates such as l-arabinose, d-galactose, l-rhamnose, dxylose,and galacturonic acid. Galacturonic acid impossibly the active ingredient that affords the coagulation capability of Opuntia spp. though it should be noted that it only accounts for only 50% of turbidity removal .Nonetheless, this is still a significant quantum and therefore, this compound deserves further evaluation on its contribution to the overall coagulation capability of cactus. These studies point to the importance of galacturonic acid which possibly acts as one of the major active coagulating agents in plants and therefore, deserves further technical assessment. Though not extensively reported in open literatures, it is highly possible that galacturonic acid [a major constituent of pectin in plants] exists predominantly in polymeric form[polygalacturonic acid] that provides a 'bridge' for particles to adsorb on. Relevant dominant molecularinteractions associated with adsorption and bridging in coagulation are shown The polygalacturonic acid structure evidently indicates that it is anionic due to partial deprotonation of carboxylic functional group in aqueous solution.

4.2 Use Of Natural Herbs In Purification Of Water

Developing countries are facing potable water supply problems because of inadequate financial resources. The cost of water treatment is increasing, and the quality of river water is not stable due to a suspended and colloidal particle load caused by land development and high storm runoff during the rainy season such is experienced in a country like Malaysia and other countries. Due to many problems created by using the synthetic coagulants such as aluminium sulphate which is used worldwide, there is a high demand to find an alternative coagulant which is preferable to be a natural coagulant. Naturally occurring coagulants are usually presumed safe for human health. Many researchers have reported on Moringaoleifera various uses and as a coagulant specifically for the last 25 years have found that the Moringaoleifera seed is non-toxic and good coagulant in water treatment. It is recommended to be used as a coagulant in developing countries. Usually, the aluminium sulphate is the most used coagulant in water treatment for coagulation-flocculation process. Aluminium sulphate is usually imported and this adds extra cost to the water treatment industry. The lime for pH adjustment is added to the water treatment process, which is considered as an additional cost for water treatment companies. Therefore, this paper is focused on presenting the developed, efficient and cost effective processing technique for Moringaoleifera seed and other natural coagulants to be used for drinking water treatment. purification of amylase from solid culture of As per gillusoryzae using C.procera latex, which have received little attention but have confirmed C. procera latex as a good clarifying agent and unveils its potential as plant material for enzyme concentration. Experiments were carried out in the laboratory of Dhaka Water Supply and Sewerage Authority (DWASA). Moringaoleifera(Sajina), Dolichos lablab (beans), and Cicerarietinum(dal) seeds used in this study were obtained from the Jahangirnagar University, Kanchanpur (Khulna) and local market of Dhaka city, respectively. All coagulation experiments were carried out using synthetic artificial turbid water. A conventional jar test apparatus was used in the experiments to coagulate sample of syntheticturbid water using coagulants.

4.3 Preparation Of Synthetic Water

Synthetic turbid water for the jar tests was prepared by adding clay materials to tap water. About 30 g of the clay materials was added to 1 litre of tap water. The suspension was stirred for about 1 hour to achieve a uniform dispersion of clay particles. Then it was allowed to settle for at least 24 hours for complete hydration of the clay materials. The supernatant suspension of synthetic turbid water was added to the sample water to achieve the desired turbidity just before coagulation.

5.APPLICATION OF AGRO-INDUSTRIAL WASTEWATERS TREATMENT

CWs are mainly used to treat domestic and municipal wastewaters but more recent applications of CWs include treatment of other types of wastewater, such as industrial and agricultural wastewaters, various runoff waters and landfill leachate . Agro-industry includes post-harvest activities involved in the transformation, preservation and preparation of agricultural produce for intermediary states or final consumption. Agro-industrial wastewaters are usually characterized by their high organic load and their quantity and quality variations over a year. In this section, the main CW applications for agro-industrial wastewater, including dairy and animal farm wastewater wastewaters. Furthermore, special discussion is made to olive mill wastewater (OMW) due its toxicity from high phenol concentrations.

5.1 Pre-Treatment Stages In Treatment Of Dairy Wastewaters

In most cases of dairy wastewater treatment by CWs, the pre-treatment stages aim mainly at removing suspended solids. Therefore, in the majority of experiments/applications, the pre-treatment stages included either simple settling basins) or a settling stage combined with biological treatment, such as aerobic and anaerobic lagoons

5.2 Treatment Of Dairy Wastewaters

The type of CW seems to be crucial for dairy wastewater treatment. As shown in Table 3.8, only four research groups have focused on dairy wastewater treatment using FWS CWs (Dunne et al., 2005; Jamieson et al., 2007; Schaafsma et al., 2000; Shamir et al., 2001), as these wastewaters have high pollutant loads and are therefore difficult to treat. As mentioned previously, dairy wastewater is characterized by high concentrations of organic matter. Thusa FWS CW cannot achieve efficient pollutant removal performance, as the high organic matter concentration creates anoxic or anaerobic conditions in the water column and reduces the amount of oxygen available for microbial organic matter oxidization. As shown in Table 3.8, when pollutant surface loads are low in FWS CWs (Newman et al., 2000; Shamir et al., 2001), removal efficiencies are high for organic matter (91-98%), nitrogen (80%), phosphorus (89-92%) and TSS (96-99%). According to Schaafsma et al. (2000), organic matter and nutrient removal efficiencies are also significant, but in some cases, nitrate and nitrite concentrations increase in the effluent. In most experiments/applications using VF CWs, it was observed that these wetland systems were poor at phosphorus removal. Dunne et al. (2005), report that their VF CW system did not show any significant reduction in pollutant concentration between the wetland's inlet and outlet, although BOD reduction was significant. HSF CW systems, however, appear to be more efficient than the other two systems when treating dairy wastewater, and 17 experiments/applications employing HSF CWs for diary wastewater treatment have been reported. HSF CWs are far more efficient bio-reactors than FWS CWs, as the removal efficiencies of the former are in the range of 28-99% for COD, 21-99% for nitrogen, 2-98% for phosphorus, and 45-95% for TSS. It should be mentioned that these removal efficiencies were achieved with pollutant surface loads 10 times higher than those applied in FWS CWs. The most efficient CW system for dairy wastewater treatment appears to be a hybrid system of both VF and HSF stages. Hybrid systems have been tested by three research groups (Browne and Jenssen, 2005; Lee et al., 2010; Rousseau et al., 2004), and each demonstrated high removal efficiencies for all pollutants (83-96% for COD, 65-92% for nitrogen, 52-99% for phosphorus and 83-99% for TSS), even with higher pollutant surface loads than those applied to HSF systems.

6.CONCLUSION

The usage of natural coagulants derived from plant based sources represents a vital development in 'grassroots' sustainable environmental technology since it focuses on the improvement of quality of life for underdeveloped communities. Fortunately, it is surprised that usage of these coagulants is far more receptive by environmentalists worldwide since it avoids the common problem faced by biofuels usage where skeptics feel that their benefits are outweighed by global food shortage and deforestation caused by mass plantation of bio fuel plants. As the dairy industry being agro-oriented, located away from urban population, generally near to disposal site and in rural/agricultural area. Normally sufficient land is available for disposal of dairy wastewater. Simple and easiest method of disposal of this wastewater is on land through irrigation; as maximum BOD5 of 500 mg/L is allowed to be disposed off through this method. Alternative simple method like physico-chemical treatment, if proved to reduce BOD5 to or less than 500 mg/L, then dairy industry is bound to opt for such simple and cheaper treatment

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