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Impact of Sugar Mill Effluents on Crop health

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Abstract

Environmental pollution is one of the primary issues of the globe. Industrialization is the main cause for environmental pollution. Water is mainly affected by industries due to huge amount of effluent released into water bodies. It changes the physico-chemical properties of water and harmfully affected plants and other living organisms. In fact, industrial waste and other different human activity waste have emerged as one of the main reasons of pollution of water bodies. Sugarcane is known to be one of the oldest cultivated plants in tropical and subtropical countries. However, untreated disposal of the effluent from sugarcane industries results in extensive water pollution. In India, most of the people depend upon the agriculture as a major occupation. One of the most critical problems in developing countries is improper management of huge amount of generated waste by various anthropogenic activities is a serious problem. These effluent from industries have a great deal of influence on the pollution of the water bodies. Water bodies especially freshwater ones are the most affected. Due to industrial effluent contamination of natural water bodies has emerged as a major challenge in developing and densely populated countries like India. India is agriculture based country and major user of water resource for irrigation but there is a great demand in water for irrigation while gallons and gallons of effluent are let out into water source as untreated. Food crops are not advisable for cultivation under effluent irrigation because it affects the food crops and deposited heavy metals in the plant tissue and also affected the consumer. This study is aimed at reviewing the sugarcane industrial process with its water consumption rates, and effluent characteristics and its adverse effects on the environment.

Key words:- Water, pollution, sugar mills, effluent etc.

Introduction

Use of industrial effluent in agriculture is common in India which accumulate toxic metals into plant tissue from soil. Water bodies, which are the major sources of drinking and irrigation are often contaminated by are the primary means for disposal of waste, especially the effluents, activities of the adjoining populations and industrial establishments. Increased industrial activities have led to pollution stress on surface waters both from industrial agricultural and domestic sources. As a result, water bodies which are major receptacles of treated and untreated or partially untreated industrial wastes have become highly polluted. High levels of pollutants in river water systems may causes an increase in biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), toxic metals such as Cd, Cr, Ni and Pb and fecal coliform which make water unsuitable for drinking, irrigation and aquatic life.

Industrial effluents from pulp and paper, sugar industry, textile industry, distillery industry, slaughter houses, tanneries and chemical industry usually have high organic and inorganic pollutants. Sugar industry is one of the most important agro based industries in India and is highly responsible for creating significant impact on rural economy in particular and countries economy in general. Sugar industries

rank second amongst agro based industries in India. A significant large amount of waste is generated during the manufacture of sugar and contains a high amount of pollution load particularly in items of suspended solids, organic matters, press-mud, bagasse and air pollution.

The continuous use of these effluents harmfully affects the crops when used for irrigation. As a result, a higher amount of various elements get deposited in the soil and make it polluted. This polluted soil reduces both the crop production as well as the soil properties. A considerable amount of waste water is released during crushing of sugar cane. This wastewater is disposed into nearby water bodies and the discharge of effluent into water bodies or on soil is causing a serious problem of water pollution resulting in severer damage to flora and fauna and environment degradation. Sugar mill effluent produced obnoxious odour and unpleasant colour when released into environment without proper treatment, farmer have been using these effluent for irrigation found the growth yield and soil health were reduced.

The discharge of untreated industrial effluents degraded water and soil, and the entire environment. During the study the majority of the people have negative opinions regarding the impacts of sugar mills effluents on fish, crops, and human health life. The higher BOD5 level in the effluents indicated that the decline in DO that the bacteria consumed the available oxygen in the water leading to the inability of fish and other aquatic organisms to survive in the water body. The surface water, groundwater, and soil were contaminated through the discharge of sugar mills untreated effluents severely degraded the environment of the areas.

Sugar mills and distilleries are one of India's 17 highest-polluting industries, discharging water into the Ganga River. The sugar industry ranks third for the amount of wastewater produced, after the pulp/paper and chemicals sectors. A huge amount of water is required throughout the entire cycle, which starts with the production of sugarcane and ends with the release of effluent from the mills. This process has an impact on groundwater levels, with serious implications for human health, livelihoods and the ecology of local water bodies. In Uttar Pradesh, the biggest 56 sugar mills generate about 32% of the state's wastewater and discharge up to 85.7 million litres per day (MLD) into the riverine system.

The industry is involved in sugarcane processing action to produce raw sugar from more than 70% of the sugarcane produced in the worldwide. In addition to sugar, the industry produces byproducts such as bagasse, press mud, molasses and wastewater. Furthermore, production of bioethanol as an industrial product is also widespread among sugar industries annexed to ethanol distilleries. Ethanol has existed since the beginning of recorded history. The ancient Egyptians and Chinese produced ethanol by naturally fermenting vegetative materials and discovered the art of distillation. Fermentation is the oldest known biotechnology and complex biological process used for the production of ethanol in the distillery. Recently, bioplastic production has emerged as one of the primary interests in the sugar processing industry in which the sugar is converted into lactic acid and polymerizes into biopolymer. Recently, biorefinery is emerging as the integration of the different sugarcane industries based on biomass feedstock. Recently, the expansion and promotion of bioethanol production are absolutely creating high competition for water resources in many places across the globe. In biorefinery, biomass is expected to go under physicochemical and biological processes to produce biofuels, power, materials, and chemicals. Nowadays, biorefinery is enhancing the environmental and economic benefits of the sugar cane industry. The sugar industry and ethanol distillery are growing at an alarming rate across the

globe but the industries are generating a huge volume of the effluent that disposed into the environment. Inadequately treated and indiscriminately disposed effluents cause extensive soil and water pollutions. The study also evaluates the most common wastewater treatment efforts made to minimize the effluent environmental burden.

Sugar industry wastewater

Sugar industries can be classified broadly into three categories:

(i) only raw table sugar producer
(ii) only ethanol producer
(iii) both raw sugar and ethanol producer

A number of sugar industries turned into ethanol distilleries. 80% of the factories approximately produce both raw sugar and ethanol. In general terms, the sugar production process comprises juice extraction, clarification, evaporation, crystallization and centrifugal processes in the cane factory. Based on the chemical utilization types, there are two categories of sugar manufacturing processes which are carbonation and sulphidation processes. According to the Central Pollution Control Board, the average untreated sugar mill effluent has a BOD of about 1,000-1,500 mg/l, which can become black and foul-smelling when it stagnates. If the untreated effluent is released into water, more oxygen will be required by microorganisms to break down the pollutants, leaving little oxygen for other aquatic life. If discharged on land, the decaying organic matter present in untreated waste can clog the naturally porous ground surface, polluting what little amount of rainwater seeps into the aquifers through the layer of waste. This process affects groundwater quality and, in turn, the health of those who depend on it for drinking purposes. The agricultural sector and industries are the major areas of the freshwater consumption rate which, indicated by the universal features of sugar production that, need huge amounts of freshwater. The freshwater is used in different units of the sugar production processes in the sugar factory and generates wastewater which is highly variable in both quantity and quality. This figure shows the details of each process in the industry and the corresponding of the wastewater generated. This variation of wastewater depends on the feedstocks, products and chemicals used in the process. In the sugar industry, water is obtained from two sources. Primarily, during cane processing water is recovered during processes such as evaporation, crystallization and refinery whereas the other water sources is mainly from barometric condensers, dust removal in the chimney and scrubbers and refrigeration of turbines including washing water.

In the sugar industry, water is used for cleaning purposes in the different sections of the factory generates wastewater. Practically, there are no single units which generate wastewater but the wastewater is produced mainly by washing on the milling house floor, boiling house like evaporators, clarifiers, vacuum pans, centrifugation, etc. Sugar industry effluent quality varies depending on chemical types utilized, the nature of the sugarcane such as the cane variety and the nature of soil in which the cane is grown. This effluent creates serious environmental problems generally, if it is not properly managed. Most of the people in the study have given their negative opinions regarding the impacts of sugar mills effluents on fish, crops, and human health life. They believed that the untreated effluents contained huge pollutants, which polluted the soil, waters, and human life around the sugar mills and effluent discharged drain adjacent areas. The survey report showed that the fish production in ponds, canals, and rivers was decreased about 67-73, 93-95, and 50-55%, respectively in the study areas due to

the discharge of untreated effluents from the sugar mills. Concerning the production of the crops, including rice, potatoes decreased to some extent. However, the production of some crops such as maize and sugarcane increased by 60 and 75%, respectively, due to the discharge of untreated sugar mills effluents. The consequences of untreated industrial effluent discharges have been known for a long time. Specially, the discharge of untreated melanoidins containing spent wash into the water bodies can block sunlight from the water, which results in reducing photosynthetic activity and oxygen concentration that inhibit the survival of aquatic life. Direct discharging of such spent wash into the water bodies could result in eutrophication of contaminated water sources. The leaching of distillery spent wash into the ground water table often results in severe ground water contaminations.

Discussion

Groundwater contamination is a matter of concern throughout the country and effluents from the industries severely affect groundwater quality in several parts of India. According to Uttar Pradesh Pollution Control Board, all the industries are inspected once every three months, and industries in red zones such as sugar mills are often inspected once a month". Industrial clusters are colour coded in India depending on their environmental impacts. With a pollution index score of 60 and above, sugar industries are categorised as red. Every industry and its ETP outlets are connected to a central monitoring system which continuously reads and sends data to State Pollution Control Board (SPCB) and Central Pollution Control Board (CPCB) authorities. If the pollution control boards receive any number that exceeds the permissible limit, the industry is sent a notice and serious action is taken. Five parameters are scrutinised for all industries which are BOD (Biological Oxygen Demand), TDS (Total Dissolved Solids), Ph value, COD (Chemical Oxygen Demand) and TSS (Total Suspended Solids). If any complaints regarding the presence of other pollutants are received, only then other parameters such as presence of heavy metals or other chemicals are checked. However, it is a general assumption that the pollution agencies lack credibility. Since the parameters monitored by CPCB are not available to the public, the institutions cannot be trusted fully.

Health impacts

In most of the villages and urban outskirts, being outdoors around the dusk is a distressing experience. Mosquitoes rise from the stagnant waters as soon as the light dies and temperature drops. Doctors at the primary healthcare centres have told that the patients come to the centre with complaints of skin rashes and other skin-related diseases, which are a direct result of industrial pollution. According to a Delhi-based ENT specialist, nothing stays limited to one part of the body. If someone inhales the toxic gases produced by the mill or due to the combustion of waste, it might start from the nose, but would further make its way to the lungs. Water from the ETP comes into direct contact with the ground. When someone is continuously exposed to toxic components in the air, the tiny particles breathed in eventually penetrates the bloodstream, which damages kidneys, intestines and other parts of the body. Prolonged exposure also increases the risk of developing cancer. The source of pollution could be air or water, but its impact on the whole human body is widely known already. Individual water samples are not sufficient to determine the extent of the potential environmental damage caused by polluting industries. Water testing is a good starting point, he concedes, but it should be complemented by soil testing, detailed mapping of the water quality from hand pumps and borewells across the area.

Limited water, unlimited demand

To mature in the field, one kilo of sugarcane requires 1,500-2,000 litres of water. After the harvest, crushing a single tonne of sugarcane requires another 1,500-2,000 litres of water, generating about 1,000 litres of wastewater. While sugarcane production has increased in the area, annual rainfall has been decreasing. A set of rainfall data compiled by Indian Meteorological Department between 1989 and 2018 for the state of Uttar Pradesh found the annual precipitation levels to decrease significantly. It is observed that over the past few years, temperatures have started to increase abnormally around February, affecting the production of crops like wheat. Despite the reduced precipitation, farmers are still cultivating sugarcane because they can tap into groundwater reserves to irrigate their fields. A number of villagers revealed that earlier water could be easily found at about 12-15 metres underground, but this is not the case now. Groundwater levels have dropped drastically, and now wells have to be dug down to more than 50 metres to find water significantly. Over the past decade average groundwater levels have gone down by 96 cm per year.

Wasting water in times of scarcity

While the region suffers from increasing water scarcity, ponds and artificial lakes are overflowing with wastewater from the mill. A UPPCB officer told that the permissible limit for a large sugar industry is to release 1,935 kl of water from the ETP and 600 kl from the sugar processing mill every day. Companies don't easily disclose details on how much water the structure is allowed to discharge every day, as well as the amount of water released. If a water body where the waste is being dumped is not big enough or does not receive sufficient fresh water to dilute the concentration of waste, the components of waste can percolate inside the ground and impact the land and groundwater. If the piece of land where the waste is dumped is confined, or if the water body does not receive enough fresh water, the amount of waste will not be able to break down and will surely impact the land, water body and eventually the groundwater quality.

Results

Sugar mill effluent confirmed that it is acidic in nature and dull white in colour with decaying molasses smell. Colour is vital role of an aquatic ecosystem and it affects photosynthesis. Colouration reduced the some other parameters such as temperature DO and BOD, etc., and it also reduced to the decomposition of substances by microbes.

Suggestions

Untreated effluent discharging from sugar mills not only degrade surface water body, fertile soil but also polluted ground water. Hence it is suggested that effluent before discharge must be treated properly. The study observed that it is good that effluent in Doiwala sugarmill is properly treated before its discharge otherwise the surface water, ground water and soil water contaminatedthrough the discharge of sugar mills very badly and surely ruin the river ecosystem. It is suggested that if the treated waste water of sugar factory will diluted with fresh water and then used for irrigation purposes may prove to be good results in agriculture. In India, there are only a limited number of studies on the effect of industrial waste on human health. To establish a link between industrial effluents and human health, there is a need for independent and detailed research.

Conclusion

Extraction of sucrose from sugarcane was started many years ago and nowadays, sugar is mainly produced from sugarcane in sugar industries globally. Sugarcane cultivations and processing in sugar industries are high water intensive processes. Proper water conservations and management are essential for sustainable freshwater uses in this sector. Sugarcane industries generate huge volume of the effluent, particularly from the sugar industry and an ethanol distillery which have different varieties of the pollutants which have a potential to cause a critical environmental pollution problems in developing countries. Nowadays, environmental regulations have been enforced many industries for proper wastes management, and checked the compatibility of the development and environment. Hence, proper management of cane industrial wastewater through the conventional treatment methods is challenging even though elimination of the pollutants is an important task for environmental protection and esthetic values. Recently, among the many treatment methods, high-rate anaerobic digestions have been recognized as effective treatment methods for highly organic saturated sugar industry and ethanol distillery effluents. However, anaerobic digestion alone cannot remove all the pollutants of sugarcane bio-refinery's wastewater. As post-treatment of the anaerobic digestion, another treatment technology is highly recommended for the removal of less biologically degradable organic compounds in terms of the treatment efficiency, cost and ease of operation as well as the social acceptance. Mostly, adsorption treatment technology is considered as a potential candidate for post anaerobic treatment of wastewater from sugarcane industries. The higher concentrations of toxic heavy metals can accumulate in the human body through the food chain and causes harmful effects on various human organs. Contaminated surface water, groundwater, and soil must be treated and reversed back to their pure form to prevent the crop health and hence immediate steps must be taken to treat the effluents before discharging them.

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