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Perspective

The Dangers of Textile Mill Effluents on Soil and Methods for Remediation

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INTRODUCTION

Untreated textile mill effluents are a major source of worry since they are linked to a variety of harmful consequences for ecosystems and human health. Complex effluent containing a variety of dyes, metal contaminations, and other organic agents used for softening, printing and heat stabilization can build in natural sources such as soil and water if discarded without treatment or after complete treatment. Soil is a loose material found on the earth's surface that serves as an anchor for plants, as well as a reservoir for water and nutrients. The presence of xenobiotic substances in open and partially covered pits left behind from industrial or residential operations changes the chemical and physical properties of arable soil.

With the introduction of xenobiotic compounds in the modern era, various harmful effects on the eco system have been observed. They endanger the flora and animals, as well as microorganisms and human health. Industrial wastes, such as pesticides, insecticides, fertilizers, heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, solvents, and colored effluent, are commonly responsible for such contamination.

DESCRIPTION

Soil is essential to the ecology. Composition of inorganic components (minerals) obtained from decomposed rocks, humus, water and other sources. Influence soil properties concurrently. The standard American Society for Testing and Materials (ASTM) edition of the unified soil classification system (ASTM, 2017) classified soil based on grain size and texture as clay, gravel, organic clay, organic slit, peat, sand, and silt. Clay fraction has a large surface area and several chemical and physical qualities similar to arable soil. The physical character is principally controlled by sand and silt fractions.

In addition, soils provide anchorage for roots, bind water and nutrients, and as the cliche goes, "we build on soil as well as with it and in it." Many variables influence the concentration of heterogeneous substances, including metals, chemicals (monomer, solvents, reactive initiator, dyes/pigments) leaking from municipal and chemical industries, unintentional spillage, and subsurface leakage, all of which produce soil contamination. These issues are of particular importance as contaminated places continue to spread and become more enticing. According to a research by the Environmental Protection Agency (EPA), more than 40,000 locations in the United States were found to be contaminated with the aforementioned pollutants conducted a statewide assessment to assess the state of soil in China and concluded that 16% of soil samples and 19% agricultural soil do not exceed China's soil environmental quality criteria. Although metals are important in nature in minute amounts, their excessive accumulation is a major worry. Heavy metal enriched soil reduces the density of earthworms in Northern French grassland.

Similarly, dye contamination in water and soil is a visible indicator of pollution. Dyes are mostly utilized in the paper, textile, rubber, plastic, pharmaceutical and cosmetic sectors, as well as paints, printing inks, art, craft, leather, and food. Widespread azo dye contamination in China's soil and water resources. The transport of organic dyes into agricultural soil is also accounted for by the application of sewage sludge on land and long-term irrigation of agricultural areas from natural streams polluted with textile effluent.

There are currently more than 1.0-10.5 commercially available dyes in the world, and more than 7.0-10.5 t is generated each year. According to a survey conducted by the Ecological and Toxicological Association of the Dyestuffs (ETAD), 90% of 4000 dyes had LD50 values more than 2 g.

Excessive pollutant concentrations in soil diminish soil fertility and quality, as well as pollutant entrance into the food chain. As a result, it is worthwhile to discuss their direct or indirect impact on the human race. Because soil pollution from effluent and sludge applications is prevalent, effective remediation options are urgently needed in developing and underdeveloped countries.

Textile mill effluent composition

Fabrics were treated in textile mills using a variety of techniques such as sizing, desizing, weaving, scouring, bleaching, mercerizing, carbonizing, fulling, dyeing and finishing, which combined a wide range of raw materials. Surface sizing or internal sizing agents such as gelatin, starch, polyvinyl alcohol, polyvinyl acetate, acrylic co-polymers, alkyl succinic anhydride, alkyl ketene dimmer and rosin are used to change the absorptive characteristics of fabrics. To remove undesired color or deintensify color, bleaching agents such as sodium hypochlorite, sodium chlorite, calcium hypochlorite and hydrogen peroxide are utilized. Because of the presence of highly oxidizing chemicals, bleached effluent has high oxygen content but a low Biological Oxygen Demand (BOD).

The toxic effects of dye components coexisting with oxidants present in textile wastewater in zebra fish were interpreted as a reduction in the quantity of enzymes superoxide dismutase and glutathione-S transferase activities, with an emphasis on cytotoxicity and genotoxicity due to reactive oxygen species production. As a result of a range of operational settings, treated wastewater has higher levels of BOD, Chemical Oxygen Demand (COD), and total solid sediments.

The drain wastewater is responsible for blocking of the soil pores, which results in loss of soil productivity. Dyes alone are not hazardous to the environment or human health; however, supplementary substances in the dying process, such as chlorinated solvents; trichloro-ethane, used to remove oils, gums, lubricants, dust, dirt and other impurities in the scouring process, are extremely dangerous to the human central nervous system. Textile dyes also contain a variety of heavy metals. Antimony (Sb) is found naturally in cotton, synthetic fibers and leather. Some dye fixatives, like as Chromium (Cr), are also used to improve color fastness and form coordination with dye in order for it to adhere to materials.

Cadmium (Cd) is applied to natural, synthetic, and leather fibers that include carcinogens such as Lead (Pb) and Cr (VI). Nonylphenol ethoxylates are industrial detergents used as emulsifiers; dye-dispersing agents for dyes and printing, and can affect human fertility and even be lethal. Nonylphenol has been banned in the EU since 2005. Cotton is treated in a NaOH bath before being neutralized with acid, which alters the pH of the resulting effluent. Fulling wastes are the most significant sources of BOD from soap, detergents, and lubricants. Unlike fabrics, dyeing polyester and polyester mix dyeing carriers such as chlorobenzene are used as degreasers and pesticides.

CONCLUSION

Textile mill effluents are complex in nature due to the presence of various dyes, metal contaminations and other organic agents that can accumulate in natural sources; soil and water after untreated disposal that are potentially toxic for ecosystem and human life; and the presence of xenobiotics elements in open and partially covered pits left behind by industrial or domestic activities that alter chemical and physical properties of arable land. Several green methods (bioremediation, bio surfactants and phytoremediation) encourage decontamination of soil in safe manner whereas; chemical and nano-based treatments are emerging technologies that facilitate remediation of soil in less time. The chemistry of bioremediation, as well as the engineering components of the process, is still unknown.