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EFFECT OF MUNICIPAL SEWAGE WATER ON SOIL CHEMICAL COMPOSITION - A EXECUTIVE SUMMARY

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Abstract

Dusts from the cement industry emitted into the atmosphere reach the plants surface as dry and wet sediments and affect the vegetation. The influence of the pollutants depends upon their composition, qualitative properties and amount as well as the soil's buffering capability. In the composition of dust emitted from the cement industry, the percentage of alkaline components is high. Hence, the soil pH values were observed in the range of 7.9. In the soil, electrical conductivity was about 13.8 m mhos during the month of December. The phosphorus content of 6, 9 and 16 kg/ha was recorded in sewage water irrigation, and control was observed 8.50, 9 and 10 kg/ha. The nitrogen content of 570, 615 and 1250 kg/ha was recorded in sewage water irrigation, and control was observed 460, 485 and 489 kg/ha. The Ca content of 0.14, 0.15 and 0.24 kg/ha was recorded in sewage water irrigation, and control was observed 0.21, 0.13 and 0.14 kg/ha. The mg content of 0.12, 0.16 and 0.18 kg/ha was recorded in sewage water irrigation, and control was observed 0.12, 0.13 and 0.14 kg/ha. The Potassium content of 300, 381 and 990 kg/ha was recorded in sewage water irrigation, and control was observed 273, 275 and 300 kg/ha.

Key words: Municipal sewage water, Pollutants, Soil and Irrigation.

1. Introduction

Municipal solid waste can be used to generate energy. Several technologies have been developed that make the processing of MSW for energy generation cleaner and more economical than ever before, including land fill gas capture, combustion, pyrolysis, gasification, and plasma arc gasification. While older waste incineration plants emitted high levels of pollutants, recent regulatory changes and new technologies have significantly reduced this concern. United States Environmental Protection Agency (EPA) regulations in 1995 and 2000 under the Clean Air Act have succeeded in reducing emissions of dioxins from waste-to-energy facilities by more than 99 per cent below 1990 levels, while mercury emissions have been by over 90 per cent. The EPA noted these improvements in 2003, citing waste-to-energy as a power source "with less environmental impact than almost any other source of electricity". Soils are complex mixtures of minerals, organic compounds, and living organisms that interact continuously in response to natural and imposed biological, chemical and physical forces (Soil Science Society of America News, June 1995).

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2. Materials and Methods

Study area

The physico-chemical properties of the soil around the Ariyalur were undertaken in the present study. The samples of undisturbed soil were collected around the Ariyalur at 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 km distances from the cultivated land in each direction for the length of 1.0 km. Soil samples were collected from the four directions *viz*., East, West, South, and North. Samples were collected at the depth of 0 - 15 cm and 15 - 30 cm, totally one control and 4 affected soil samples were collected from four directions.

Method of collecting soil samples

About 1.0 kg of undisturbed places at the depth of 0 – 15 cm and 15 – 30 cm by ticking the soil at angle of 45^0 using pickaxe form each spot. The soil were collected in a separate thick polyethylene bags and properly labeled and brought to the laboratory for the following analysis.

Study on physico-chemical properties of soil.

i) Preparation of soil extract.

Ten gram of soil was finely ground using mortar and pestle and transferred to 150 ml beaker. The 200 ml of glass-distilled water was added with soil sample and the extract was stirred using glass rod. After 30 minutes, the extract was filtered through Whatman No. 1 filter paper and the filtrate was used for the analysis of pH and electrical conductivity.

3. RESULTS AND DISCUSSIONS

The temperature of the sample of soil has been recorded during the period of November 1^{st}December 31^{st} of 2014. The surface soil temperature was observed in the range of $25.8^oC \pm 1^oC$. The pH values were observed in the range of 7.9. In the soil, electrical conductivity was about 13.8 m mhos during the month of December.

Phosphorus

The phosphorus content of 6, 9 and 16 kg/ha was recorded in sewage water irrigation, and control was observed 8.50, 9 and 10 kg/ha.

Nitrogen

The nitrogen content of 570, 615 and 1250 kg/ha was recorded in sewage water irrigation and control was observed 460, 485 and 489 kg/ha.

Calcium

The calcium content of 0.14, 0.15 and 0.24 kg/ha was recorded in sewage water irrigation and control was observed 0.21, 0.13 and 0.14 kg/ha.

Magnesium

The magnesium content of 0.12, 0.16 and 0.18 kg/ha was recorded in sewage water irrigation and control was observed 0.12, 0.13 and 0.14 kg/ha.

Potassium

The potassium content of 300, 381 and 990 kg/ha was recorded in sewage water irrigation, and control was observed 273, 275 and 300 kg/ha.

Organic carbon

The organic carbon content of 1.36, 2.37 and 6 kg/ha was recorded in sewage water irrigation, and control was observed 0.005, 0.05 and 0.15 kg/ha.

The changes in physical properties of soil polluted with cement kiln dust were studied by analyzing core soil samples from the area around a cement factory. Among the mechanical fractions of soil the silt fraction of the heavily polluted soils showed a market increase due to dust deposition. The bulk density, particle density, total pore space, hydraulic conductivity and infiltration rates were reduced in the sites receiving higher cement kiln dust especially in the areas closer to the factory in the directions having higher wind velocities (Saravanan and Appavu, 1997).

Cement kiln exhausts in the form of dust emissions settle on the soil and vegetation surrounding the cement factory and cause pollution problems. Soils polluted with cement kiln dust have been reported to exhibit a decrease in water holding capacity and pore space, an increase in thermal conductivity, specific heat, density and absolute specific gravity (Parthasarathy *et al*., 1975).

Table – 1: Changes in the chemical properties of sewage irrigated soils

Parameters	Sewage water irrigation			Control		
	Dry land	Irrigated	Water logged	Dry land	Irrigated	Water logged
Nitrogen (kg/ha)	570	615	1250	460	485	489
Phosphorus (kg/ha)	6	9	16	8.50	9	10
Potassium (kg/ha)	300	381	990	273	275	300
Calcium (kg/ha)	0.14	0.15	0.24	0.21	0.13	0.14
Magnesium (kg/ha)	0.12	0.16	0.18	0.12	0.13	0.14
Organic carbon (kg/ha)	1.36	2.37	6	0.005	0.05	0.15

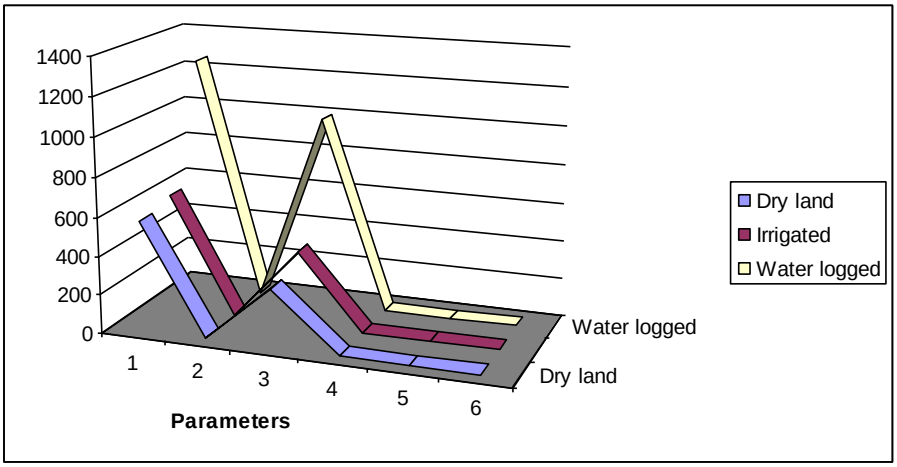

Fig - 1: Diagrammatic representation of chemical properties of affected sewage irrigated soils

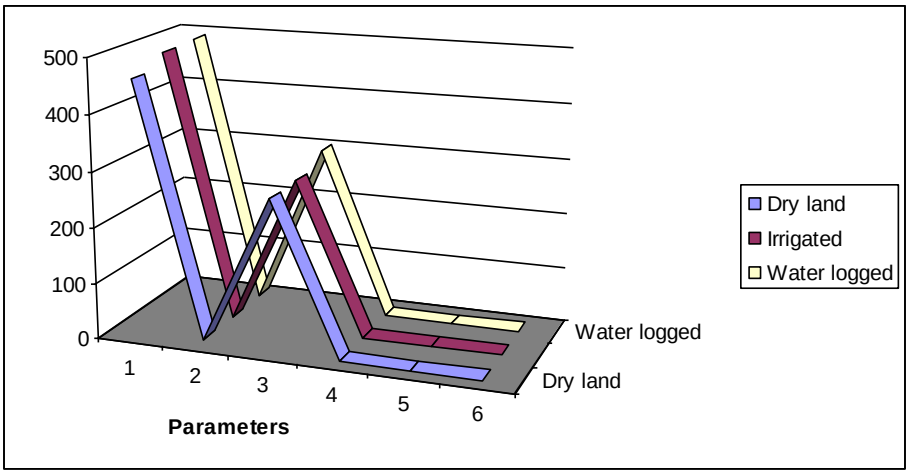

Fig – 2: Diagrammatic representation of chemical properties of control sewage irrigated soils

The production of building materials open-cast mining and quarrying metallurgical engineering and chemical Industry are among the most important polluters which during their technological processes emit solid pollutants in the form of dust. The highways provide a great amount of dust pollution also. In several countries the growth of dust pollution due to the intensification of the Industrial processes and transport has been observed (Stanton 1989; Farmer. 1993). For that reason the increase in ethnogeny dust loads on natural ecosystems needs serious consideration.

The physical and chemical characteristics of the dusts affecting the environment depend on the used raw materials, technological process, and the existence of cleaning equipment, their type and performance. Usually the ethnogeny dusts are a conglomerate of chemically heterogeneous substances. Lerman and Darely (1975) stress that the impact level on vegetation depends largely on the amount of calcium silicate and a relatively high rate of carbonation (Zaja (1962) states that the hydration process of crust formation releases calcium hydroxide, which may penetrate and damage the leaf tissue. So the diversity in the chemical composition and pH of dust from various sources is one of the reasons of contradictory results of investigations and conclusions on the impact of cement dust on vegetation. Several researchers have been stressed that the high pH values of the dust-water suspensions and the shading effect of the cement crusts are the most damaging factors for plants (Czaja, 1961; Lerman and Darely, 1975; Mudd and Kozloski, 1975; Oblisami *et al*., 1978; Mender, 1985; Mandre *et al*., 1992).

4. Conclusion

Soil is used in agriculture, where it serves as the anchor and primary nutrient base for plants however, as demonstrated by hydroponics, it is not essential to plant growth if the soil-contained nutrients could be dissolved in a solution. The types of soil and available moisture determine the species of plants that can be cultivated.

Soil material is a critical component in the mining and construction industries. Soil serves as a foundation for most construction projects. The movement of massive volumes of soil can be involved in surface mining, road building and dam construction. Earth sheltering is the architectural practice of using soil for external thermal mass against building walls.

Soil resources are critical to the environment, as well as to food and fiber production. Soil provides minerals and water to plants. Soil absorbs rainwater and releases it later, thus preventing floods and drought. Soil cleans the water as it percolates through it. Soil is the habitat for many organisms: the major part of known and unknown biodiversity is in the soil, in the form of invertebrates (earthworms, woodlice, millipedes, centipedes, snails, slugs, mites, springtails, enchytraeids, nematodes, protists), bacteria, archaea, fungi and algae; and most organisms living above ground have part of them (plants) or spend part of their life cycle (insects) belowground. Above-ground and below-ground biodiversities are tightly interconnected, making soil protection of paramount importance for any restoration or conservation plan.

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