Studies on the effect of Physico-chemical characteristics of the soil on mixing with treated effluents with S.P.S and used as potential fertilizer for growing vegetables and wheat crop , after tertiary treatment with indigenously prepared cation exchanger from wheat straw.

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ABSTRACT : Soil is one of the three natural resources and is the medium in which floras grow .It also acts as reservoir for various micro flora and fauna which along with their chemical constituents maintain the fertility of the soil. The micro flora and fauna also helps in maintaining the ecological balance. Although industrialization is essential for improvement in our life style , the effluents released from the industries create a number of problems . Mostly the effluents containing various organic and inorganic chemicals, which are toxic in nature having adverse effect on soil properties thereby , disturb the ecological balance .Keeping in view chemists in general and soil scientists in particular have been endeavouring in recent past to device techniques to make the effluents , either as such or after certain treatments.Keeping this in view control soil is mixed with effluents of different dilutions and studied the effect of these on soil parameters, these studies were carried out at regular intervals . Industrial effluents when discharge through sewage system causing several soil and water borne diseases. Disposal of various industrial wastes is the major problem responsible for soil pollution. These industrial pollutants are mainly discharged from pulp paper mills, chemical industries, oil refineries , sugar factories , metal industries etc. As a result hazardous chemicals can enter into human body through food chain and disrupt the biochemical process.

Most of these pathogens are insusceptible to degradation and are injurious to health. Therefore effluents from various industries should be treated by following primary, secondary and tertiary treatment processes before disposing.

For analysis of various samples of soil mixing with different proportions of various treated effluents of the industries which are used as potential fertilizers for the growth of various plants . Treated effluents of distillery and paper mill has been used for growing vegetables and wheat crop by varying different dilution , the fertility of the soil had changed .

Kerywords : reservoir, soil ,effluent , cation exchanger, pollutants,Sulphonated paper mill straw(SPS).

1INTRODUCTION

The **protection of the biosphere from pollution by various industrial wastes and paper mill sludges is an extremely important problem of modern times.**

The number of chemical substances from various industries , agriculture and vehicles increasing day by day in the atmosphere. India being an agricultural country, the various wastes from agriculture contains many pollutants. Conversion of wheat straw i.e Paper mill sludge into cation exchanger is an indigenous approach for waste management. The exchange capacity of S.P.S was found to be 0.9 meq/gm only. While that of synthetic cation exchanger is app (1.9 to 2.9 meq/gm).But the cost **of formation of cation exchanger from paper mill sludge in finished form is appx (Rs 40/500gm) to commercially available product (appx 250/500gm). Thus the prize of cation exchangers from paper mill sludge would may be one fourth the prize of synthetic cation exchangers without losing exchange** capacity **can also be regenerated easily by dipping them in decinormal hydrochloric acid for 24 hours. There is no storage problem for them .It has been observed that the distillery**

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effluents when treated with sulphonated wheat straw show considerable reduction in various physico-chemical parameters like D.O, BOD, COD .free carbon-dioxide ,total solids, total dissolved solids and suspended solids. The percentage reduction in these parameters in some cases were even more than 80%.

The various parameters studied for analysing the soil samples were pH, conductance, total nitrogen, phosphorous, potash , Mn , Zn and Fe .(Table 1)

Exchanger like Dowex 50 showed less rate of percentage reduction as compare to S.P.S as shown in table 3. Treated Distillery effluent had been used for growing vegetables and wheat crop in pot as well as in field by varying different dilution, the fertility of the soil had changed .The main value of a pH measurement of a soil is not that it shows a soil to be acidic or alkaline but the information at gives about associated soil properties such as phosphorous availability, base status and so on. Most agricultural soils have pH laying between 4 and 8 .More acidic soils are usually peaty in nature and often contain a high proportion of sulphur and aluminium. The more acidic a soil the more mobile will become such elements as iron , manganese, zinc, copper and other minor elements . Thus at low pH value soil may contain toxic quantities of certain elements and toxicity is responsible for poor plant growth.

A study of conversion of paper mill sludge into cation- exchanger and exploring the possibility of its use as a potential fertilizer for the cultivation of various vegetable crop is a meaningful proposition.

2 Materials and Methods

The present study was carried out on a paper mill sludge of Ballarpur Paper Mill , Yamunanagar ,Haryana and treatment of distillery mill effluent. All the chemicals used in the study were of analytical grades .Double distilled water was used throughout the study .All glassware and polycans were thoroughly cleaned and rinsed with distilled water . Standard methods for the examination of water samples and waste water samples were used.

For analysis of various samples of soil mixing with different proportions of various treated effluents of the industries which are used as potential fertilizers for the growth of various plants , the soil samples for analysis had been properly prepared by following different steps .

The soils were spread on flat trays to dry. The tray are commonly about 50 by 60 cm , 2.5 cm deep and made from wood , zinc ,fibre glass or plastic. During drying the trays were numbered with a plastic tag. The soils were allowed to dry in the air , the trays being placed in special racks ideally in a cabinet with warm circulating .The temperature should not be allowed to exceed 35^{o} C and relative humidity should be between 30 and 70 % .

Drying causes changes in the chemical and physical characteristics of a soil , the chemical changes often being the results of microbiological changes. The degree to which such changes occur varies with the temperature and time of drying , and for this reason the procedure for drying soils should be standardized as far as possible.

2.1 Grinding and Sieving -When a soil was air dry , stones and pieces of macro-organic matter were picked out,weighed and remainder of the sample was crushed and sieved.Large lumps were broken up by hand and then the soil was grounded by rolling gently with a wooden roller .After grinding , the soil was screened through a 2mm sieve , which was used for more routine analysis. The composition of the grinding and sieving apparatus can be important especially if trace elements are to be determined.

2.2 Storage of Soil Samples

The soil samples were stored in a screw capped glass jar which were labelled after packing .Soil will undergo changes during storage and that will affect on the same analytical studies. Mostly microbial changes take place due to changes between organic and mineral constituents of a moist soil.Soil should be properly dried .

2.3 Treatment of Distillery Mill Effluents with newly formed Cation- Exchanger -

Various physico-chemical and biological parameters of distillery mill effluent were determined for the assessment of its pollution load by standard methods.(fig 2-3)

Chromatography columns were packed with newly formed cation-exchangers from waste sludge of paper mill and effluents of distillery mill was passed through the column by varying the amount of cation exchangers packed and the contact time.The status of effluent were again determined in terms of same physico-chemical and biological parameters.

Result and Discussion

The paper mill straw can be converted into cation exchanger and it is an indigenous approach for making use of agricultural waste for the production of cation exchangers .The average value of exchange capacity of various forms of cation-exchanger from wheat - straw was found to be 0.9 Meq/gm only .While the exchange capacity of synthetic cation- exchangers is app (1.9 to 2,9 Meq/gm)Table(4). But the cost of formation of cation-exchanger from wheat-straw in finished form is (appx Rs 40/500gm) compared to commercially available product (appx Rs 250/500 gm). Thus the price of cation-exchangers from paper mill straw may be one fourth the price of synthetic cation exchangers without losing exchange capacity can also be regenerated easily by dipping them in decinormal hydrochloric acid for 24 hours. There is also no storage problem for them. It has been observed that the effluents of various industries when treated with S.P.S show considerable reduction in various physico-chemial parameters such as acidity, hardness, D.O, B.O.D,C.O.D free CO_2 and total suspended solids are shown in table .Reduction of pollution load in these effluents with synthetic exchangers like Dowex 50 and Amberllite were even less as compared to S.P.S . The exchange capacity of S.P.S was found to be 0.9 meq/gm only while the exchange capacity of synthetic exchanger is appx (1.9 to 2.9 meq/gm) .But the cost of formation of cation exchanger from paper mill sludge in finished form is Rs 40/500 gm to commercially available product (Rs 250/500 gm) . Thus the price of synthetic exchanger is one fourth the price without losing exchange capacity. Today resins of various quality are freely available in America, Britain, Germany , Japan ,Russia etc but not in India.The use of these exchangers now covers almost the whole field of chemistry .There is practically no field of science or industry in which these are not put in use. Therefore the study of conversion of paper mill sludge into ion-exchanger gives an impression of an indigenous approach to make use of all natural resources for the production of a useful product .The utilisation of such type of wastes like paper mill sludge would be step towards right direction.

Treated industrial effluents like paper mill and distillery had used for growing spinach , potato, and wheat crop by varying dilution of effluents , the fertility of soil had changed. The maximum growth of these plants were observed with dilution (60 ml eff +40 ml water) and (50 ml eff +50 ml water) .All the nutrients required for these crops were according to standard. Distillery effluent without any treatment is acidic in nature having pH 3.4 to 3.7 .After tertiary treatment with S.P.S pH increased to 7.6 ,Similarly in Paper mill it changes from acidic to less acidic which is suited to plant growth. Conductance of the soil is more due to the excess of soluble salts. Distillery effluent has TDS 82,212 ppm . After treatment with S.P.S it reduces to 825 ppm i.e more than 80%. Similarly organic nitrogen tested in the soil sample without effluent was 18kg/hectare .With addition of different amount of SPS the organic nitrogen contents increases upto 42 Kg/hectare. It means fertility of the soil increases. In soil sample without any effluent have phosphorous 41. 5 Kg hectare , whereas it goes on increasing from 41.5 to 50.5 Kg/ hectare . Potassium contents in soil without effluents was 47 Kg/hectare .It increases from 47 to 51 Kg/hectare. Therefore treated effluents with S.P.S not only reduces pollution load .It also reduces the contamination of heavy metals in soil which enters in food chain is largely avoided. Distillery effluent after treatment with S.P.S has improved the soil fertility and amount of all the contents required for growth of plants are within permissible limit.

fig 1. Variuos metal ions studies on soil samples after mixing treated effluent of paper mill in different proportions.

Soil sample information W-water E-Effluent	Mn (ppm)	Fe (ppm)	Zn (ppm)
(80% W + 20% E)	14.08	10.71	9.81
(60% W + 40% E)	12.45	11.86	10.94

(40% W + 60% E)	11.94	12.00	7.58
(20% W + 80% E)	12.14	11.57	6.32
(100% E)	12.45	12.43	12.74
Soil without any effluent only water	13.88	11.57	11.55

fig2. Studies of soil samples after mixing treated effluent of paper mill in different propotions.

Soil sample information W-water E-Effluent	**K_2O Kg/Hectare**	**pH**	**Conductivity**	NItrogen content **Kg/Hectare**	**P_2O_5**
(80% W + 20% E)	**180**	**8.3**	**0.25**	**23.31**	**3.93**
(60% W + 40% E)	**170**	**8.3**	**0.34**	**34.96**	**3.68**
(40% W + 60% E)	**135**	**8.3**	**0.30**	**28.31**	**3.61**
(20% W + 80% E)	**175**	**8.3**	**0.28**	**16.65**	**3.05**
(100% E)	**215**	**8.3**	**0.36**	**46.62**	**8.24**
Soil without any effluent only water	**130**	**7.8**	**0.33**	**14.43**	**3.93**

fig 3 Treatment of distillery effluent with cation-exchangers from Paper Mil sludge .

Parameters	**Untreated effluent**	**Treated effluent with SPS**	**With Dowex 50**	**% with SPS**
pH	**3.4**	**7.6**	**7.9**	**---------**
Acidity(ppm)	**450**	**70**	**Nil**	**84.44**
Alkalinity(ppm)	**260**	**150**	**110**	**42.30**
Chloride(ppm) Content	**180.5**	**96.2**	**160**	**46.70**
D.O	**0.2**	**4.6**	**5.2**	**---------**
B.O.D	**42590**	**225**	**210**	**99.47**
C.O.D	**96500**	**428**	**410**	**99.55**
Free CO_2(ppm)	**21**	**112**	**Nil**	**99.46**
Total Hardness(ppm)	**4800**	**1425**	**1128**	**70.31**
Permanent Hardness (ppm)	**2525**	**864**	**675**	**65.78**
Temporary Hardness (ppm)	**2275**	**561**	**453**	**75.34**
Total Solids	**98.216**	**448**	**374**	**99.54**
Dissolved Solids(ppm)	**92,212**	**325**	**292**	**99.64**
Suspended Solids(ppm)	**6004**	**123**	**82**	**97.95**

fig 4 Exchange Capacity of various forms of S.P.S

S.No	**Form Of SPS**	**Exchange Capacity inMeq/gm**
1.	**H^+**	**0.90**
2.	**Na^+**	**1.2213**
3.	**K^+**	**1.0364**
4.	**NH^+**	**1.1136**
5.	**Ca^+**	**1.337**
6.	**Mg^+**	**1.471**

7.	**Ba^{+}**	**1.1008**

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