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Impact of Neem Leaf on Physical and Chemical Profile of Fly Ash Incorpoted Soil

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ABSTRACT: The fly ash is the waste material of coal based thermal power plants and is produced in a large amount in our country as well as in all over world. It has been registered that due to increase the power demand in world the percentage of fly ash also increases very fast. Hence, so many efforts have been made day by day to reutilize this waste material in various sectors. The present work is deal with the variation in the physical - chemical profile of fly ash incorporation soil with and without Neem leaf for the period of 120 days of incubation. The result of this study is based on different properties like pH, specific conductivity, organic carbon, nitrogen and potassium in different concentration of amendment. The percentage of organic carbon and nitrogen have showed decreasing order without Neem leaf. While the percentage of organic carbon and nitrogen showed increasing order in presence of Neem leaf. But in case of potassium it showed increasing trend with and without Neem leaf.

Keywords: Fly ash; Neem leaf; pH; specific conductivity; organic carbon; nitrogen and potassium.

INTRODUCTION: Fly ash is a waste material of coal based thermal power plant, its nature and properties depends on nature of coal combusted, boiler unit design, fining and loading conditions, degree of pulverization, handling and storage method. It has been reported by many workers that about 180 MT of fly ash is generated in India. It has been observed by number of scientists that the disposal and dumping of fly ash now becomes the most notable pollutants of soil and ground water. Therefore it is not only concerned the agricultural uses of land area but also its risk to human society and natural ecosystem [Rayalu et al. (2001), Gupta A. K. (2001), Kumar et al (2003), Pandey et al. (2009) and Agrawal et al. (2011)]. Agrawal et al. (2011) have suggested that the phyto remediation of fly ash by amending the fly ash at various percentages with natural soils to improve the plant growth. It has been documented that generally fly ash increases the alkalinity of soil because of its low S contents and occurrence of Ca, Al, Mg and OH^- ion, along with other cationic trace elements. The nitrogen available in coal volatiles during its combustion, therefore the deficiency of nitrogen may retards the plant growth. The experiments also suggested that fly ash has generally negligible organic matter.

However the percentage of heavy metal like Fe, Ni, Cu, Al, Mn and Si is found in large quantity and may cause toxicity to growing plant species[Singh B. K. (1993), Barman et al. (1994), Kim et al. (1994), Kabata Pendias et al. (2001), Pandey et al. (2009) and Agrawal et al. (2011)]. Some workers have recorded that fly ash contains very little or negligible amount of P and N contents. However small concentrations of Ca, Na, K, Ti and S were also documented to vary notable in fly ash [Pathak et al. (1996 b), Kalra et al. (1996 a) and Nidhi Jamwal (2003)].

Addition of fly ash to soil may improve the physical chemical properties as well as nutritional value of the soil. Jabeen and Sinha (2012) have reported that fly ash contains most of the macro and micro plant nutrients. Satya et al. (2012) have registered that fly ash contains some toxic heavy metals along with these beneficial plant nutrients. According to Tiwari et al. (2008) fly ash contain low percentage of nitrogen and phosphorus content and pH ranges from 5.8 to 10.8 depending on sulphure content of parented coal (Jabeen and Sinha, 2012). The botanical name of Neem tree is Azadirachta indica, have a lot of benefits as direct or indirect manner to our environment and human beings. Neem leaf plays a definite role in the fixation of nitrogen in soil and increases the percentage of organic carbon and potassium also. Neam leaf acts as a conservator and checks the loss of mineral nitrogen and thus increases the effectiveness of the soil (Dhar and Mukerjee, 1936). The present work is

conducted to draw out the impact of neam leaf as the physical chemical profile of fly ash incorporated soil.

MATERIAL AND METHODS: For the laboratory experiment fly ash is collected from Chachai Thermal Power Plant, Anuppur which was air dried and grinded. Then this fly ash is mixed in soil in the ratio of 10, 15 and 20% as a one set and in the other set neem leaf 1% incorporated with same percentage of soil to observe the ameliorating effect up to 120 days at an interval of a month. The soil pH is measured by an electrical pH meter using soil suspension (1:2 soil water ratios). The specific conductivity determination is carried out at 30°C in an electrical maintained thermostat using WTW conductivity meter, type LBR, German. Organic matter is estimated according to Walkley and Black method (1934), where as nitrogen content of soil is estimated by Kjeldhal method of Jackson (1974). Potassium and phosphorus are analyzed using the method given by Mishra (1973).

RESULTS AND DISCUSSION: The physical and chemical properties of the soil and fly ash are given in table 1.The pH, specific conductivity, organic carbon, organic matter, nitrogen, phosphorus and potassium contents of soil and fly ash are 5.98 and 7.2, 21.3 and 80.4, 0.45 and 0.16, 0.72 and 0.22, 0.086 and 0.172, 0.032 and 0.16 and 1.86 and 1.98 respectively.

Variation in pH: The effect of pH to soil with flies ash alone and mixed with Neem leaf has shown in table 2 in different incubation period. The pH value of pure soil have shown an increasing order up to 120 days, experimentation at an interval of 30 days, as from 5.98 to 6.24.When it mixed with various amendment of fly ash as 10%, 15% and 20%, the value have shown increasing trends from 7.22 to 7.48, 7.24 to 7.52 and 7.32 to 7.58 respectively. While, when soil incubated with neem leaf the value of pH in different incubation periods have shown a decline trends from 5.98 to 5.48. Whereas with their incorporation in the soil fly ash and neem leaf mixture, pH declined over the days of incubation from 7.22, 7.24 and 7.32 to 7.08, 7.06 and 7.12 respectively.

The variation of pH with respect to days may be explained on the basis of the neutralization of H^+, the salts present in the soil as well as the solubility of basic metallic oxides of fly ash with the time interval. It has been registered that the less availability of micro nutrients occurs due to change in pH or higher activity of metals present in fly ash imparting toxic effect to soil. The addition of neem leaf to the sets further decreases the pH. The neem leaf has higher percentage of carbon which due to micro biological action gets converted to carbon di oxide. The CO_2 reacts with H_2O to form H_2CO_3, which increased the H^+ concentration (Waksman, 1961).

$$\text{Oxidation of Neem leaf} \longrightarrow CO_2$$
$$CO_2 + H_2O \longrightarrow H_2CO_3 \longrightarrow H^+ + HCO_3^-$$

The CO_2 converts calcium salt of the soil to $CaCO_3$, which is used by the plants (Willium and Jerry, 1952). Kumar et al. (1998) has been reported that neutral pH may be generally used in amending both acidic and alkaline soil. It has been reported by Maite et al. (2005) that fly ash generally highly alkaline due to low S content of coal and presence of hydroxide and carbonates of Ca and Mg. It has been reregistered by Jastraw et al. (1979) that addition of fly ash improves soil pH in one hand, while it simultaneously adds plant nutrients to the soil on the other hand.

Specific Conductivity: The table 3 indicates the specific conductivity of soil, which has shown an increasing order up to 120 days incubation, experimentation at an interval of 30 days without convertor. The value have seen from 21.3 to 22.9 and it changed from 85.8 to 87.2, 92.2 to 94.3 and 92.8 to 94.9 respectively in 10, 15 and 20% fly ash amended soil. Whereas with their incorporation in the soil, fly ash and Neem leaf mixture, specific conductivity increased over the days of incubation from 85.8, 92.2 and 92.8 to 87.4, 94.6 and 95.1 respectively. While the data obtained with Neem leaf alone in such incubation in a range of 21.3-23.2. The increase in conductivity is due to presence of more cations and anions in amended soil have been suggested by Kumar (2004) and Kishore et al (2009). Pitchel and hayes (1990) have also seen the similar effect during their work. Addition of Neem leaf increases specific conductivity of soil enhances the decrease in pH due to hydrogen ion activity and favorable to biological activities and there are more soluble minerals present in to it for rapid liberation of plant food.

Organic Carbon: The percentage of organic carbon with fly ash only and with mixture of fly ash and Neem leaf have reported table 4. It has been registered that with increasing fly ash concentration from 10 to 20 % the organic carbon have shown decline trend up to 120 days, while in presence of Neem leaf the value increases up to 120 days. It has been also noticed that the concentration of organic carbon decline gradually when excess amount of fly ash added, because fly ash contain low amount of organic carbon as well as higher concentration of toxic heavy metals. According to Amontte (2003) the organic matter of soil is dependent on the microbial activity of micro organism.

Nitrogen: It has been recorded that on increasing amount of fly ash up to 120 days the concentration of total nitrogen was found to be in decreasing order

(table 5), whereas with fly ash mixture it have shown an increasing trends in all incubation periods. This decline trend of nitrogen has been registered on the basis of low nitrogen content of fly ash. It has been reported by Sadashivan et al. (1993) that carbon and period due to release of gaseous nitrogen by the microbial activity (Russel 1958 and Punjwani et al. 2011).

Potassium: The present investigation showed that potassium content increased with increasing amendments of fly ash in both compositions with and without Neem leaf. It has been also documented by Basker et al. (1993).The obtained data have shown in table 6 by which it has registered that in different incubation period the potassium content increased from 1.98, 2.04 and 2.08 to 2.05, 3.08 and 3.14 with 10, 15 and 20 % fly ash accordingly, whereas with Neem leaf the values increased from 1.86 to 1.99. However with the mixture of fly ash and Neem leaf have shown different trends from 1.98, 2.05 and 2.08 to 2.11, 3.09 and 3.16 respectively with 10, 15 and 20% amendments.

Table 1: Physical and chemical parameters of soil and fly ash.

S. No.	Parameters	Soil	Fly ash
01	pH	5.98	7.2
02	Sp.Cond.10^{-5} Mhos. at 30°C	21.3	80.4
03	Organic Carbon (%)	0.45	0.16
04	Organic Matter (%)	0.72	0.22
05	Nitrogen ((%)	0.086	0.172
06	Phosphorus (%)	0.032	0.16
07	Potassium (%)	1.86	1.98

Table 2: Showing the effect of fly ash and Neem leaf on soil ph in different incubation period.

S. No.	Days / Composition	0	30	60	90	120
01	**Soil**	5.98	6.02	6.08	6.16	6.24
02	**Soil+Neem leaf**	5.98	5.82	5.74	5.62	5.48
03	**Soil+10% FA**	7.22	7.29	7.33	7.39	7.48
04	**Soil+10%FA&NL**	7.22	7.20	7.16	7.12	7.08
05	**Soil+15%FA**	7.24	7.30	7.36	7.42	7.52
06	**Soil+15%FA&NL**	7.24	7.18	7.12	7.10	7.06
07	**Soil+20%FA**	7.32	7.38	7.42	7.52	7.58
08	**Soil+20%FA&NL**	7.32	7.26	7.22	7.16	7.12

(FA=Fly ash, NL= Neem leaf)

Table 3: Showing the effect of fly ash and Neem leaf on soil specific conductivity in different incubation period.

S. No.	Days / Composition	0	30	60	90	120
01	**Soil**	21.3	21.7	22.1	22.4	22.9
02	**Soil+Neem leaf**	21.3	21.9	22.4	22.8	23.2
03	**Soil+10% FA**	85.8	86.2	86.6	86.9	87.2
04	**Soil+10%FA&NL**	85.8	86.3	86.8	87.1	87.4
05	**Soil+15%FA**	92.2	92.8	93.4	93.9	94.3
06	**Soil+15%FA&NL**	92.2	93.1	93.6	94.1	94.6
07	**Soil+20%FA**	92.8	93.4	93.9	94.3	94.9
08	**Soil+20%FA&NL**	92.8	93.5	94.1	94.5	95.1

Table 4: Showing the effect of fly ash and Neem leaf on soil organic carbon in different incubation period.

S. No.	Days / Composition	0	30	60	90	120
01	**Soil**	0.45	0.42	0.39	0.36	0.30
02	**Soil+Neem leaf**	0.45	0.47	0.50	0.53	0.56
03	**Soil+10% FA**	0.16	0.14	0.13	0.11	0.10
04	**Soil+10%FA&NL**	0.16	0.22	0.25	0.29	0.32
05	**Soil+15%FA**	0.15	0.14	0.12	0.11	0.09
06	**Soil+15%FA&NL**	0.15	0.17	0.19	0.22	0.26
07	**Soil+20%FA**	0.14	0.13	0.11	0.09	0.08
08	**Soil+20%FA&NL**	0.14	0.16	0.20	0.23	0.27

Table 5: Showing the effect of fly ash and Neem leaf on soil nitrogen in different incubation period.

S. No.	Days / Composition	0	30	60	90	120
01	**Soil**	0.086	0.078	0.071	0.064	0.058
02	**Soil+Neem leaf**	0.086	0.088	0.091	0.095	0.098
03	**Soil+10% FA**	0.072	0.070	0.067	0.064	0.057
04	**Soil+10%FA&NL**	0.172	0.175	0.179	0.182	0.186
05	**Soil+15%FA**	0.069	0.066	0.062	0.058	0.054
06	**Soil+15%FA&NL**	0.0179	0.185	0.189	0.193	0.198
07	**Soil+20%FA**	0.068	0.067	0.064	0.062	0.052
08	**Soil+20%FA&NL**	0.189	0.192	0.193	0.196	0.199

Table 6: Showing the effect of fly ash and Neem leaf on soil potassium in different incubation period.

S No.	Days / Composition	0	30	60	90	120
01	**Soil**	1.86	1.88	1.91	1.93	1.96
02	**Soil+Neem leaf**	1.86	1.90	1.94	1.96	1.99
03	**Soil+10% FA**	1.98	1.99	1.01	2.03	2.05
04	**Soil+10%FA&NL**	1.98	2.02	2.06	2.09	2.11
05	**Soil+15%FA**	2.04	2.08	3.02	3.05	3.08
06	**Soil+15%FA&NL**	2.05	2.07	3.03	3.06	3.09
07	**Soil+20%FA**	2.08	3.10	3.12	3.13	3.14
08	**Soil+20%FA&NL**	2.08	3.11	3.13	3.14	3.16

CONCLUSION: This investigation concludes that Neem leaf decrease pH value whereas the specific conductivity, organic carbon, nitrogen and potassium content enhanced. Thus it may be said that neem leaf ameliorated the nutrient profile of the fly ash amended soil and increased productivity of agricultural prospects with higher efficiency up to 20 % fly ash amended soil.

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