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RESEARCH ARTICLE

Impact of coal mine overburden leachates on pea plant growth with their quality

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ABSTRACT : The study was carried out on coalmine overburden leachate's effect on pea plant growth and also investigated the quality of leachates.The pea plant growth performance was shown in coalmine overburden leachates and growth compare with standard water. The pea plant has low growth in leachates as compared with standard water and the physico-chemical parameters *i.e.* temperature, pH, electrical conductivity, total organic carbon, total nitrogen and total phosphate of coal mine overburden leachates are higher than standard water and parameters are slightly higher than permissible limit.

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The coal mine leachates, defined as water that has percolated through the coal mine overburden (rain water or spread water) and contaminated to the surface and ground water. This is one of the source of water pollution.

Mining has a very important role for the development of civilization. Mining has occupied second position in industrial sector after agriculture. Overburden is the term used in mining to describe material that lies above the area of economic interest e.g. the rock and soil that lies above the coal seam. Overburden remove during surface mining, but is typically not contaminated with toxic components and may be used to restore the mining site to a semblance of its appearance before mining began.

The purpose of this study was to collect the information about the impact of the coal mining on water from the surrounding human community of coal basin and compare the information with the existing data for the justification of impacts of coal mining and its impacts on water with a special focus on recommendation to overcome the resulted problems.

In rainy season, internal and external overburden materials are eroded at an exchange rate. The eroded materials are deposited in nearby water bodies and nearby agricultural land, regarding to decline productivity. In open cast mining, extraction of coal follows removal and storage of overlaying rock masses in the form of dumps. The top soil and sub soil are toremoved before blasting the rock mass. This is rare practiced in Indian coal mining area (Kumar, 1997).

The impact of mining arising from the disruption of hydrological pathway, seepage of contaminated leachate into aquifers and dispersion of the water table tend to be relatively localized and limited compared to dispersal of mining water (Younger *et al.*, 2004). Disposal of mining water is worldwide problem, occurring operating mines, both

underground and opencast working are found (Pulles *et al*., 1995).

The problems caused by mining activities are land degradation, disposal of over burden, deforestation, washing rejects, subsidence, water pollution due to wash off, discharge of mine water, acid mine drainage, coal washing operation, air pollution due to release of gases and dust, noise pollution, mine fires, damage to forest flora and fauna, wildlife habitat destruction and occupational health hazards (Singh *et al*., 2011 and Ahanger *et al*., 2014)

Mining is widely regarded as having adverse effects on environment of both magnitude and diversity. Some of these effects include erosion, formation of sinkhole, biodiversity loss and contamination of groundwater by chemical from the mining process in general and open pit mining in particular (Gupta and Kumar, 2016).

The background of the study area is it has several coal mines overburden leachates spread in small and large rivers or nalas which are used for the domestic and agricultural purpose like washing of clothes and animals. The leachates of overburden generated from open and underground mining activity in huge quantities and disturbing the natural quality of terrestrial and aquatic ecosystem.

Coal mine overburden leachates are generated during coal cleaning activities and frequently generate large area of potentially acidic waste disposal fills (Stewart and Daniels, 1992).

EXPERIMENTAL METHODOLOGY

Assessment of study on impact of coal mine overburden leachates on pea plant growth with its quality and through the quality characterization and morphological changes in pea plant and its comparison with standard water on lab scale.

Collection of sample:

Leachates sample was collected from streams of coal mine overburden hills after rainy season. This coal mine overburden leachates sample was filtered in laboratory, after that sample directly used for analysis and for pea plant growth.

Plantation in green house:

Seeds was sown in the pots containing native forest soil in well-established greenhouse. Pea plant were selected for plant growth monitoring in coal mine overburden leachates and in standard water. Total six pots were used for monitoring plant growth of pea plant. All six pots were filled with forest soil sample. In green house, temperature, humidity, etc.was maintained. The *Pisum sativum* (Green pea) were planted in December, 2016 (winter season) for three months. Every 7 days time interval monitored the plant growth for three month in laboratory. The coal mine overburden sample and standard water quality were analyzed before sowing the pea plant seeds. The temperature, pH, electrical conductivity, total organic carbon, total phosphate and total nitrogen of coal mine overburden leachates and standard water was analyzed according to standard method of NEERI manual (1987) and Trivedy and Goel (1984).

EXPERIMENTAL FINDINGS AND DISCUSSION

The data obtained after analysis of coal mine overburden leachates and standard water sample and that is used for seed sowing of pea plant and for three month growth of plant.

Physico-chemical analysis:

The temperature of coal mine overburden leachates sample at sampling time was found to be 31^0C and standard water sample was found to be 29^0C. pH of coal mine overburden leachates sample at sampling time was found to be 9.5 and standard water sample was found to be 7.2. Electrical conductivity of coal mine overburden leachates sample at sampling time was found to be 0.798 millimhos/cm and standard water sample was found to be 0.245 millimhos/cm.These results reflect that the pH of all the four samples of leachates is slightly acidic in nature. It is generally observed within the permissible limits as per the IS: 2490. There were not very much variation in conductivity in all the four samples (Table 1).

Fertility status of coal mine overburden leachates sample was found to be *i.e.* total organic carbon is 15.8 mg/l, total nitrogen is 72.2 mg/l and total phosphate is 112 µg/l. The fertility status of standard water *i.e.* total organic carbon is 10.1 mg/l, total nitrogen is 49.9 mg/l and total phosphate is 69.6 µg/l, respectively.

Plant growth performance:

The pea plant grown with use of coalmine

Table 1: Physico-chemical characteristics

Parameters	Coal mine overburden leachates sample	Standard water sample
Temperature (^{0}C)	31	29
pH	9.5	7.2
Electrical conductivity (millimhos/cm)	0.798	0.245
Total organic carbon (mg/l)	15.8	10.1
Total nitrogen (mg/l)	72.2	49.6
Total phosphate (µg/l)	112.2	69.6

Table 2 : Pea plant growth performance (every 7 days time intervals)

Time interval (Weakly)	Coal mine overburden leachates sample (height in inches)	Standard water sample (height in inches)
7th day	02	03
14th day	05	07
21st day	07	09
28th day	10	12
35th day	13	15
42nd day	16	17
49th Day	18	19
56th day	19	21
63rd day	20	23
70th day	21	24
77th day	22	27
84th day	24	29
91st day	25	32

Table 3: Morphological characters of pea plant growth

Morphological characteristics		Coal mine overburden leachates	Standard water
Leaf	Colour	Yellow	Yellow
	Hairiness	Absent	Absent
	Shape	Round	Round
	Petiole pigmentation	Light yellow	Light yellow
Stem	Colour	Whitish green	Whitish green
	Type	Semi erect	Semi erect
	Hairiness	Absent	Absent
	Pigmentation	Whitish green	Whitish green
Root	Type	Tap root	Tap root
Plant	Height	25 inches	32 inches
	Growth habit	Semi determinate	Semi determinate
	Flowering time	No flowering	36-39 days
Fruit	Colour	Absent	Absent
	Shape	Absent	Absent
	Surface	Absent	Absent

overburden leachates sample instead of water, full plant height after three month was 25 inches and in standard water means normal water full plant height after three month was 32 inches shown in Table 2.

Morphological characteristics:

The morphological characteristic of plant growth were analyzed with the help of *Pisum sativum* (Garden pea plant) in coal mine overburden leachates and standard water upto three months duration observations and results are showed in Table 3. It was observed that, pea plant was not conducive to the growth in coal mine overburden leachates however, it was give some response in standard water sample. During the study period, fruiting was not observed in the plants.

Conclusion:

On the basis of the study of the leachates samples of coal mine overburden materials the following conclusions are drawn: The pea plant growth performance in the coal mine overburden leachates has low as compared to standard water. The parameter like total organic carbon and total nitrogen found to be 15.8 mg/l and 72.2 mg/l in coal mine overburden leachates but the agricultural science says, due to higher concentration of organic carbon and nitrogen, the plants grow higher or more but they also says that the organic carbon and nitrogen having specific in amount to plant growth.

The coal mine overburden leachates has very harmful to natural water bodies and create water pollution. But that leachates is not harmful to plant growth, that causes little bit effect as per IS: 2490. Before use of leachates to plantation or irrigation purpose, that can be treated, due to that the contaminant war removed.

The self-purification process of water bodies can also minimized the contaminant load which can come from coal mine overburden leachates and purify the contaminated running water bodies after some kilometers.

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