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Soil and Water Quality Monitoring in Opencast Mines

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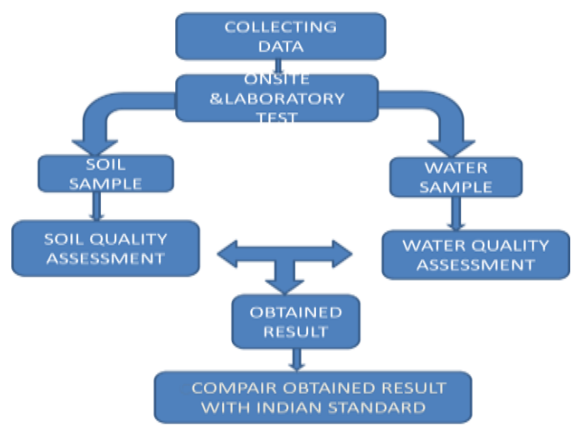
Abstract:Opencastmininghasanumberofnegativeeffectsontheenvironment.Itisoneof thecharacteristics of the environment that has the greatest impact on the soil and water. As a result,estimating the quality of soil and water is critical for properly assessing the associated risks. Asubstantial degree of environmental degradation and ecological damage to soil and water occurs as a result of a lack of effective planning and regulatory carelessness. The mines are where thesoil samples are taken. pH, organic carbon, soil nitrogen, calcium, magnesium, potassium, and sulphur are some of the soil characteristics that are examined.The mines are where the watersamples are taken. The determination of turbidity, conductivity, solids, iron, chromium content,pH, hardness, ammonia, nitrate, sulphate, phenol, fluoride, phosphate, and organic parameters of importance such as Dissolved oxygen, Bio-chemical Oxygen Demand, and Chemical OxygenDemandwereamongthephysical,chemical, metallic,andorganicparametersfound.Itisadvised that the industry, the State Contamination Control Board, and the government takeadequate steps to prevent soil and water pollution. Implementing the indicated preventive steps can be quite beneficial.

I. INTRODUCTION

Opencast mining harms the environmentin a variety of ways. It is one of the characteristics of the environment that has the greatest negative impacton the soil and water.Asaresult,estimating the quality of soil and water is critical for effective risk assessment. A significantamount of environmental deterioration and ecological damage has occurred as a resultof a lackofeffectiveplanningandregulatoryneglect.Becauseopencastminingactivitiesalterthesurrounding environmentby exposing previouslyundisturbed earthen materials,soil qualitymonitoringis critical.Exposed soils,extracted mineral ores, tailings,andfine debrisin wasterock heaps can all cause significant sediment loading in surface waters and drainage ways. Inaddition, hazardous substance spills and leaks, as well as the deposition of polluted wind blown dust, can contaminate the soil.



II. SOILQUALITYASSESSMENT

To monitor the top soil in the opencast mine, we must first collect and prepare the sampleaccording to the procedures outlined above.We proceed to

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the tests once all of the samples are ready for testing. Or lab soil testing kit is used to perform a soil quality test. Here's what we'll look at for the following parameters:

Fig1 Or lab Soil Testing Kit

SoilpH

The pH scale is used to determine whether something is acidic or basic. The pH of soil canrange from 3.5 to 11.0, although plants thrive in the range of 5.0 to 8.5. Some nutrients can reachdangerous levels in low pH (acidic) soils, and soil microbial activity is severely reduced. Soilswith a high pH (alkaline) have a lower availability of micronutrients, and some levels may beinsufficient.

SoilOrganicCarbon

Organic carbon plays an important role in determining biological activity and soil fertility. InIndia, the organic carbon content of the soil is relatively low, necessitating the use of manure.Soil organic carbon concentration of 1.5 to2.0 percentincreases soil porosity, which is thoughttopromotesoilmicroorganismgrowth.

SoilNitrateNitrogen (NO3)

In the organic matter (humus) component, more than 90% of the nitrogen in the soil is found incomplex combinations. After being broken

down into simple forms and then mineralized, itbecomesavailabletocrops.Biologicaltransformationsarethemostcommonsortoftransformation. As a result, procedures involving the identification of mineral forms of nitrogen,suchas NH4-NandN03-N,areused.

SoilAmmoniumNitrogen (NH4-N)

FordeterminationofAmmonium,Nessler'sreagentisemployed,whichisanalkalinesolutionof Mercury (II)IodideinPotassiumIodide.Whenareactionoccursbetweenthereleased ammonia and the reagent, Nessler's reagentis added toa solution of ammonium salt.The ammonium nitrogen (NH4-N) content of the orange brown product generated is determinedbycomparingittothe colourchart.

SoilCalcium

The key to productive plant nutrition is soil biological life, and that biological life has a strongneed for calcium. The beneficial biology of the soil complex is aerobic by nature and respondswell to the soil complex's porosity, which is provided by the calcium cation's flocculation of theexchange complex. In addition, soil biology relies substantially on accessible calcium in the soiltomeettheirbiologicaldemands.

SoilMagnesium

For agricultural purposes, magnesium is a component of various main and secondary minerals inthesoil,allof whicharevirtuallyinsoluble.Thesearetheoriginalsourcesofsolubleoraccessible Mg. Magnesium can also be found in ionic form (Mg^{++}) adhering to the soil colloidal complex incomparatively soluble forms.Crops can use the ionic form.

III. WATER QUALITY ASSESSMENT

The physical, chemical, and biological qualities of water are referred to as water quality. Thesefeatures are determined in the current study using rules established by the Bureau of IndianStandardsandtheCentralPollutionControlBoard(CPCB).

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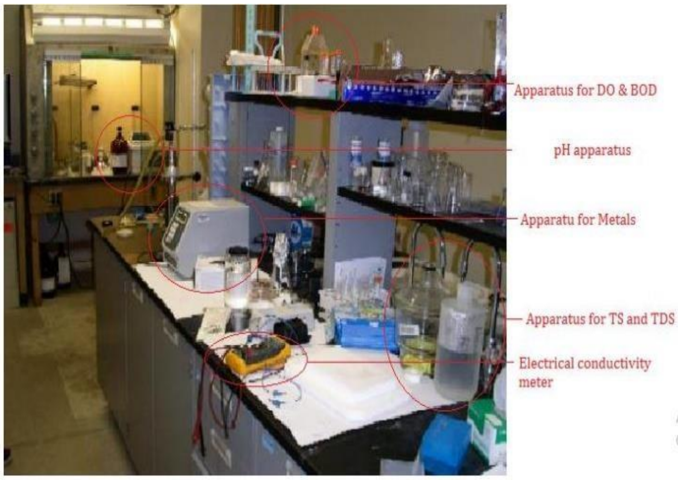

Fig2 Water Quality Monitoring Instruments

pH

The electromotive force (EMF) of a cell containing an indicator immersed in test solution and areference electrode is used to detect the pH. (usually a calomel electrode). The liquid junction,which is part of the reference electrode, is used to make contact. A pH metre is used to determinethe cell's EMF.Because pHismeasured on a potentiometric scale,thisinstrumentis alsopotentiometricallycalibratedwithanindicatingelectrodeandareferenceelectrodeusingstandardbuffers withapHvalueof5.5-7.

Electrical Conductivity

The conductance created by various ions in the solution was measured using this method. Bymultiplyingspecificconductance(inmS/cm)byanempiricalfactorthatvariesbetween0.55and 0.90dependingonthesolublecomponentsofwateranddthetemperatureofmeasurement,aroughestimateof dissolvedioniccontentsofa watersample canbemade.

Total Solids

The term "solid" refers to the substance that remains as residue after evaporation and subsequentdrying at a specific temperature, whether it is filterable or not. Consumers have an adverse physiological reaction to water with high dissolved solids. Many industrial applications are also incompatible with it. High suspended particles in water might be unappealing to the eye. Totalsolids analysis is critical for determining which unit operations and procedures to use in physical and biological waste water treatment.

Total Dissolved Solids

The material that passes through a conventional glass filter disc and remains after evaporationanddryingat180°Cis knownas thefilterableresidue.

Suspended Solids Total

The total dissolved solids are subtracted from the total solid sto arrive at this figure.

DissolvedOxygen

The oxygen content of any water body is referred to as dissolved oxygen. This is essential for thesurvival of all aquatic species. As a result, the DO level aids in determining the quality of rawwaterandpreventingcontamination.

Chemical Oxygen Demand

With the use of a strong chemical oxidant, the Chemical Oxygen Demand (COD) test Evaluates the oxygen requirement equivalent of organic matter that is vulnerable to oxidation. It is acritical, quickly measurable characteristic that can be used to determine the organic strength ofstreams and polluted water bodies. With its limits in mind, the test can be empirically linked toBOD, organic carbon, or organic matter in samples from a given source. This test is simple,accurate,andquick.

Hardness

Water hardness is a classic indicator of a liquid's ability to precipitate soap. Dissolved polyvalentmetallicions are to blame.Calcium and magnesium,which precipitate soap in fresh water, arethemainhardness-causingions.The sum of calcium and magnesium concentrations,both reportedas CaCO3,inmg/L,is referred toastotal hardness.

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NitrateContent

The most oxidised form of nitrogen molecules found in natural waterways is nitrate. Chemicalfertilisers, rotting vegetable and animal matter, home effluents, sewage sludge disposal to land,industrialdischarge,trashdumpleachates,andatmosphericwashoutareallmajornitratesources.Thoughitcanbefoundinvarioustypesofwaterbodies,becauseofitsorganicorigin,itsconcentrationmaybehigherinlocationsnearcoalmines.

Determination ofMetals

Theatomicabsorptionspectrometricmethod,thephenanthrolinemethod,andthetitrationmethodcanallbeusedtodetectthemetalcontentofwater.AtomicAbsorption Spectrophotometry (AAS)is the mostsensitive, quick, andmodern technology among them.This approach has a high level of accuracy. As a result, AAS is utilised in this study to determinemetals.

IV. RESULTS

Results of Soil Quality Monitoring:

The following table shows the pH, Organic Carbon, Nitrate and Ammonium Nitrogen, Calcium, Magnesium, Potassium, and Sulphur values obtained:

Table1SoilQualityMonitoringResultsofSample

PARAMETRERS	S1	S2	S3	S4	Limits
pH	5	5.5	5.5	6	6-8
Organic Carbon	<0.5%	<0.5%	<0.5%	<0.5%	0.5-1%
Nitrate Nitrogen (Kg/Hec.)	0	0	0 - 280	0 - 280	280
Ammonium Nitrogen (Kg/Hec.)	17	17	15	13	-
Calcium(meq/100gm)	15	20	15	15	-
Magnesium (meq/100gm)	0	5	5	10	-
Available Potassium (Kg/Hec.)	<150	<150	<150	<150	150-300
Available Sulphur (Kg/Hec.)	22.4	22.4	33.6	22.4	40

Table2 Soil Quality Monitoring Results

PARAMETERS	S5	S6	S7	S8	Limits
pH	5	5.5	6.5	6	6-8
Organic Carbon	<0.5%	<0.5%	0.5-1%	<0.5%	0.5-1%
Nitrate Nitrogen (Kg/Hec.)	0	0	>280	0	280
Ammonium Nitrogen (Kg/Hec.)	17	17	17	23	-
Calcium (meq/100gm)	10	15	10	5	-
Magnesium (meq/100gm)	0	5	10	0	-
Available Potassium (Kg/Hec.)	<150	<150	<150	<150	150-300
Available Sulphur (Kg/Hec.)	22.4	33.6	44.8	33.6	40

Results of Water Quality Monitoring:

The water quality monitoring results are listed below.

Table3 WaterQualityMonitoringResults

PARAMETERS	W1	W2	W3	W4	STANDARD (IS:10500) 1991	Max value effluent (IS:1069) 1993
pH	7.17	7.43	7.68	8.17	6.5-8.5	5.5-9
E.C. (Ms/Cm)	136	192	199	200	300	-
DO (Mg/L)	6.64	6.47	6.72	7.1	5	5
COD(Mg/L)	115.2	114.04	114.44	113.86	250	250
TDS(Mg/L)	433	471	422	384	2000	2100
Total Suspended Solids	76	72	74	69	100	100
Hardness (Mg/L)	158	157	159	154	300	600
Tubidity (Ntu)	26	23	32	27	10	10
Alkalinity (Mg/L)	138	136	142	131	200	500
Chloride (Mg/L)	94.4	92.38	56	50.4	250	1000
Nitrate (Mg/L)	5	4.65	3.39	3.25	10	10
Sulphate (Mg/L)	74.2	72.87	67.26	62.25	150	400
Calcium (Mg/L)	102	101	98	100	75	-
Magnesium (Mg/L)	56	56	61	54	30	-

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Sodium (Mg/L)	15.35	17.25	12.64	17.21	-	-
Potasium (Mg/L)	1.42	1.32	1.01	1.64	-	-
Iron (Mg/L)	0.27	0.23	0.37	0.16	1	3
Copper (Mg/L)	NIL	NIL	NIL	NIL	0.05	1.5
Manganese (Mg/L)	NIL	NIL	NIL	NIL	0.1	0.3
Lead (Mg/L)	NIL	NIL	NIL	NIL	0.5	0.1
Zinc (Mg/L)	NIL	NIL	NIL	NIL	5	15

V. CONCLUSION

The maximum permitted limit was comparedto soil samples from the iron ore mines. The majority of the metrics in the samples were either extremely low or extremely high in comparison to the standards. All of the water samples were analyzed, and it was discovered thatthe water quality is good, with only a few parameters such as turbidity (23-32 NTU), calcium(98-102 mg/L), magnesium, and hardness (54-61 mg/L) slightly exceeding the permissible value,indicating that it is not harmful to human health. When all of the soil and water parameters arecompared, the soil is found to be more polluted than the water. As a result, it is proposed that mines take necessary measures tocontrol soil and water pollution. Ascertain that the State Pollution Control Board and the government collaborate to prevent soil and water pollution in mines, and those Indian requirements are followed.

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