Study On Leachate And Its Effects On Soil Properties

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Abstract:
The resources of earth are supporting the man kind , but various actions of man increases the generation of waste causing a huge solid waste , presently which is a third pollution in world –wide . The gradual decomposition of solid waste , includes various bye-products and soluble materials like nutrients , pesticides ,chemicals are leaching into the soil and causing a soil pollution as well as ground water pollution .The leaching liquid known as Leachate, percolates into the layers of soil and effects the Various Geo-technical properties. The study confines to identify the effects of the leachate on soil properties and also to study the variations in treating the leachate by Recirculation method to decrease the concentrations levels. By collecting the waste, an artificial dump yard is created and water is added to the waste for formation of leachate. A setup is made, the leachate is treated by one of the Leachate treatment methods the method of recirculation. Leachate is collected and parameters pH, BOD, COD, Alkalinity ,Sulphates, Nitrates, Conductivity, Total hardness, Total Dissolved Solids, Total Suspended Solids, Chlorides of leachate are tested in before and after the recirculation process. The soil property at the site was observed before and after leachate formation. Also the recirculated leachate is sprinkled in the site, soil properties was tested. For soil engineering properties, geo-synthetics like geo-membranes can be used at the dumping site to reduce the effect of leachate on soil properties.

Keywords : Solid Waste, Leachate , Recirculation ,Soil Properties ,Geo-membranes

1. Introduction :
The generation of solid waste shows a considerable variations in urban and small towns . An average of 450 grams of waste will be generated per person per day . In urban places , with all modern facilities an average percapita of 650 grams will be generated . Some types of waste are consisting of materials which can decompose with the available moisture and rainfall like food waste, paper, chemicals etc. Utilization of open lands or Dumping of Municipal solid waste is a major concern. Expanding city lines increases for the outlook of land availability Rapid development of the city outskirts and scarcity of land in the city creating the issue of dump yard stations and also reclaiming the dumpsite for future development like constructing the buildings. Open dump yards and Landfills are the conventional methods for solid waste disposal where large area of open –spaces are available. Landfilling method is causing environmental problems such as odorous smell, infectious vectors, leachate pollution etc .Leachate is a liquid, arises from the municipal solid waste
decomposition process and percolates into ground water and causes ground water pollution. Leachate percolation, the impurities present in the Leachate Liquid causing a potential threat by affecting the quality of ground water and also causes soil pollution, some effects in the properties of soil. This changes effects the constructing activities, like load carrying capacity of the soil, causing increasing the cost of Construction with applying different remedies. The present study observes the variations in leachate characterization and treated the Leachate by recycling or recirculation method.

2. Methodology:
The study was conducted by collecting the waste from municipal waste dump and prepared a artificial dump yard, to study the Leachate and soil properties before and after the generation of Leachate. The available soil at the site is murram soil, two artificial dumping yards were created. Each pit is of 1.5 X1.5 m. The pit is dug at a depth of 15 cm. One pit is left simply and on the other geomembrane is laid. In each pit around 50 kg of waste is placed. Based on rainfall data in the study location, water is poured. Daily 3 liters of water is poured into the two dumping yards. The 3 litres of water was decided based on the rainfall data at the selected site. This process is continued for 14 days. Before, the soil properties of the fresh soil are tested and values are noted. After 14 days, the leachate will be formed and soil properties are tested for both the pits by removing the waste from it. The values obtained from tests are noted. Also the soil properties was tested collecting the soil sample where the Leachate percolation is done in the soil sample.

2.1 Artificial leachate formation
- Artificial leachate is prepared by an experimental setup. This setup consists of
  - Pipe - length (2m), diameter (16cm)
  - Dummy
  - Stand
  - Collecting tubs
  - Coarse aggregates

A layer of coarse aggregate was laid at the top and bottom of solid waste to retain suspended solids to pass through. The pipe is held in vertical position with the help of stand. Water is added to waste of 1 litre per day for 14 days to generate the leachate. The leachate produced after adding of water for 14 days is 9 litres. 2 litres of leachate is taken separately for testing the parameters of leachate. Remaining 7 litres is taken for recirculation. In re-circulation
process fresh leachate is added into the pipe column of 1 litre per day for a week. Here, the fresh leachate reacts with the waste present in the pipe. The leachate produced after recirculation process is of 4.5 litres. 1 litre is taken for tests and remaining is poured on to the fresh soil at the study area. Then the soil properties are tested after pouring of recirculated leachate on to the study area. All values are noted and calculated.

2.2 GEOMEMBRANE
A geomembrane is very low permeability synthetic membrane liner used to arrest the movement of the fluid in a material. Geomembrane are made from relatively thin continuous polymeric sheet. It acts as a barrier between the any two layers. The Lifetime of the Geo-Membranes in landfill can be approximately used for about 25 years. The different Geo-membranes is having different life times in usage.
Specifications:
- Gsm-150 (gram per square metre)
- Smooth surface
- Thickness – 2.5mm
- Impermeable
- Longevity (30 years)

Characteristics:
- Low biological degradation
- High resistance to chemicals
- High impact resistance
- High tear resistance
- High Interface Shear strength

2.3 Tests Performed on soil and Leachate

The following are the tests performed on the soil:
- California Bearing Ratio test
- Direct shear test
- Permeability test

California Bearing Ratio Test:
To evaluate the strength of below sub-layers of the soil, this test is conducted. The CBR is a measure of resistance of a material with respect to the load.

Direct Shear Test:
To identify the shear strength of the soil properties and is a function of Normal load, angle of friction which determines the interlocking between the soil particles.

Permeability Test:

Constant Head Method:
The test was done to determine the permeability Nature of the soil, to calculate the Discharge in a given time.

Presently this test was conducted to known the rate of movement of Leachate into the soil.

The Various tests conducted on to study the Characteristics of Leachate
- pH
- BOD
- COD
- Alkalinity
- Sulphates
- Nitrates
3. Results And Observations
The soil samples was collected and tested before the formation of dump yard, after the formation of leachate and with recirculated leachate. The different tests were conducted on freshly formed leachate and recirculated leachate. The rate of generation of Leachate in recirculation was observed as decreased by 15 ml

| Tests                  | Fresh soil | Soil sample after formation of leachate without geomembrane | Soil sample after formation of leachate with geomembrane | Soil sample with recirculated leachate |
|------------------------|------------|------------------------------------------------------------|--------------------------------------------------------|--------------------------------------|
| Direct shear test      | cohesion=30| cohesion=75                                                | cohesion=50                                            | cohesion=45                          |
|                        | Angle of internal friction=10.42° | Angle of internal friction=2.1° | Angle of internal friction=8.75° | Angle of internal friction=3.9° |
| Permeability           | 0.089mm/sec | 0.08mm/sec                                                | 0.085mm/sec                                            | 0.083mm/sec                          |
| CBR test               | 20.56%     | 10.6%                                                     | 16.78%                                                 | 12.09%                               |

Table 2: The following are the Tests conducted on Leachate

| Tests                | Fresh leachate | Recirculated leachate |
|----------------------|----------------|-----------------------|
| pH                   | 6.5            | 7.48                  |
| Conductivity         | 6.59           | 7.49                  |
| TDS                  | 10208 mg/l     | 8964 mg/l             |
| TSS                  | 56 mg/l        | 45 mg/l               |
| Chlorides            | 282 mg/l       | 220 mg/l              |
| Alkalinity           | 3926 mg/l      | 2897 mg/l             |
| BOD                  | 1023 mg/l      | 912 mg/l              |
| COD                  | 3223 mg/l      | 2987 mg/l             |
| Sulphates            | 120 mg/l       | 90 mg/l               |
| Nitrates             | 35.2 mg/l      | 29.6 mg/l             |

4. Conclusions:
1) The recirculated leachate parameters such as Alkalinity, Nitrates, Chlorides etc, are decreased as compared with fresh leachate.
2) By leachate recirculation process the effects of landfill leachate can be decreased.
3) As compared with fresh soil properties and dumping yard, the parameters like shearing strength, permeability is decreased by different percentages with leachate percolation process.
4) Usage of geo-membrane at the dumping yard site does not show any decrease in the soil characteristics and it will be as same as with fresh land.

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