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# IMPROVE THE PHYSICAL PROPERTIES OF SOIL BY USING MINING WASTE MATERIAL

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**Abstract -** *Waste is coming out from the mining site which is a big problem. Because mining waste has a huge impact on the environment and humans, we did some research, testing, and even comparison. Mining has covered an area of 34 hectares. Every year 50lakh cubic/m of waste is extracted from mining and there is no solution for it and man-made mountains are being created. For this, we also researched it to check some of its properties. And, we also surveyed the mining site from which we found out how much waste is being generated. The experiment conducted in this project specific gravity, water contain determination, plastic limit, liquid limit, and Proctor compaction test. The project aims to increase the strength of mining waste by using black soil.*

***Key Words***: Mining Waste, Cost reduction, reduction of building material, transition filling material.

## 1. INTRODUCTION

The waste in the opened hand area creates nuisance and environmental pollution. The scarcity of usable land, to major environmental problems all over the world is the production and accumulation of water. The minerals of mines are usable to store dumps due to damage collection of substances is rejected and overburdened. There are 316 mining dumps spread across the mining active region of the state. The material that must be removed to get admittance to the mineral resources. Mining in India meets the mineral requirements of various industries. We will understand that the mining waste that comes out is dumped, then it causes environmental impact erosion loss of biodiversity, and contamination of soil. We took the soil sample and tested the mining sample and after adding mining to it, our result was safe. Mining waste can be composed of sedimentary, metamorphic, or igneous materials ranging from fine particles to boulders. Mining activities have a widespread negative impact on the environment, particularly on soil. Research on mining waste has increased by almost 40%, focusing on waste management practices. Studies have highlighted the detrimental effects of mining waste on the environment, as well as on social and economic factors.

## 2. LITERATURE REVIEW

**1. N. Shahid1, S. Amardeep2,** Mine waste from the Rajpura-Dariba mine in Udaipur has varied sizes. Test the different soil classification specific gravity ranges from 2.90 to 2.96 due to zinc and lead. Proctor dry density ranges from 2.01 to 2.15 g/cc, indicating good density.

**2. Punith H B1, Sudhakara H N2, Dristi3, Thejas Shankar C P4, Supriya M J**, Replacing 20% of black cotton soil with mine tailing significantly enhances properties like maximum dry density and optimum moisture content lime addition slightly reduces maximum dry unit weight due to soil-lime interaction. Both mine tailing and lime improve soil stability.

**3. S.Mabroam[1],S.Mookanna[2],A.El. Machi[3], Y. Taha, M. Benzaazoua, R. Hakkou,** Research focuses on synthesizing geo-polymers from mine waste, considering reduction and mechanical properties geo-polymerization offers promising waste management, reducing environmental impact.

**4. Pauline segai[1], Amine el Mahdi safhi[2], Mustapha Amrani[3], & Mustapha Benzaazoua,** The paper reviews mine by product for road construction, emphasizing their potential as aggregate with treatment mining industry prioritize eco-friendly practice sustainable management of mine waste crucial.

**5. S, Sing[1], L. B. Sukla[2], S. K. Goyal[3],** India's mineral wealth can boost GDP, our research demonstrates the recovery of pure iron oxide, aiding in sustainable mining operations.

## 3. METHODOLOGY

**a. Site Visit**
**b. Problem Identification**
**c. Collection of material**
**d. Testing**

### A. SITE VISIT

We visited two types of mining sites and learned some information.

**1. Dongari Buzurg Mining (Open cast mining)**
The Dongri Buzurg mine located in the Bhandara district of Maharashtra is the largest opencast mine in Maharashtra. The Dongri Buzurg mine produces manganese dioxide for use by the dry battery industry. The area of the Dongri Buzurg mine is spread over 34 hectares. 50 lakhcumic/m of waste is extracted every year from the open-cast mine. Waste material is not used for any other purpose.


Fig: 1. Dongri Buzurg Mine.

**2. Gumgaon Mine (Underground Mine)**

Gumgaon Mine is an underground mine located in Saver Tehsil of Maharashtra. The proposed manganese ore production is 1, 02,000 Tone's (TPA) ROM. The area of Gumgaon Mine is spread over 126.84Ha. The region has good deposits of Manganese and has major demand in the Steel Industry. Gumgaon mine is safe for the environment and human health.


Fig: 2. Gumgaon Mine

### B. PROBLEM IDENTIFICATION

Mining waste material, which has no alternative use, requires the acquisition of ortho land for dumping. As a result, trees suffer damage due to poor soil quality, inhibiting their proper growth and increasing environmental degradation. This highlights the urgent need for sustainable waste management practices to reduce adverse ecological impacts. Because, of the waste material some environmental problems are observed:

- Climate Changes.
- Deforestation.
- Habitat destruction.
- Pollution.

### C. COLLECTION OF MATERIAL.

We collected three types of samples as follows:

- Collecting mining waste material.
- Collecting Soil Samples.
- Collecting Murum of Sample.

**D. TESTING.**

Here are some methods we used for testing:

- 1. Determine Specific gravity.
- 2. Determine the Water contains determination.
- 3. Determine Atterberg limit.
- 4. Determine the Proctor Compaction.

**1. Determine Specific gravity**

**• Use by Pycnometer Process.**

Specific gravity is the ratio of density of fluid & density of water. The procedure to calculate specific gravity is given below:

**Procedure:**

1. Weigh the empty and clean pycnometer (W1).
2. Fill the pycnometer with distilled water up to the graduation mark.
3. Weigh a pycnometer filled with distilled water (W2).
4. Empty and dry the pycnometer.
5. Weigh around 100 grams of soil material.
6. Use the funnel to carefully place the soil into the pycnometer and weigh it (W3).
7. Fill around 2/3 of the pycnometer with distilled water.
8. Use a vacuum pump to remove all the bubbles from the water. Remove the vacuum, clean and dry the flask, and add distilled water up to the mark.
9. Weigh of the Pycnometer (W4).

**Formula:**

Specific gravity Gs' Calculate as:

$$\textbf{Specific Gravity (Gs)} = \frac{(W2 - W1)}{(W2-W1)-(W3-W4)}$$

Table: 1

| Specific gravity | Soil Sample1 | Soil Sample2 | Only Mining | Soil + Sample1 | Soil + Sample2 | Murum |
|---|---|---|---|---|---|---|
| Reading | 2.03 | 2.64 | 3.04 | 2.04 | 2.26 | 2.29 |

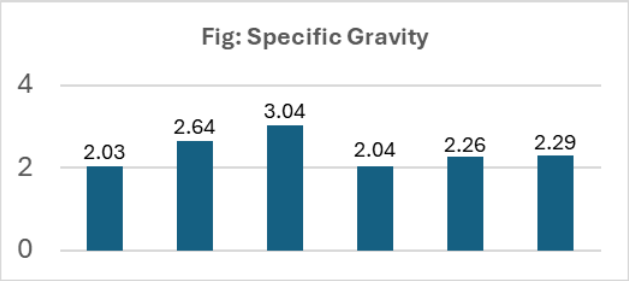




Fig: 3. Specific gravity

**2. Determine Water Contain Determination**

**• Use by Oven Dry Method**

The oven-dry method is the simplest and most accurate method. The procedure to calculate Water contain determination is given below.

**Procedure:**

1. Weigh empty containers with lid (W1).
2. Weigh containers with a lid and soil sample (W2).
3. Weigh around 50 grams of soil material.
4. Keep the container in the oven with the lid removed (W3).
5. Keep it for at least 24 hours & keep its temperature between 60ºc and 80ºc.

**Formula:**

Water contain determination calculate as:

$$\textbf{Moisture Water content} = \frac{W2 - W3}{W3 - W1} \times 100$$

Table: 2

| Water Contain. | Soil Sample1 | Soil Sample2 | Only Mining | Soil + Sample1 | Soil + Sample2 | Murum |
|---|---|---|---|---|---|---|
| Reading | 12.78 | 12.8 | 15.06 | 9.97 | 11.58 | 19.84 |

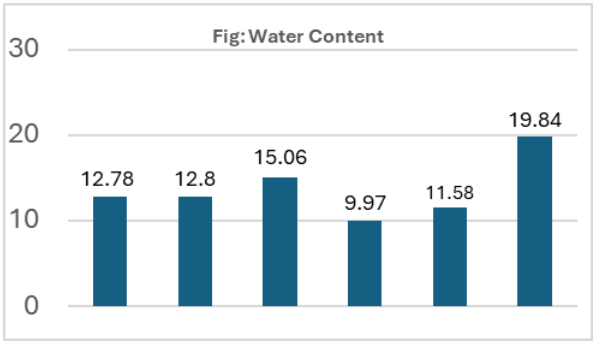



Fig: 4. Oven dry

### 3. Determine Atterberg limit

**• Liquid Limit.**

Casagrande method, the amount of water in the soil that can be dissolved by giving 25 blows. When the soil is spread per 12 mm, that amount of water is called liquid limit. Different soil has different amount of water per liquid limit. The procedure to calculate Liquid limit is given below:

**Procedure:**

1. Take the soil sample and passing through the 420-micron sieve.
2. Mix it thoroughly with distilled water to form a uniform pest.
3. Place a portion of the pest in the cap of the liquid device. Smoothen the surface with the spatula to a maximum depth of 1cm.
4. Draw the growing tool through the sample along the symmetric axis of the cup holding the tool perpendicular to the cup.
5. Forming the group of soil samples. Two revolutions per second and the count blows till the two ends come in contact.
6. Take the empty weight of the container (W1).
7. Put 50 grams of soil in the container and weight (W2).
8. Keep it in the oven for 24 hours for the determination (W3) mass i.e. mass of dry soil sample.

**Formula:**

Liquid limit is calculated as:

$$\textbf{Water content} = \frac{W2 - W3}{W3 - W1} \times 100$$

Table: 3

| Liquid Limit. | Soil Sample1 | Soil Sample2 | Only Mining | Soil + Sample1 | Soil + Sample2 | Murum |
|---|---|---|---|---|---|---|
| Reading | 12.76 | 18.10 | 18.35 | 22.44 | 23.42 | 24.34 |

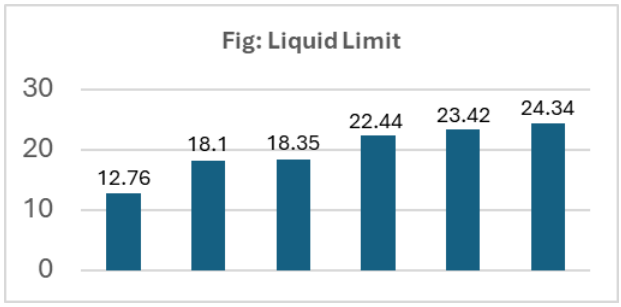




Fig: 5.Liquid limit

**• Plastic Limit.**

The plastic limit test is a standard soil test used to determine the plastic limit of a soil sample. It helps in identifying the moisture content at which soil transitions from a plastic to a semi-solid state. The procedure to calculate the plastic limit is given below:

**Procedure:**

1. Take the soil sample and passing through the 420-micron sieve.
2. Mix it thoroughly with distilled water on the glass plate.
3. Take about 10 grams of plastic soil mass and roll it in the form of thread using the path and glass plate.
4. If the diameter of the thread becomes less than 3mm without crack, it shows that water added in the soil more than the plastic limit. Hence the soil needs to be rolled into a thread again.
5. It shows a sign of cracks repeat the rolling and remolding process until the thread just crumbling at a distance of 3mm.
6. Take the empty weight of the container (W1).
7. Collect the crumbled soil thread a container & weight it (W20).
8. Keep it in the oven for 24 hours for the determination (W3) mass i.e. mass of dry soil sample.

**Formula:**

Plastic Limit calculate as:

$$\textbf{Water content} = \frac{W2 - W3}{W3 - W1} \times 100$$

| Plastic Limit. | Soil Sample1 | Soil Sample2 | Only Mining | Soil + Sample1 | Soil + Sample2 | Murum |
|---|---|---|---|---|---|---|
| Reading | 27.46 | 26 | 33.18 | 28.58 | 30.99 | 30.75 |

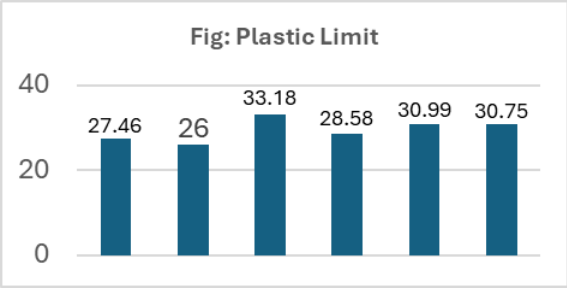




Fig: 6. Plastic limit

**4. Determine the proctor compaction.**

Compaction is the process of densification of soil mass by reducing air voids. The procedure to calculate and determine proctor compaction is given below:

**Procedure:**

1. Empty the weight of the mould without the cover.
2. Take the soil sample maximum of 2kg and add water 30% (add the water in % wise).
3. We will gradually add water and mix slowly. So that it makes the soil in moist.
4. After making the pest add water to make three parts of the soil sample & parts-wise fill the soil in mould.
5. After filling the first parts of the soil then we will use the steel rambler & will blows 25 standard number of blows to compact the soil.
6. Similarly, add mould two parts of soil samples and 25 times blows in a steel rambler.
7. After compacting the soil removal the cover & the soil's top edge of compacted we will level it.
8. Weight the mould with the soil sample, and remove the soil using the apparatus of the core cutter method.
9. Take the empty weight of the metal container.
10. Put the soil sample which is collected from the mould. We will take off the container weight of the soil.
11. Keep it in the oven for 24 hours for the determination mass i.e. mass of dry soil sample.

**Formula:**

Proctor compaction calculate as:

(Bulk Unit) $\gamma t = \frac{M}{V}$

Water Content $= \frac{Weifht\ of\ water}{weight\ of\ dry\ soil} \times 100$

Dry unit wt = $\gamma t = \frac{\gamma t}{1+w}$

Table: 5.

| Proctor Comp. | Soil Sample1 | Soil Sample2 | Only Mining | Soil + Sample1 | Soil + Sample2 | Murum |
|---|---|---|---|---|---|---|
| Reading | 1.03 | 1.2 | 1.34 | 1.35 | 1.35 | 1.0 |

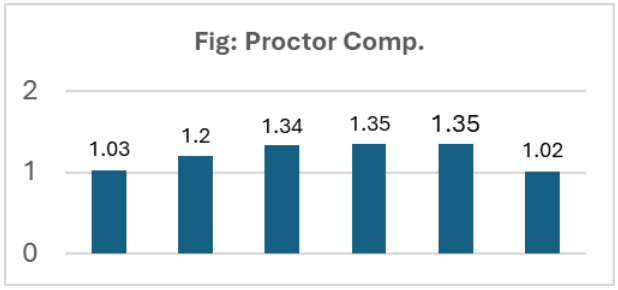




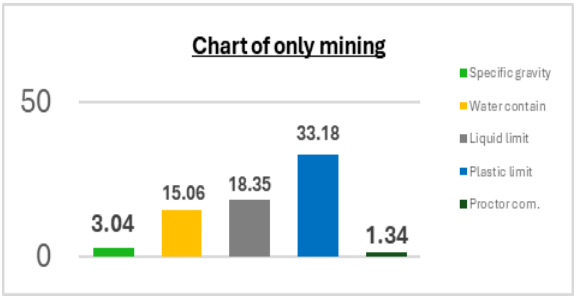
Fig: 7. Proctor Compaction

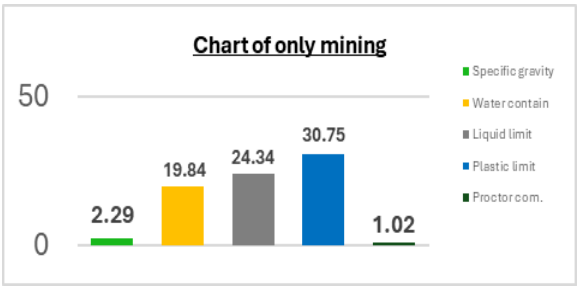
## 4. RESULT

The provided data consists of various soil samples and their respective properties.

| | Soil Sample1 | Soil Sample2 | Only Mining | Soil + Sample1 | Soil + Sample2 | Murum |
|---|---|---|---|---|---|---|
| Specific gravity | 2.03 | 2.64 | 3.04 | 2.04 | 2.26 | 2.29 |
| Water Contain | 12.78 | 12.8 | 15.06 | 9.97 | 11.58 | 19.84 |
| Liquid Limit | 12.76 | 18.10 | 18.35 | 22.44 | 23.42 | 24.34 |
| Plastic Limit | 27.46 | 26 | 33.18 | 28.58 | 30.99 | 30.75 |
| Proctor Comp. | 1.03 | 1.2 | 1.34 | 1.35 | 1.35 | 1.02 |

❖ **Comparison of Only Mining & Murum.**




## 5. CONCLUSION

Based on the test results obtained thus far, it can be inferred that mining waste material demonstrates the capability to enhance the properties of loose soil. Moreover, these findings suggest that such waste material has the potential to serve as a viable substitute for murum as a filling material.

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