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Management Of Coal Mine Overburden And Fly Ash using Bamboo Cultivation

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Abstract: ***Coal mine in India is one of the biggest source of energy production. Coal is the major component used in thermal power plants which helps in consuming 71% of electricity generated by these thermal power plants in India. In opencast coal mining excavation of coal is done and huge area is abandoned after coal is being excavated. The OBD soil which is present at these mine sites is very poor in nutrients that it is usually unfavorable for any type of plantation to be carried out. Keeping this in mind another factor comes across is that thermal power plants are located nearby coal mines which gives fly ash as combustion product of coal and disposal of this fly ash is very crucial. Therefore, this fly ash can be used along with coal mine OBD soil which it has efficiency in improving soil fertility in many ways. Revegetation is one of the most accepted way of soil reclamation and reduction in soil erosion. The suitability of soil for growth of bamboo is checked by planting bamboo saplings in an area of 3 x 3 feet having depth 1 foot in a systematic manner by attempting field trial.***

Index Terms**: bamboo plantation, coal mine overburden, fly ash disposal**

I. INTRODUCTION

India is a country where agriculture is the main and most important source of livelihood in rural area. Therefore, land is most important asset or a factor on which maximum population rely upon. In our country mineral exploitation like coal is continuously done so as to fulfil overall necessities such as industrialization, economic development and growth and urbanization. The overall growth of our country is depending highly upon mining industry and therefore the end effect of mining activities of opencast mines is waste produced i.e. overburden soil and alteration in geology of an area. The total amount of OBD (overburden) soil produced is around 1.86 billion tones to excavate only 750 million ton of mineral. This is a huge amount to be worried about. Therefore, efforts are to be taken to restore its original conditions and its geology. These overburden dumps affect adversely in many ways as it lacks moisture, less organic matter, higher compaction etc. therefore the effects of these OBD dumps are several such as water pollution, air pollution, loss of biodiversity, toxicity and overall reduced economic growth. It is imperative that after mineral exploitation process it must ensure that productivity of affected are is re-established.

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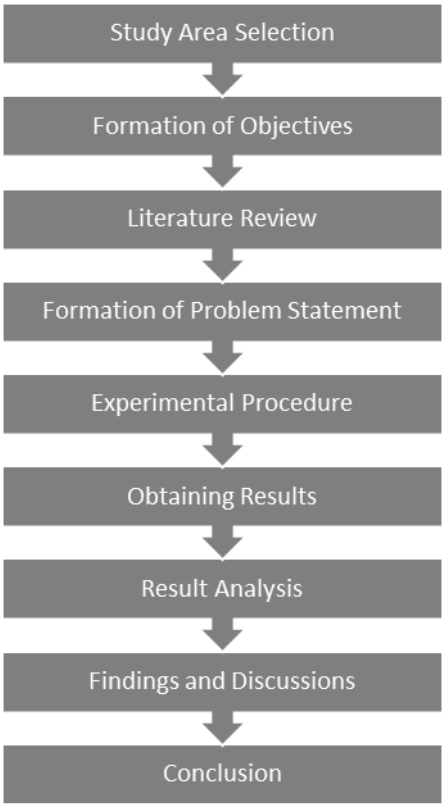
The power requirement of our country depends highly upon coal. The power generation capacity is 298000 MW till 2016. And 185170 MW out of total capacity generated is produced from coal based thermal power plants which is approximately 62.0% of total capacity. On this basis India secure third place after China and USA in largest coal producing country in the world. The coal produced in India is high in ash content which varies from 30 - 40% of total coal combustion. It implies that for the generation of same amount of energy India consumes more coal than other countries and therefore produce more fly ash. This fly ash is very minute in particle size and due to more production there is a huge problem of its disposal. The biggest advantage in front of us is that most of the thermal power plants are situated nearby coal mines so the transportation cost fly ash will be reduced to almost negligible and its usage will get imperative value. Government of India has taken up very straight laws so that there is 100% utilization of fly ash despite of this its utilization has reached up to only around 67.96% till date. This methodology of disposing off fly ash in different manner can add up to some more percentage of fly ash in systematic manner. There is a sector wise utilization of fly ash for year 2014-15 only 1.93% of fly ash is being used in agriculture sector which is very small share by agriculture which shall be improvised. After plantation on coal mine spoils the percentage of sand was lowered as compared to before plantation. Bamboo plants are the one which grow abundantly in tropical and subtropical regions. This very fast growing property of bamboo makes it stand out as there is wide usage of bamboo in different sectors all over country. Due to its fast growing property it is reported that it absorbs huge amount of carbon dioxide and convert it into biomass. The growth dynamics makes it good source for preventing soil erosion and degradation of land. They are grown under multiple climate-environmental conditions such windy, arid, and sloppy lands. Bamboo species are reputed worldwide for their extraordinary performance on nutrient deficient soil and therefore they are best species used for reclamation of abandoned mine sites.

II. RESEARCH OBJECTIVE

To study the characteristics of the mixture of coal mine overburden and fly ash in fixed proportion for bamboo cultivation. Statistical analysis between natural soil and coal mine overburden soil mixed with fly ash to check the suitability of soil for cultivation. To study the growth of bamboo plants cultivated on a pit filled with coal mine overburden and fly ash mixture

III. METHODOLOGY



Natural Vegetation and Soil

The natural vegetation in the area is seen to have a rich plantation in the area where there is a large amount of rainfall annually. The area nearby to the mine site is under cultivated due to the spread of overburden soil in the area in the circumference of the mine site. Due to which natural vegetation is also damaged. The air quality nearby the mine site is also not good. The Ph of the soil at mine site is around 7.75. The bulk density is 1.20 gm/cm3. And the other contents like organic carbon is 1.8 and total organic matter is 3.1 along with available nitrogen as 0.7, available phosphorus as 19 and lastly available potassium as 21.

Soil Sampling

The overburden soil samples were collected from a coal mine site from a city in Nagpur. The name of the city where this coal mine located is Umrer Makardhokra. The following soil samples were collected from this site.

1. **Top most bed sand**

Whenever any coal mine is to be excavated to remove off coal there is a top most layer of debris. Which consist of top most bed sand. While coal mine is being excavated top soil must be properly stored. This soil is coarser in shape and size than other layers of soils. Vegetation on this soil is possible.

2. **Detrital Mantle**

This is the second layer of the mine where detrital mantle is found. Detrital mantle is continental geological rock aggregates that form on the earth's surface as a result of rock weathering.

IV. SITE PREPARATION AND PLANTING

The site for cultivation of the bamboo sapling were selected at the MIT college. An area of about 3x3 feet is dug with the help of the digger. Two sites are generated controlled site and reclaimed site respectively. In the reclaimed site mainly the area of 3x3 feet and a depth of 3 feet is dug. The soil samples collected from the coal mine site from Nagpur are taken in equal proportions and added with the fly ash. Layers of soils and alternate layers of fly ash is poured. This practice was done so that the fly ash will not affect the ground water table abruptly. The soil consisted of Top most bed soil, Detrital mantle, Weathered sandstone and fly ash. All these soils are mixed properly and are laid inside the pit. Then the nursery raised bamboo saplings around 8 – 10 in numbers are planted in the backfilled pit. The bamboo saplings were of Melocanna Baccifera species which are available in local nursery easily. The saplings costed around 20 Rs. Per saplings. While the bamboo saplings were bought it was not showing any new leaves or clumps. The leaves were green and height measure was 45 cm in aggregate. These species were selected as per the requirement of the thesis that the study is required and project is done so as to help the paper industries can use the bamboo for making paper pulp as a raw material in paper industry.

Fig. No. 1: Plantation Done On Actual Site

The site is cleared of all the organic matter. Plantation is done of a saplings of 45 cm in height bamboo saplings. The plantation is done on the top of the soil to biologically stabilize the overburden dumps. To prevent the fly ash to disperse in air fly ash was mixed in overburden soil carefully in closed drum so that its dispersion in air is avoided and healthy air is maintained. At the top layer of natural soil is spread over so as to plant the bamboos carefully over it.

V. DATA ANALYSIS

Growth Assessment:

First Assessment

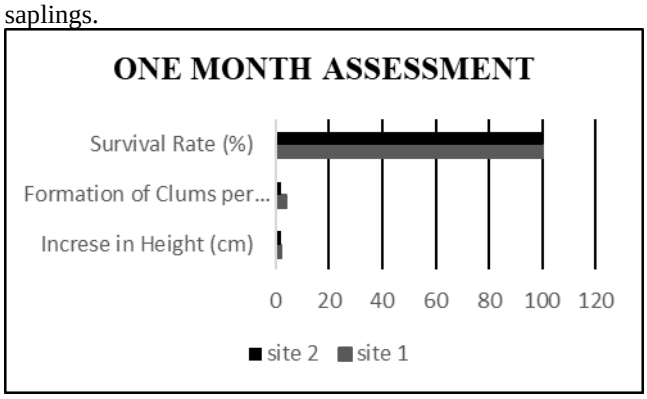
The controlled site and the reclaimed site are both cultivated with the bamboo (Melocanna Baccifera) saplings. The site 1 is controlled site and site 2 is reclaimed site. The first site assessment is being performed a month after plantation of the saplings to assess the condition of the saplings. In the first month the site 1 showed the formation of new clumps and growth of the sapling of about 2 cm which in total became 47 cm. Similarly, the site 2 is also assessed it also showed formation of new clumps and overall increase in height of about 2 cm which again in total became 47cm in aggregate.

The survival rate of the sapling is also assessed. At site one 8 saplings were planted and at the end of the first month survival rate of the sapling is 100 percent. At site two 8 saplings were planted and the survival rate of the second site at the end of the first month is also 100 percent.

Table No. 1: Table shows the one-month assessment of both site saplings

Site	Increase in Height (cm)	Formation of Clums (nos.)	Survival Rate (%)
Site1	2	3-5	100
Site2	2	2-4	100

The following graph is given with the one-month assessment for different criteria between site 1 saplings and site 2 saplings.



Graph No. 1 Graph showing statistical analysis of the site 1 and site 2 saplings.

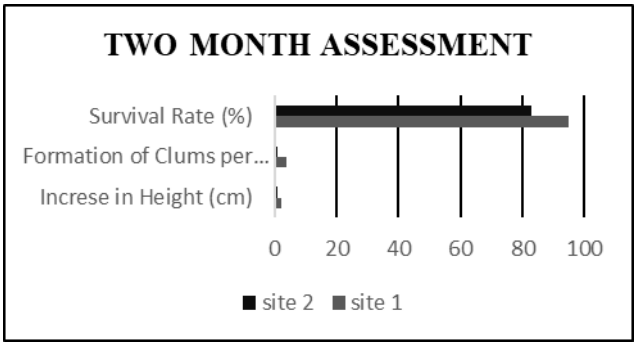
Second Assessment

In the second assessment the growth rate was assessed after 2 months of plantation. Both site 1 and site 2 were observed. The site 1 is controlled site and site 2 is reclaimed site. The second site assessment is being performed a 2 months after plantation of the saplings to assess the condition of the saplings. In the first month the site 1 showed the formation of new clumps and growth of the sapling of about 3 cm which in total became 50 cm. Similarly, the site 2 is also assessed it also showed formation of new clumps and overall increase in height of about 2 cm which in total became 49 cm in aggregate.

The survival rate of the sapling is also assessed. At site one 8 saplings were planted and at the end of the first month survival rate of the sapling is 98 percent. At site two 8 saplings were planted and the survival rate of the second site at the end of the first month is 90 percent.

Table No. 2: Table shows the two-month assessment of both site saplings

Site	Increase in Height (cm)	Formation of Clums (nos.)	Survival Rate (%)
Site1	3	3-5	98
Site2	2	2-4	90



Graph No. 2 Graph showing two-month assessment

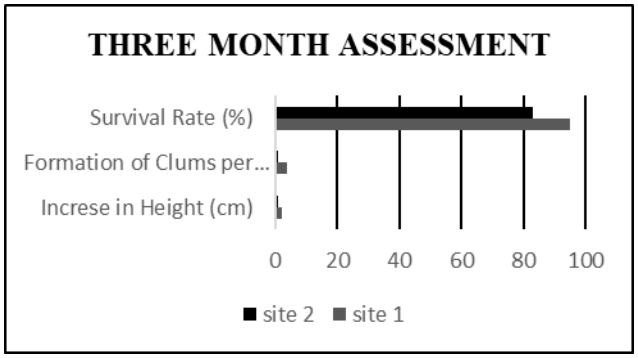
Third Assessment:

The third assessment is done after three months of plantation. In the third assessment the growth rate was assessed after 3 months of plantation. Both site 1 and site 2 were observed. The site 1 is controlled site and site 2 is reclaimed site. The third site assessment is being performed a 3 months after plantation of the saplings to assess the condition of the saplings. In the third month the site 1 showed the formation of new clumps and growth of the sapling of about 2 cm which in total became 52 cm. Similarly, the site 2 is also assessed it also showed formation of new clumps and overall increase in height of about 1 cm which in total became 50 cm in aggregate.

The survival rate of the sapling is also assessed. At site one 8 saplings were planted and at the end of the first month survival rate of the sapling is 95 percent. At site two 8 saplings were planted and the survival rate of the second site at the end of the first month is 83 percent.

Table No. 3: Table shows the three-month assessment of both site saplings

Site	Increase in Height (cm)	Formation of Clums (nos.)	Survival Rate (%)
Site1	3	3-4	95
Site2	1	2	83



Graph No. 3 Graph showing assessment of third month

After the third assessment the reclaimed site was showing a very good rate of survival of about 83% which is quite good. The formation of clumps is seen very good. The clumps formation is green and healthy in both site 1 and site 2. There was an average rate of clumps formation in all three months of about 2 – 3 clumps per sapling.

VI. CONCLUSION

Following are the conclusions which are attained on the basis of the study and practical performed in earlier chapters.
The plantation of the bamboo species Melocanna Baccifera is done on the pit of 3 X 3 feet in size and 3 feet deep. Also cultivation of 8 bamboo saplings is done on the natural soil. The analysis between these two condition is done for a period of three months. It is observed that in first assessment the control condition and reclaimed condition showed 100% survival rate. In second assessment (at the end of two months) it is observed that the survival rate of the site 1 is 98 % and site 2 is 90%. Here the survival rate is reduced but it is due to bad environmental conditions. In third assessment (at the end of third month) it is observed that the survival rate of the site 1 is 95% and that of site 2 is 83%. The site 1 showed the increase in height of 2,3 and 3 respectively. Similarly, site 2 showed increase in height of about 2,2 and 1 respectively. Therefore, on the basis of these results it is observed that the plantation of bamboo on the overburden soil for the reclamation of mine site is successful. These results prove the suitability of bamboo species for rapid improvement of degraded mine site. Therefore, Melocanna Baccifera is recommended for rapid improvementt of degraded mine site in Nagpur and possibly any other tropical countries with similar climate-edaphic conditions bedeviled with surfacing mining activities. This study shows that the Mellocanna Baccifera is the best species recommended for reclamation of degraded coal mine in Nagpur as well as in the areas having similar tropical conditions. This will also help to reduce the transportation cost of the fly ash if the thermal power plants are situated near the coal mine site. Therefore, this will be useful in reclamation of abandoned coal mine by revegetation which will improve the environment conditions as well.

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