Revegetational Approaches for successful reclamation of Iron Ore Mine Dumps

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In the process of winning valuable mineral resources the earth, important for the economic development ɜ nation, mining leaves behind an environmentally ɔcologically unpleasant landscape. Mine wastes are oidable byproducts of the mining industry. Two ɛs of wastes are produced, viz., piles of surface ɔurden waste rock and lean ore, which constitute the t dumps; and a fine grained waste resulting from the ɔeneficiation process termed tailings which are ɔsited in large man made basins called tailing ponds.

Mining causes disturbance to the natural landform, ɔreation of an artificial landform (mine rejects dumped ɜaps on barren land and tailing ponds) which are e to erosion. The common approach to stabilization provide a protective cover to the dump surface ɹgh revegetation or application of a stable liner such ɔck. Stabilization by rock surface will lead to the tion of vast bare areas which is not desirable. ever, the best approach to stabilization of reject ps is a vegetation cover. The establishment of a ɲanent cover of vegetation involves not only growing ts. It necessitates bringing into being a plant munity that will maintain itself indefinitely without ıer attention or artificial aid, and which will intum ɔort native fauna. Such permanence could be eved by selecting species adapted to growth, spread reproduction under the severe conditions provided ı by nature of the dump material and the exposed ation on the dump surfaces.

Mine rejects are not true soils but are derived ɜtly from crushed bedrock and/or glacial deposits. y are very low in organic matter, and normally have levels of available nitrogen (N), phosphorus (P), and ɲetimes potassium (K) (Jeffrey et al., 1975; Grandt, 8). The initial vegetation has a beneficial effect on the ironment. The dump material initially contains no anic matter; there are no micro-organisms other than ı- and sulphur- oxidizing bacteria and no nitrogen. ɜ role of micro-organisms in rehabilitation has received ɜ attention than correction of nutritional deficiencies ɹ imbalances, toxicity, moisture deficits and wind sion (Hutnik & Davis, 1973). In successional terms soil microflora is important in nutrient cycling. velopment of a suitable microflora on wastes could be important element of a successful rehabilitation effort. ɔrofauna are also of importance. Majer (1981) has ıwn attention to the rôle of ants and termites in aeration ɹ efficient soil turnover.

It is necessary to search for native species which colonise similar habitats to those formed after the land has been mined. Such plants which appear on abandoned mine reject sites provide a source of potential species for rehabilitation programmes. Grasses have value as a first stage (Hunter & Whiteman, 1974), not least through reduction of surface temperature extremes (Richardson, 1958). Early colonisers include legumes (Gudin & Syratt, 1975) and other nitrogen-fixing species or ecto-mycorrhizal tree species (Marx, 1975). Leguminous species are important colonishers on abandoned mine spoils (Jefferies et al., 1981). The predominance of legumes on revegetated mine sites suggests that these have an advantage in colonising spoils especially low in available nitrogen (Dancer et al., 1977).

The pioneer species improve the site through their rooting and incorporation of organic matter, gr ally changing the soil status in that later successional species can be grown. As a result of the improved conditions and the shelter provided by the vegetation, species from the flora of the surrounding areas begin to appear on the dumps. Lower plants with minute air-borne propagules often appear first on the site. Some, attempts have been made to use algae, lichens and mosses to enhance stabilization (Jurgensen, 1979). On pit-heaps the rate of pioneer establishment is accelerated by the presence of a moss/lichen surface layer (Richardson, 1958). Local native grasses will eventually colonise the site.

Screening trails for species best suited to the mine rejects should commence with pot trials in the range of available final surface materials. Pot trials with suitably amended reject should preceed field trials. While selecting plants for revegetation, efforts should be made to use native species as far as possible as research using many exotic species has so far failed to produce an economically viable land use. Native species have evolved to survive and reproduce successfully in the local environment. Even though the soil profile on the rejects has been markedly changed, many native species which have been sown, planted or which have voluntarily colonised regeneration areas are already demonstrating that they can survive and reproduce in regenerated areas. Native flora can be permanently established cheaply and efficiently. Seed is available locally and it is suitable for direct seeding of large areas. Fertilizer requirements of native species are generally lower than for introduced species and maintenance fertilizer is not required. Also

it is expected that native flora will be self-sustaining and maintenance free.

In case of grasses and herbs, it is not possible to plant seedlings on the vast areas requiring revegetation. It is cheaper and more efficient to sow seed rather than planting seedlings. When enough seed from a wide range of suitable species is sown under favourable conditions, then each species gets an equal opportunity to select its own niche. If excessive number of seedlings establish, then the fittest will survive. Aerial sowing is a very effective method of revegetation, particularly when sown on fresh overburden soils. Native grasses could be economically used to stabilize active dumps during the monsoons.

Hydromulching is another technique which applies seed, fertilizer and a mulch in one operation. The seed, fertilizer, mulch and water are agitated in a large tank to produce a homogenous slurry which is then pumped, under pressure, through a spray gun onto the area requiring treatment. The mulch holds the seed and fertilizer on the treated surface and also provides some initial protective cover to the soil surface, against the erosive action of water and wind. The advantage of this technique is that it provides protection against erosion to seed, fertilizer and the soil surface. Through the use of pressurised spray gun, the hydromulch can be applied to inaccessible areas. As hydromulch is applied as a slurry mix, the seed is applied in a wet condition, which stimulates immediate germination for fast establishment of vegetal cover. The major reason for failure of this technique to provide a good vegetal cover, is the lack of follow-up rain or irrigation. As hydromulch is applied as a wet slurry and seed germination is immediate, the hydromulch may set hard and kill the seed if follow-up rain or irrigation is not received within a week or so. After an initial short drying period to effectively utilize the binder, the hydromulch must retain some moisture until germination and establishment of a vegetal sward. If high intensity rainfall is received immediately after the hydromulch application, then the mulch has not had sufficient time to bind to itself and the soil, and as a result may be removed or disturbed by raindrop impact or heavy overland flows.

In case of shrubs and trees, seedlings or saplings have to be planted for effective revegetation. Since mine wastes are generally low in organic content, the addition of organic amendments is an integral part of many reclamation programmes. However, refertilizing older rehabilitated areas with nitrogenous fertilizers is costly, incurs access problems and presents the possibility of causing eutrophication of streams. An answer to the long term nitrogen nutrition of trees probably lies with nitrogen fixing legumes. Leguminous plants are commonly used as part of many mine waste revegetation programmes (Johnson et al., 1977, Moore & Zimmermann, 1977). Legumes play a key role in many agricultural systems by providing high protein grain and herbage as well as maintaining and improving soil fertility.

The fast growing legumes, although building up the nitrogen status of the soil, can sometimes compete with the crop trees for light and supress growth rates. Initially a thick plantation of exotic plant species such as **Acacia auriculiformis, A. mangium, Casuarina equisetifolia,** etc. as nurse plants would protect the land against erosion and help in soil stabilization and building up of soil organic matter. Introduction of exotic species should be made with great care as these species may be very successful and escape out into the neighbouring areas, and turn out to be a nuisance, Exotic species used for rapid cover establishment and to build up soil organic matter should be replaced by native species in the later stages. This is necessary to avoid monocultures and to bring about plant diversity.

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