

Utilization of artificial soils, made out of waste materials, in mine rehabilitation

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During open cast mining, large areas of bare ground are created and there generally isn't enough topsoil to cover the whole area. The overburden material is generally poor in nutrients, easily erodible and acidic with traces of heavy metals. There is a need for a cover material, that would enable plant growth, prevent heavy metal leaching and erosion. We may have found it!



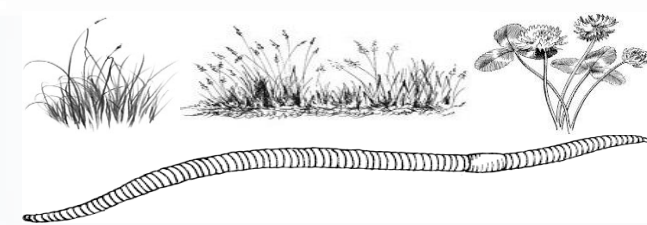
The brown coal mining in Latrobe Valley produces large amounts of waste material:

- **Overburden**, acidic material, rich in trace metals (OB)
- **Fly ash**, highly alkaline substrate, rich in trace metals (FA)
- **Brown coal powder** of low quality, rich in humic substances (BC)

These materials are toxic to plants and soil biota when used alone, however when mixed together and with addition of **Paper mill waste** – anaerobically digested sewage sludge from paper mill industry – which is high in organic matter, they form substrate that has neutral pH and is favorable for plant growth



Mesocosm experiment:



3 different soil mixtures + controls OB + FA, OB, SS. We tested plant growth, nutrient content, earthworm survival

Results

- Best plant growth was observed in buckets with OB + FA only.
- Artificial soils had low N and P concentrations but high sorption capacity and water retention capacity
- In the mix with highest SS content earthworms were reproducing
- Earthworms positively affected plant growth

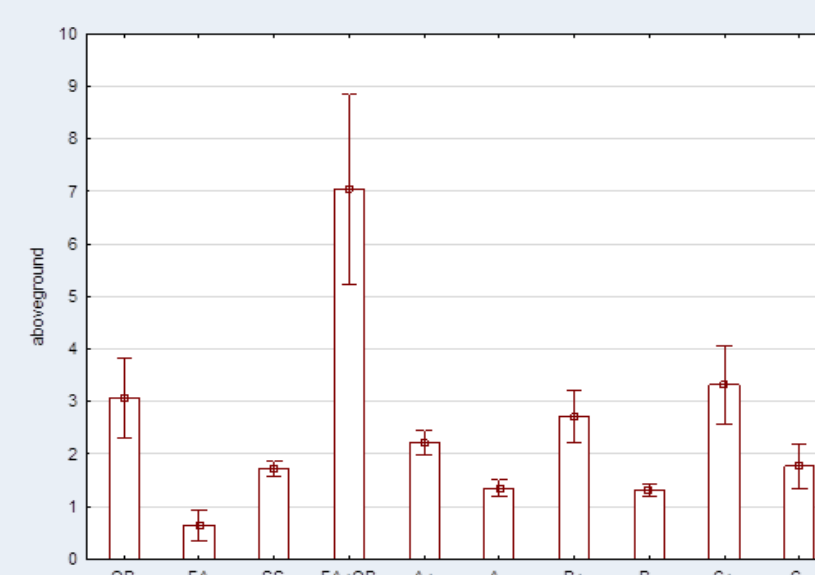


Fig. 1: Plant growth in different mixtures.

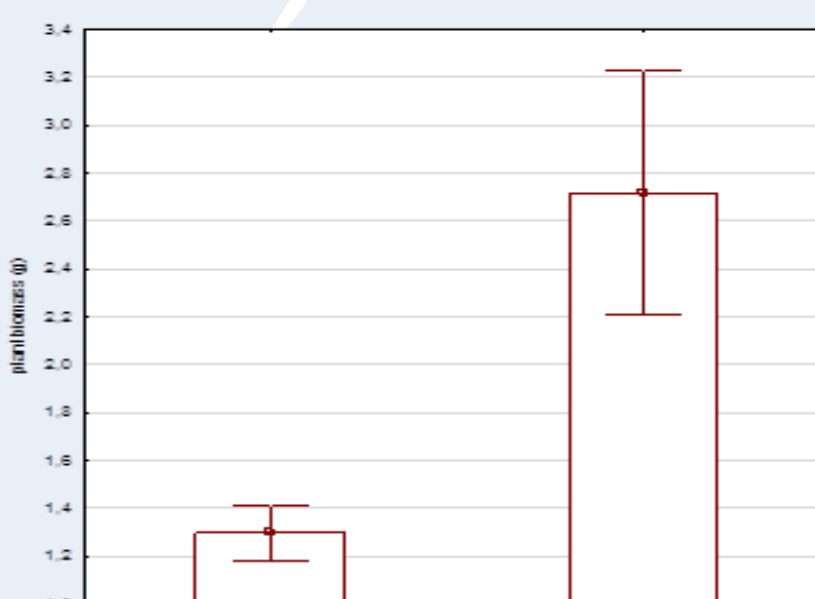


Fig. 2: Plant growth in artificial soil with and without earthworms



Field trial

3 mixtures from the mesocosm experiments + topsoil as control, 10 cm layer on top of overburden. NPK fertilizer and pasture seed mix were added to all plots

Planned measurements

- Soil erosion rates
- Bulk density
- Heavy metals in pore water
- Heavy metals in plants
- Plant growth

Preliminary results

Bulk density and erosion rates highest at the topsoil treatment



Conclusions:

This study should help us find the best way to establish productive and stable ecosystems at the rehabilitated mine sites at minimum cost, reducing the amount of waste material at the same time. We propose that the soils made out of waste material may prevent erosion on the mine batters. We also found that earthworm introduction to these soils increases plant nutrient uptake and productivity of the plant community.