Backfilling technologies for Estonian oil shale mines

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Estonia
Mineral resources in Estonia

Map showing mineral deposits in Estonia with different symbols representing various types of minerals. The legend includes:
- Järvelubi (1)
- Granit (1)
- Fosforit (5)
- Järvemuda (4)
- Meremuda (4)
- Turvas (107)
- Savi (7)
- Kruus (128)
- Liiv (138)
- Paekivi (55)
- Põlevkivi (18)
Oil Shale mining area

Baltic sea

Russia

Kilometre

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Oil Shale deposit

- Oil shale deposit is located partly in farming district
- Used for: power generation, 90% electricity in Estonia, oil, chemistry, thermal power.
- Half is underground room and pillar mining
- About 7 million tonnes of oil shale per year
- Plus separated limestone 40%
- +7 Mt/y surface mining
Oil shale deposit

- Largest number of underground mines was 13 with a total output of 17 million tonnes per year (31Mt/y total)
- Depth 80 m, Seam thickness 2.8 m.
Oil Shale

- Losses in pillars increase up to 40%.
- Large amount of neutral (limestone) and hazardous waste (ash) is generated.
- Using ash and limestone as backfilling materials could reduce the volume and area required for surface disposal.
- The main source of the backfill material today is Heavy Media Separation (HMS). Oil shale seam consists 30 to 50% of limestone.
Steps

• 1. Underground and surface mining space modeling
• 2. Tests for the fill material
• 3. Determination of technological schemes for backfilling
Where and why?

• A quasi-stable area has been detected in large areas. Areas of collapse, subsidence and zones of stability have been determined.
Oil shale deposit
Backfill mix components

- Water, limestone (waste rock from oil shale mining), ash
- If limestone could be separated from the oil shale in situ -> reduction in haulage costs
- Dry separation -> tests in drums
- + crushing buckets
Selective crushing (stripping)
Tests

- dry casting of waste rock to the mined out rooms and adding ash and water mixture
- pumping wet mixture with piston pump to the rooms
- Experiments continued with new ashes (new burning and heating technologies) and waste rock aggregates.
Backfilling tests
Tests with samples

• 8 degrees C temperature and 90% humidity
• + keeping in water
• Warming effect – higher UCS, increases to 10MPa
• Higher water content resulted in higher compressive strength
Surface mine backfilling

- Space between the spoils could be used for depositing ash and at the same time for stabilising spoils.
- Increase overburden thickness
- Peat and quaternary sediments could be mixed with ash.
Backfilling technology?

Figure 10: Partial backfilling with waste rock.

Figure 11: Combined room and pillar mining with partial backfilling with hardening material.

Figure 12: Mining with combined pillars.
Information

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