Near-to-Face Processing
An Approach towards improved Primary Resource Efficiency

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Content

- Introduction
- Basic Aspects of Underground Processing
- Semi-mobile sensor-based Sorting Unit
- Case Study: Room-and-Pillar Potash Mining
- Conclusion and Outlook
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Task: Mine-to-Mill Integration

- **Objective:**
  - To integrate underground processing (near-to-face processing) associated with backfill into the entire mining process
  - and to model the effects on economy and resource efficiency.

  Integrated Underground Processing (IUP) 
  "Leave Waste Underground"

- RWTH Aachen in co-operation with Tomra Sorting Solutions
Content

- Introduction
- **Basic Aspects of Underground Processing**
  - Differences, Synergies and Potentials
- Semi-mobile sensor-based Sorting Unit
- Case Study: Room-and-Pillar Potash Mining
- Conclusion and Outlook
Definitions

- **Underground Processing (central):**
  - Full-scale processing plant; stationary
  - Long term installation for whole life of mine or life of main level

- **Near-to-Face Processing (semi-mobile):**
  - Small-scale; semi-mobile processing unit
  - Waste rejection close to the workings
Examples for **central** Underground Processing

- **Noront Resources Ltd. (Canada) feasibility study**
  - “The Eagles Nest”
  - Underground processing plant for nickel-copper-platinum
  - Crushing, grinding, flotation and dewatering
  - Daily production 3,000 tons

Source: Noront Resources Ltd.
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Examples for near-to-face Underground Processing

- **Python semi-mobile processing unit developed by GekkoSystems**
  - Throughput: 10-30 t/h
  - Modular system for gold ore processing

Source: Gekko Systems

- **Semi-mobile sensor-based sorting unit by TOMRA**
  - Throughput: 150 t/h
  - Recoveries: 95-98%

Source: TOMRA Sorting Solutions
Near-to-Face Processing Effects on Sustainability

Resource Efficiency:

- **Less environmental impact** by less waste material to be stored at surface

- **Less energy consumption** for mass transport to surface and for grinding

- **Less water consumption** in the processing step by early waste rejection in combination with dry processing technologies

- **Less surface subsidence** via backfilling the mining voids
Near-to-Face Processing Effects on Sustainability

Primary Resource Efficiency:

- Compensation of ore dilution at an early stage which enables mining of areas with narrowing deposit parts or low ore grades.

- Increased extraction rate by reducing pillar volume by means of backfill.

- Reducing costs along the mining process chain leads to lower effective cut-off grades.
Content

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  - A conceptual study of Tomra Sorting Solutions | Mining
- Case Study: Room-and-Pillar Potash Mining
- Conclusion and Outlook
Content

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- Basic Aspects of Underground Processing
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- **Case Study: Room-and-Pillar Potash Mining**
  - Approach for Integrated Underground Processing
- Conclusion and Outlook
IUP Model:
Interaction of Sub-processes

Surface
- Tailings Pond/Waste Dump
- Mine Ventilation
- Mine Development
- Mine Services (Water, Energy, ...)
- Transport

Underground
- Tailings/Mining Waste
- Backfill Preparation
- Backfill Placement
- Void
- Orebody
- Extraction
- Surface Processing
- Concentrate
- Near-to-Face Processing

Integrated Underground Processing (IUP)

Resource-to-Product Integration

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Panel Layout with Near-to-Face Processing

Working Faces (11-Entry System)

Feeder Breaker with Belt

Waste Material

Near-Face Sorter (Rejection ratio 25%, Recovery 98%)

Backfilling by LHD’s
Model Scenarios

**Base Case**

- Common mining system
- All extracted material is transported to the surface processing plant

**Near-to-Face Processing**

- IUP near-to-face
- **Decreased mass movement** to surface
- Same production rate
- **Savings** in downstream processes

**Near-to-Face Processing with higher production**

- IUP near-to-face
- Same mass movement to surface, but higher ore grade
- **Higher production rate**
- **Shorter mine life**
Preliminary Results

Successful implementation of near-to-face processing in underground room-and-pillar potash mining.

Rate of Underground Processing: 23%

Reduction of mining waste movement to surface: 24%

Other key figures to be modeled:
- Land use
- Energy/water consumption
- Economic feasibility (cost analysis, cash flow, NPV/IRR)
- Extraction rate

Results are in validation.

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Conclusion

- Integrated mining and waste rejection processes near to face have high potentials for deep underground mining.
  - Current developments to realize near-to-face processing by modular semi-mobile sorting units.

- Potential for improved (primary) resource efficiency:
  - Less mass movement to surface
  - Less land use
  - Less energy and water consumption
  - ...

- IUP effects gain impact with increasing depth.
Outlook

- **More scenarios and case studies** (cut-and-fill mining, sublevel stoping) with different commodities are part of the project plan!

- IUP mining systems can increase the production rate of a mine:
  - Deposits can be mined faster and thus shorten the project time / mine life.
  - This can significantly increase the NPV of a project.
  - **Increase of the NPV** in the range of **15-20%** is possible.
Thank you for your attention!