



ERA-MIN 2

RESEARCH & INNOVATION PROGRAMME
ON RAW MATERIALS
TO FOSTER CIRCULAR ECONOMY

REWO-SORT

Reduction of Energy and Water consumption of mining Operations by fusion of
sorting technologies LIBS and ME-XRT



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ERA-MIN 2 Final Conference and Final Seminar of Call 2017 projects
18-19th November 2021





- Main call: Supply of raw materials from exploration and mining
- Subtopic: Mining operations
- Project start – end date: 01.05.2018 – 30.04.2021 / 36 months
- Project consortium:
 - Fraunhofer EZRT, Germany, funded by BMBF
 - Universidad de Chile, Chile, funded by CONICYT
 - Luleå tekniska universitet, Sweden, funded by VINNOVA
 - SECOPTA GmbH, Germany, funded by BMBF





- Start – end TRL
 - 3 → 4 for Sensor fusion of ME-XRT and LIBS
 - 3 → 5 for technology ME-XRT
 - 8 → 9 for technology LIBS
- Budget
 - 714.840 € project budget
 - 608.340 € requested funding
 - 100% project execution (finished on time and budget)





Objective: Reduction of energy and water consumption

- pre-concentration sorting of low grade rock pieces before comminution
- Such sorting needs classification of mineral particles
- Single sensor approach limited
- Fusion of two sensor technologies using deep learning to overcome their individual drawbacks



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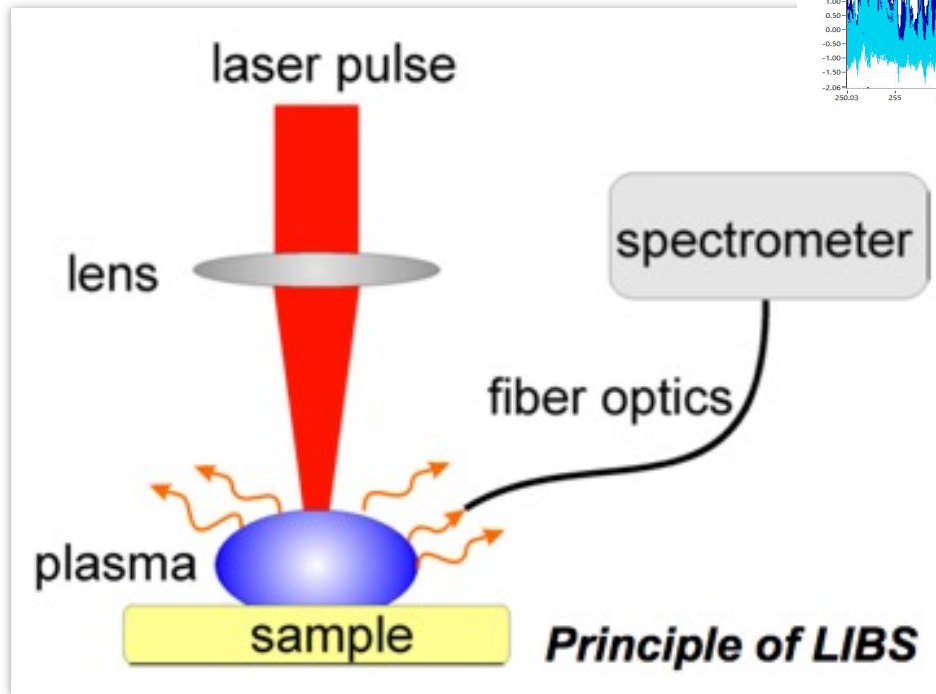
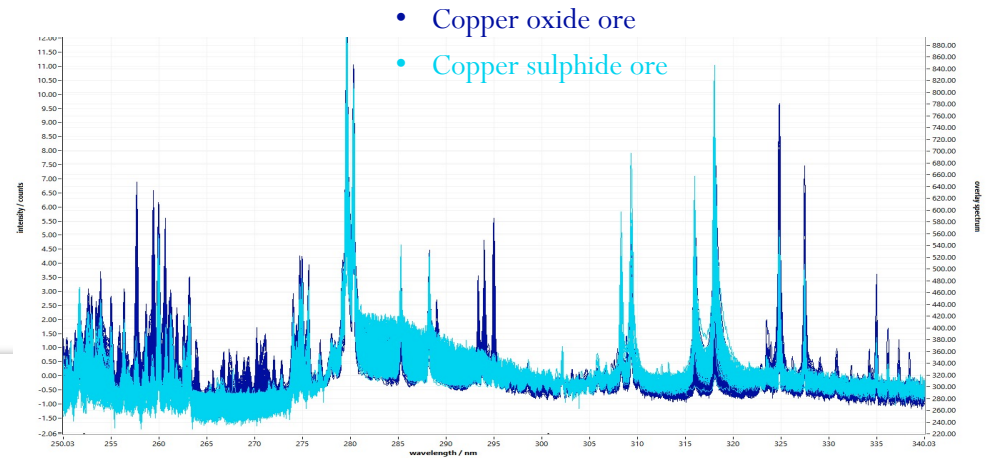




LIBS - Laser induced breakdown spectroscopy

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example of spectra from
REWO-SORT samples
from Chile



- Advantage:
 - Elemental accuracy
 - Chemical information
- Drawbacks:
 - Sampling speed
 - Small measurement spot

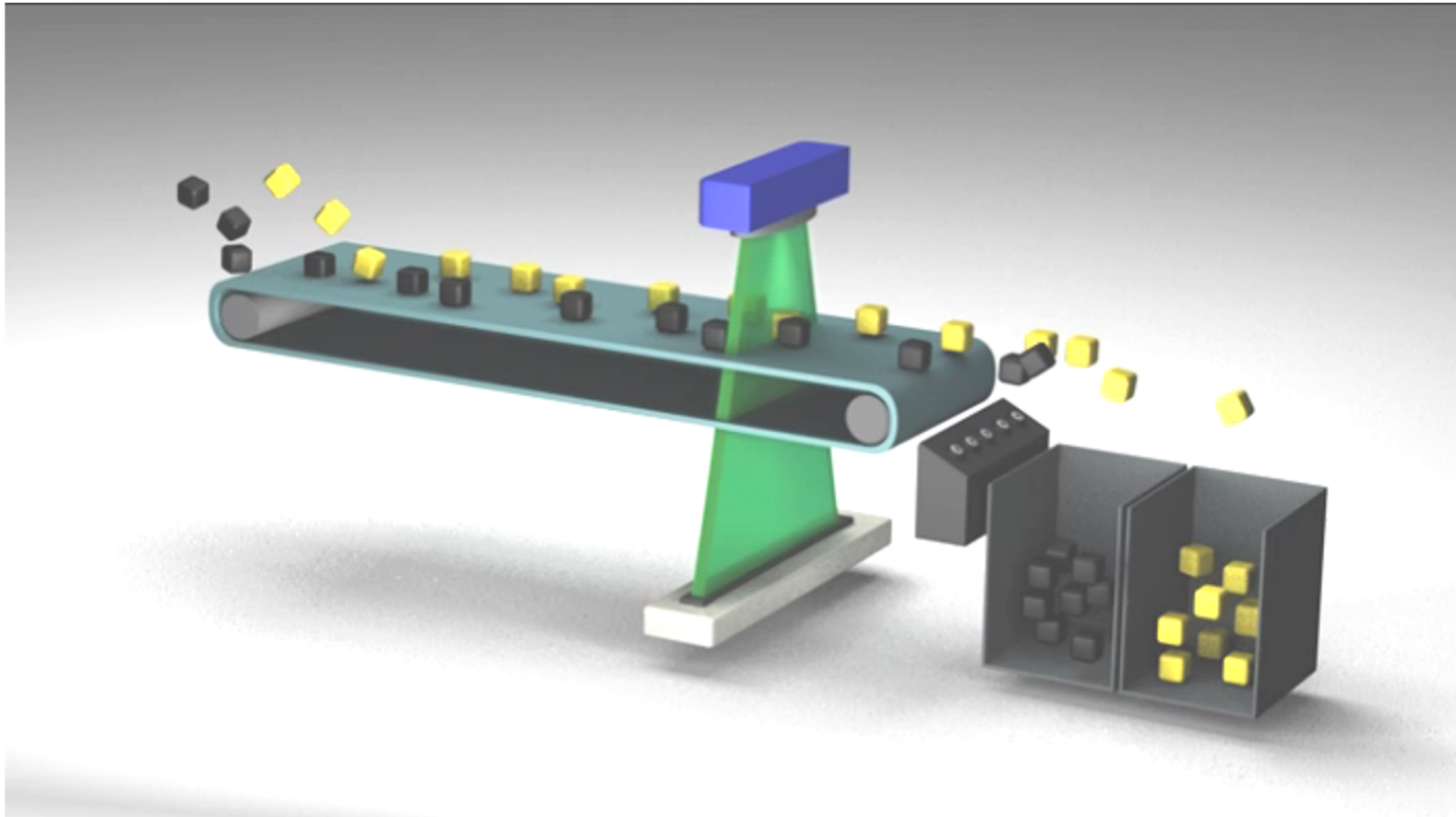




ME-XRT - Multi energy X-ray transmission imaging

Sorting

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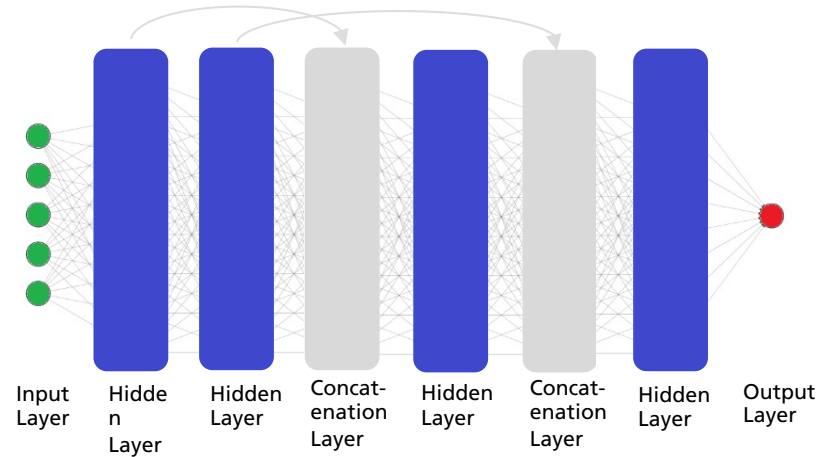
Co-funded by the Horizon 2020 programme
of the European Union





Final Results (scientific)

- Method improvements
 - Improvements in both individual methods
 - Sensor fusion of ME-XRT and LIBS (completely new method)



- Results
 - Sensor Based Sorting can lead to significant reduction in energy (up to 33%) and water (up to 23%)
 - Allows increasing the throughput (gangue material is removed early)





Final Results (scientific)

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- LIBS and ME-XRT in exploration and mining (lab application)
 - The project also demonstrated that LIBS and ME-XRT are suitable methods for geological characterization of ores and other rock types in an exploration and mining context



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Final Results (dissemination)

- Visit to Chile (late 2019)
 - Personal meeting with Chilean project partners
 - Contact to small/medium mines companies (Rafaela)
 - Mine visits (El Teniente and Rafaela)
 - Procemin-Geomet Conference 2019: “REWO-SORT Sensor Fusion for Enhanced Ore Sorting”
- Three master theses (one each at LTU, UC, Fraunhofer)
- Paid tests and studies





- Lessons learnt (i.e. impact of COVID-19)
 - Pro and cons of virtual meetings
 - Different funding organizations appear to have different expectations on the output of the project





Contribution to the ERA-MIN Research Agenda and the Strategic Implementation Plan of the EIP on Raw Materials

- Sensor based sorting with ME-XRT and LIBS has shown the potential for reduction of energy and water for primary resources by sorting used as a pre-concentration stage
- Potential for reduction of energy and water for the example of copper ore: energy (up to 33%) and water (up to 23%)





- Further R&D
 - Paid tests and studies (LIBS scans at SECOPTA)
 - New research projects (recycling of waste wood with ME-XRT, FhG)
- Partners are still in contact and discuss new project possibilities (Horizon Europe, ERA-MIN 3)

