MINING THE FUTURE

Introduction to the competition

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the European Union’s Horizon 2020 research and innovation programme under grant agreement No 951754.
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The ‘Mining the Future’ competition
   - Sample locations
   - Lithology, Mineralogy, Geotechnics
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The Applications

The Finalists
General conditions for reusing excavation materials

Technical
- Tunnel advance method, length, -diameter
- Site organisation
- Material yield parameters
- Material analysis
- Processing technology

Geological
- Geological situation
- Chemistry/ mineralogy/ strength properties of excavated materials
- Customer specifications
- Processability

Legal
- Ownership
- Waste law
- End of waste character

Economic
- Supply and demand
- Raw material price vs. landfilling costs
- Transport route/ -range to customers / landfills
Technological Parameters

1. Classification of advance sections
2. System behaviour
3. Conventional or Mechanized?
4. Muck conveying
5. Muck disposal
6. Specifying details regarding excavation technologies
7. Geology, Mineralogy, Geotechnics

Technology
Sample locations

(A) Total amount of samples per outcrop, well and excavation site location in the vicinity of the current FCC layout (blue circle)\(^1\)

(B) Distribution of the 756 analysed locations grouped by their respective purposes\(^1\)

\(^1\) Haas 2022
Lithology

Lithotypes analysed in the field and on rock cores encountered along the FCC’s planned perimeter

A1-A2: Quaternary glaciogenic deposits,
M1-M5: different marls (Molasse Rouge),
S1-S5: different sandstones (Molasse Rouge),
HC: hydrocarbon-bearing sandstone (Molasse Rouge),
C1-C2: different conglomeres (Molasse Rouge),
L: freshwater limestone (Molasse Rouge),
G1: sandstone (Siderolithic formation),
AG: gypsum layer (Molasse Rouge)

1 Haas 2022
Mineralogy

Major minerals based on XRD analyses

1 Haas 2022
Available parameters for the competition

Aim of the contest is to find sustainable reuse solutions for about 9 million m$^3$ (23.8 Mio. t) of excavated material, mainly molasse.

Several analysis on the FCC’s expected geology were conducted$^1$

Geotechnical
- UCS
- Brazilian Tensile Strength
- CERCHAR Test
- Point Load Test
- LCPC Test

Geochemical & Petrophysical
- Eluate Analyses
- Water absorption
- Porosity, Permeability
- Density
- Carbon content
- Shear wave velocity

Mineralogical
- XRD
- XRF
- ICP-MS
- Optical Microscopy

$^1$ Haas 2022
Correlation of Point Load Index and UCS

Equation: 
\[ y = a + b \times x \]
Intercept: \( a = 0 \pm - \)
Slope: \( b = 0.05342 \pm 0.0033 \)
Pearson’s r: 0.93645

1 Haas 2022
Correlation of Cerchar Abrasivity Index and LAC (LCPC Abrasivity Index) \(^1\)

Equation: \( y = a + b \cdot x \)
Intercept: 0 ± ...
Slope: 0.00478 ± 0.25793
Pearson's \( r \): 0.93904

\(^1\) Haas 2022
THE COMPETITION

The Jury Members
# The Judging Panel – Evaluation of Applications

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Affiliation</th>
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</thead>
<tbody>
<tr>
<td>Prof. Robert Galler</td>
<td>Austria</td>
<td>Montanuniversität Leoben, Head of the Jury</td>
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<tr>
<td>Guillaume Attard</td>
<td>France</td>
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<tr>
<td>Agathe Denot</td>
<td>France</td>
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<tr>
<td>Julie Paciello</td>
<td>France</td>
<td>Cerema, Lyon</td>
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<td>Jacques Burdin</td>
<td>France</td>
<td>Consulting engineer, Les Deserts</td>
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<td>Laetitia D’Aloia Schwartzentruber</td>
<td>France</td>
<td>CETU, Lyon</td>
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<tr>
<td>Cédric Thalmann</td>
<td>Switzerland</td>
<td>B+G SA, Bern</td>
</tr>
<tr>
<td>Manuela Rocca</td>
<td>Italy</td>
<td>Sustainability and Safety director for Tunnel Euralpin Lyon Turin</td>
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<tr>
<td>Alexander Wyss</td>
<td>Switzerland</td>
<td>Simatec Maschinenbau AG</td>
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<tr>
<td>Severin Seifert</td>
<td>Germany</td>
<td>Fraunhofer Institute for Building Physics IBP</td>
</tr>
<tr>
<td>Klaus Marhold</td>
<td>Austria</td>
<td>Institute for Entrepreneurship and Innovation Vienna University of Economics and Business</td>
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</tbody>
</table>
Participation Criteria

Persons and companies who were allowed to apply:

- Natural Persons
- Academic organisations
- International organisations of European interest
- For-profit organisations

Technological maturity of applications

- TLR 3 at the time of submission
- TLR 9 at start of construction in 2030

Applications were submitted on

- Stage 1: 30 April 2021 to 31 October 2021
- Stage 2: 01 January 2022 to 31 July 2022

Evaluation criteria

Jury awards points for each of the following criteria:

- Technical feasibility
- Economic viability
- Societal value
- Project relevance
THE APPLICATIONS

Stage 1
Submitted proposals

<table>
<thead>
<tr>
<th>n.</th>
<th>Submitter</th>
<th>Country</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AMBERG</td>
<td>CH</td>
<td>System to sort, characterize and redistribute the molasse into fractions of known composition</td>
</tr>
<tr>
<td>2</td>
<td>ARCADIS</td>
<td>FR</td>
<td>Manufacturing of compressed raw earth bricks</td>
</tr>
<tr>
<td>3</td>
<td>BG Ingénieurs</td>
<td>CH+FR</td>
<td>Treatment to separate the molasse into granulometric or petrographic fractions by online flow analysis</td>
</tr>
<tr>
<td>4</td>
<td>RISE</td>
<td>AT</td>
<td>Algorithmic platform that supports and establishes logistics and collaboration</td>
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<tr>
<td>5</td>
<td>EDAPHOS</td>
<td>CH+FR</td>
<td>Innovative soil engineering concept</td>
</tr>
<tr>
<td>6</td>
<td>IRD</td>
<td>FR+CH</td>
<td>Valorize the excavation materials via soil engineering to reclassify degraded urban surfaces and to build GI (Green infrastructures)</td>
</tr>
<tr>
<td>7</td>
<td>FORSTER</td>
<td>DE</td>
<td>Construction of landfill silos with sandwich walls- Gravity storage plant</td>
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<tr>
<td>8</td>
<td>LOMBARDI SA</td>
<td>CH</td>
<td>Methodology to forecast, quantify, characterize and manage excavated material</td>
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<tr>
<td>9</td>
<td>MONTANTEC*</td>
<td>AT</td>
<td>Interdisciplinary workflow: geological model and tunneling technique, processing plant for excavated material, mineral processing to produce permaculture on dumped material</td>
</tr>
<tr>
<td>10</td>
<td>NEO-ECO</td>
<td>FR</td>
<td>Develop valuable eco-materials from the excavated materials</td>
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<tr>
<td>11</td>
<td>VOLKMER MiV</td>
<td>DE</td>
<td>Sorting and cleaning excavated materials in view of reuse</td>
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<tr>
<td>12</td>
<td>KONOVALOVO</td>
<td>RUSSIA</td>
<td>Production of Working Body (loads) for a 1200MW Gravity storage plant</td>
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THE FINALISTS

Stage 2
# The Finalists

<table>
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<tbody>
<tr>
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</tr>
<tr>
<td>Briques Technic Concept Arcadis</td>
<td>FR</td>
<td>Manufacturing of compressed <em>earth bricks</em></td>
</tr>
<tr>
<td>EDAPHOS</td>
<td>CH+FR</td>
<td>Innovative <em>soil engineering</em> concept</td>
</tr>
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</table>
Thank you for your attention.
The result of the competition
The Finalists

Amberg Engineering AG
Concrete production

BG Ingenieurs
Production of building raw materials

Briques Technic Concept
Arcadis
Manufacture of molasse bricks

Edaphos Engineering
Production of fertile soil materials