MINING THE FUTURE | MOLASSE IS THE NEW ORE

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INGENIOUS SOLUTIONS
OUR JOINT VENTURE

CIVIL ENGINEERING OFFICE, SPECIALIZED IN INFRASTRUCTURE, BUILDING AND ENVIRONMENT

INTERNATIONAL AND MULTI-LOCAL CEMENT GROUP

VICAT SUBSIDIARY DEDICATED TO THE CIRCULAR ECONOMY

CONCRETE AND MATERIALS TESTING LABORATORY

SWISS MATERIAL AND CEMENT GROUP

MANUFACTURE OF INDUSTRIAL MACHINERY, INNOVATIVE SOLUTIONS AND SERVICES FOR WATER CONSERVATION AND SAND RECOVERY

SWISS CONSTRUCTION COMPANY IN THE LAKE GENEVA AREA

CIVIL ENGINEERING OFFICE, SPECIALIZED IN SPOIL MANAGEMENT
## MOLASSE IS THE NEW ORE

<table>
<thead>
<tr>
<th>Type</th>
<th>Designation</th>
<th>For 1 m³ of Molasse</th>
<th>Technical feasibility</th>
<th>Recovery channels</th>
<th>Economic viability</th>
<th>Societal value</th>
<th>Project relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpolluted Molasse</td>
<td>&gt; 20 mm: Blocks of sandstone</td>
<td>≈ 18%</td>
<td>- Granulometric sorting. (TRL 8)</td>
<td>- Crushed to generate sand particles, and mixed with washed natural fine sand of the molasse to constitute a concrete sand 0/4 mm.</td>
<td>- Competitive price, annual quantities not sufficient to destabilise the local market.</td>
<td>- Circular economy.</td>
<td>- Huge range of possibilities of material valuation, Circular economy.</td>
</tr>
<tr>
<td></td>
<td>4 / 20 mm: Gravels / small blocks</td>
<td></td>
<td>- Screen (under water spraying). (TRL 8)</td>
<td>- Recombined in 0 / 4 mm: Granular materials sector (concrete sand, coating sand, filtration sand, trench backfill, etc.).</td>
<td>- Sorting costs: 5.5 €/ton, Investment costs: 2.5 €/ton, Stockpile costs: 0.5 €/ton, Transport costs: 12 €/ton, Market value: 25 €/ton.</td>
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<td></td>
<td>2 / 4 mm: Coarse sand</td>
<td>≈ 12%</td>
<td>- Cyclonic sifter (patented equipment) for the 1mm size. (TRL 8)</td>
<td>- Granular materials sector (filler complement for coarse sands).</td>
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<td></td>
<td>500 μm / 2 mm: Middle sand</td>
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<tr>
<td></td>
<td>63 μm / 500 μm: Fine sand</td>
<td>≈ 12%</td>
<td>- Hydro-cyclones, dewater. (TRL 8)</td>
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<td></td>
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<tr>
<td></td>
<td>15 / 63 μm: Slit particles</td>
<td>≈ 12%</td>
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</tr>
<tr>
<td></td>
<td>&lt; 15 μm: Clay particles</td>
<td>≈ 36%</td>
<td>- Filter press (with polymer when needed). (TRL 8)</td>
<td>- Activated clays for the production of low carbon cement. (TRL 6)</td>
<td>- Economic viability: very promising that could also be used on the FCC site, Sold on the local market. Needs 100 €/ton to balance budget, Clay available at a price of 8,5 € per ton on production site or 20-21 € /ton in the neighborhood.</td>
<td>- Creation of industrial jobs and the promotion of a promising environmental sector, Circular economy.</td>
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<tr>
<td></td>
<td></td>
<td>≈ 12%</td>
<td></td>
<td></td>
<td>If demand is assessed, we aim for economic viability: obvious and assured.</td>
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<tr>
<td>Polluted Molasse due to</td>
<td>Heavily polluted molasse</td>
<td>≈ 10%</td>
<td>-</td>
<td>- Cements plants (TRL 9)</td>
<td>- Demonstrated since previous CERN projects</td>
<td>- Circular economy.</td>
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<td>hydrocarbons</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Bioremediation (TRL 9).</td>
<td></td>
<td>- Increasing the cost.</td>
<td></td>
<td></td>
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<tr>
<td>Limestone</td>
<td></td>
<td></td>
<td>-</td>
<td>- Filler for the production limestone cement.</td>
<td>- Logistical costs are minimised.</td>
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<tr>
<td>Water</td>
<td></td>
<td></td>
<td>- Water treatment plant (a thickener), Using oil separators or other complementary water treatment.</td>
<td>- Recycled, Remove hydrocarbons.</td>
<td>- Water is ensured with the planned sorting plant: more than 90% of water will be re-used.</td>
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</tr>
</tbody>
</table>

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# SUMMARY OF ESTIMATED EXTRACTED VOLUMES BY SITE AND BY YEAR

<table>
<thead>
<tr>
<th>Year</th>
<th>A (CH)</th>
<th>B (CH)</th>
<th>D (F)</th>
<th>F (F)</th>
<th>G (F)</th>
<th>H (F)</th>
<th>J (F)</th>
<th>L (F / CH)</th>
<th>Sum (m3)</th>
<th>Sum (to)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80 326</td>
<td>73 186</td>
<td>16 072</td>
<td>57 464</td>
<td>23 759</td>
<td>58 713</td>
<td>72 554</td>
<td>119 489</td>
<td>501 563</td>
<td>1 203 751</td>
</tr>
<tr>
<td>2</td>
<td>327 043</td>
<td>303 296</td>
<td>290 849</td>
<td>114 929</td>
<td>149 409</td>
<td>240 378</td>
<td>82 771</td>
<td>280 891</td>
<td>1 789 566</td>
<td>4 294 959</td>
</tr>
<tr>
<td>3</td>
<td>354 197</td>
<td>282 570</td>
<td>221 372</td>
<td>187 648</td>
<td>80 310</td>
<td>470 912</td>
<td>374 716</td>
<td>332 037</td>
<td>2 303 762</td>
<td>5 529 030</td>
</tr>
<tr>
<td>4</td>
<td>40 078</td>
<td>197 647</td>
<td>197 094</td>
<td>284 351</td>
<td>285 669</td>
<td>305 203</td>
<td>85 727</td>
<td></td>
<td>1 395 769</td>
<td>3 349 845</td>
</tr>
<tr>
<td>5</td>
<td>31 029</td>
<td>47 472</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>78 501</td>
<td>188 402</td>
</tr>
<tr>
<td>Sum (m3)</td>
<td>801 644</td>
<td>856 699</td>
<td>756 416</td>
<td>691 864</td>
<td>253 478</td>
<td>1 055 672</td>
<td>835 244</td>
<td>818 144</td>
<td>6 069 161</td>
<td></td>
</tr>
<tr>
<td>Sum (to)</td>
<td>1 923 946</td>
<td>2 056 078</td>
<td>1 815 398</td>
<td>1 660 474</td>
<td>608 348</td>
<td>2 533 613</td>
<td>2 004 586</td>
<td>1 963 545</td>
<td>14 565 987</td>
<td></td>
</tr>
</tbody>
</table>

**ASSUMPTIONS CONSIDERED:**

- Estimated m3 in place (shafts, caverns, tunnels);
- Bulking factor: 1.5 to tend towards the 9 Mio m3 announced by CERN;
- Assumed: 2.4 t/m3 in place, or 1.6 to/m3 expanded.
THE TESTS CARRIED OUT EXPECT THE FOLLOWING RANGE OF SPOIL GENERATED
- 36 to 48% clay particles which may be used to produce low carbon cement,
- 10 to 15% of silt particles which could be used as filler complement for coarse sands,
- 10 to 15% of sand particles from 63 µm to 4 mm that can be separated and blended to produce specific sands as concrete sand, coating sand, filtration sand, etc.
- 15 to 20% of particles over 4 mm which could be crushed to produce coarse sand.
DIAGRAM HIGHLIGHTING THE PROCESSES ENVISAGED

The given grain size fractions are only sales designations and do not take into consideration the misplaced particles.

- Sand and gravels
- Water and sand
- Fresh water
- Industrial water
- Water to be treated
- Filtrates
- Additive
- Concentrated slurry

- MS
- Customer
3D VIEW OF THE POTENTIAL MATERIAL SEPARATION PLANT

Pressing section

On-line analysis (TRL 4)
Chemical analyser

Attrition and screening

Hopper

Water treatment plant

Required area 7 700 m²

Sand treatment
EXAMPLE OF GRANULOMETRIC SEPARATION PLANT
EXAMPLE OF WATER TREATMENT PLANT
EXAMPLE OF PLANT PROTECTION TO LIMIT NOISE AND DUST (OLD PORT OF NICE, 06 – FRANCE)
EXAMPLE OF MEASURES TO REDUCE NOISE AND DUST
CLAY ACTIVATION TEST - RESULTS

TECHNICAL ASSESSMENT

Hydrocycloning demonstrated enrichment of the clay fraction, the finer it is, the higher the amount of clay:

- At 28 days, the optimized thermal activation shows a moderate reactivity of the molasse,
- The finer the fraction, the better the strength obtained.

FINANCIAL & VOLUMES FIRST ASSESSMENT

- 1 M. Ton consumption over 10 years feasible – It is (only) 20% of the total amount available,
- The costs for material preparation, temporary storage and transport are likely to be similar or higher than the costs of direct final disposal: finances to be further investigated,
- Thermal activation in a flash calciner in France. Molasse is to be mixed with other more reactive materials,
- Investment cost to be amortized over 10 years,
- Incorporation in an innovative low-carbon cement, sold on the French / Swiss markets.
3D VIEW OF A TYPICAL FLASH CALCINATION PLANT FOR CLAYS

Required area: 10 000 m²
POTENTIAL USERS OF CORRECTION SAND 0/1

Potential users of correction sand 0/1

Western Switzerland
FINANCIAL ANALYSIS

MATERIAL SEPARATION PLANTS

- Raw production cost: processing only (excluding commercial and management services),
- Investment costs amortized over 3 years,
- Labor cost: 850 k€ per year.

⇒ Prospective production cost: \( \approx 5 \text{ € per ton raw material} \) (energy and land costs to be added).

CORRECTION SAND 0 / 1 MM MARKET FOR CONCRETE PLANTS AND QUARRIES

- Sand 0 / 4 mm for the Lemanic area market:

  ⇒ 4 million tons a year.

- Lemanic area market absorption potential for the Correction Sand 0 / 1 mm:

  ⇒ 10 to 20 % of the 4 million of tons of sand 0 / 4 mm, equivalent to \( \approx 600\,000 \text{ tons} \),
  ⇒ Potential selling price for road transportation (not yet evaluated for rail transportation):

  \( \approx 25 \text{ € per ton} \) (with a potential price increase of around 30% over 5 years).

- On the French market, the Correction Sand 0 / 1 mm should be limited to the needs of the construction sites.
CONCLUSION

TECHNICAL FEASIBILITY

- Possible reuse of ultra-fine fraction: the activation potential of the clay has been demonstrated,
- Possible reuse of sands and fine sands.

ORGANIZATION

- Installation size determination,
- Need for temporary storage (life of treatment plants, smoothing of the production curve).

SOCIETAL VALUE

- Area where molasse will be excavated and not only by CERN, synergies for the reuse of technical installations can be envisaged,
- Circular economy,
- Creation of jobs.

REQUIREMENT

- Deposit financial contribution to balance the budgets (from FCC Project).
  => To be balanced with the evolution of the carbon tax and the fuel market so uncertain.
THANK YOU FOR YOUR ATTENTION