The perspective of end users: applications of UHDC in an industrial context

Sandra Scalari
Enel Green Power spa
The projects have received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°760639, 760824 and 761072.
Enel Green Power: Italian geothermal focus

- More than 500 wells
- 570 km pipelines
- 37 generating units
- 916 MW net installed capacity
- 87.3% average load factor

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Why Ultra High Durability Concrete in geothermal plants?

Geothermal energy comes from the heat contained within the earth which, in some areas of the earth’s crust, rises to the surface in the form of very hot steam: heat and mechanical strength which can feed a thermoelectric power station to move the turbines. After use, the steam is condensed back into the water in the cooling tower and injected back into the subsoil to supply the groundwater and maintain pressure.

<table>
<thead>
<tr>
<th>Plant</th>
<th>Location</th>
<th>Date</th>
<th>Typology</th>
<th>T °C</th>
<th>pH</th>
<th>Cond µS/cm</th>
<th>Alk meq/L HCl</th>
<th>Alk nit</th>
<th>O₂ dissolved</th>
<th>H₂S mg/L</th>
<th>SO₄²⁻ mg/L</th>
<th>SO₃²⁻ mg/L</th>
<th>Cl⁻ mg/L</th>
<th>Na⁺ mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le Prata</td>
<td>LAGO</td>
<td>12-gen-17</td>
<td>Blown down water</td>
<td>7,07</td>
<td>4.430</td>
<td>3</td>
<td>1,8</td>
<td>0,1</td>
<td>0,4</td>
<td>1.223</td>
<td>77</td>
<td>26</td>
<td>213</td>
<td>n.d.</td>
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<tr>
<td>Bagno Re</td>
<td>PIANCASTAGNAIO</td>
<td>26-gen-17</td>
<td>column C2 water inlet</td>
<td>7,08</td>
<td>6.460</td>
<td>11</td>
<td>n.d.</td>
<td>n.d.</td>
<td>0,2</td>
<td>2.292</td>
<td>980</td>
<td>229</td>
<td>1,1</td>
<td>1.352</td>
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<tr>
<td>Bagnore 4</td>
<td>PIANCASTAGNAIO</td>
<td>26-gen-17</td>
<td>Injection water</td>
<td>19,9</td>
<td>6.49</td>
<td>24.200</td>
<td>3,1</td>
<td>n.d.</td>
<td>0,3</td>
<td>10.020</td>
<td>505</td>
<td>11,2</td>
<td>2,8</td>
<td>0,9</td>
</tr>
<tr>
<td>Chiusdino</td>
<td>RADICONDOLI</td>
<td>07-lug-17</td>
<td>cooling tower water inlet</td>
<td>6,9</td>
<td>7.870</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td>1,5</td>
<td>5.119</td>
<td>325</td>
<td>46</td>
<td>1</td>
<td>n.d.</td>
</tr>
</tbody>
</table>

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Why Ultra High Durability Concrete in geothermal plants?

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Why Ultra High Durability Concrete in geothermal plants?

Walls and columns damage and restoration

Lining maintenance

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Expected advantages from Ultra High Durability Concrete

**IMPROVED PRODUCTIVITY**
- reducing the stops and times associated with the maintenance of the basins.

**EASIER MAINTENANCE**
- Longer lasting materials
- Elimination of additional protections

**ENVIRONMENTAL BENEFITS**
- Better “sealing” performance

**SUSTAINABILITY**
- reduced use of materials in construction (also less incidence of steel because of fibers)
- in the decommissioning phase, reduce the quantity of materials to be disposed of, both in terms of volume and because, for the new materials, direct reuse on site is envisaged.
EGP exploitation strategy for UHDC

- EGP has the role of **end-user of the advanced materials technologies**: applications for geothermal and biomass plants for which buried basins made of concrete are usually used as tanks for the water treatment, drilling mud, and tanks for firefighting water.

- Used both for the **construction of new** tanks and for the **maintenance of the existing** tanks already built which are currently in operation.

- In **Italy** EGP has about 34 geothermal plants on working, about 50 existing well pads. For the future, EGP is trying to apply the technology of geothermal and biomass plants abroad. Presently are under construction two geothermal plants one in **Chile** and the other one in **Germany** while a new geothermal plant under development in **Indonesia**.

- EGP expects to:
  - explore new business opportunities, and developing **new competitive design concepts** with the partners.
  - introduce the technology in the tenders for structure construction, providing more value, and **reducing the maintenance** costs during the concession.
EGP exploitation strategy for UHDC: pilot demonstrators

As end user EGP will build and operate 2 pilots in Tuscany (Italy):

- a reduced-scale water tank (about 1:2) connected to the tank of a power plant in order to derive a stream of geothermal water
  - test several structural design concepts
  - test different UHDC mixes with different functionalizing constituents
- a mud debris tanks, built near a drilling station and used during the phases of execution of a new production well, reproducing the same operating conditions.

The two pilots will be monitored for more than 2 years: site visit organized in June 2021 in conjunction with International Conference on Self-Healing Materials
WHAT KIND OF BUILT ENVIRONMENT FOR FUTURE GENERATIONS?

Thank you for your attention

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