SANITARYWARE PRODUCTION
use of waste glass for saving energy and resources

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SANITSER use of waste glass for saving energy and resources
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1. The sanitary ware production: facts, figures & challenges

The European Vitreous Sanitary ware (VSW) ceramic sector is well acknowledged at international level for its exceptional quality. The sector is characterized by a concentration of large, multinational groups, as well as by the vertical integration of highly competitive small and medium enterprises. Throughout the years, the sector has started a path toward sustainability, not only to chase cost reduction goals but also to address pragmatic efforts to control production processes efficiency and environmental performances. Particular care is always devoted to raw materials selection and to water and energy use optimization during the process, probably representing the most relevant hot spots from an environmental life cycle assessment point of view.
Environmental challenges

SAVING OF VIRGIN RAW MATERIALS and transports optimization from quarries

ENERGY SAVING during sanitary ware production processes

GREENHOUSE GASES EMISSIONS REDUCTION
SANITSER wants to contribute to the VSW ceramic sector innovation by replacing large amounts of virgin raw materials with glass cullet from urban solid waste recycling, resulting in energy intensity decrease during the production process.

Waste glass recycling from urban areas has in fact an interesting additional potential.

Usually, the remaining scrap after the first industrial waste glass separation is still landfilled; thanks to an advanced separation process, SANITSER gives new life and value to this secondary material, providing an extra amount of useful glass to generate new products.

In sanitary ware vitreous-china formulation waste glass, granite and ceramic production scraps were introduced.
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The glass cullet for vitreous sanitary ware production
SANITARYWARE PRODUCTION

3. The SANITSER project

Partners

**MINERALI INDUSTRIALI**
produces and sales raw materials for glass, tiles, and sanitary production

**GE.MI.CA.**
produces ceramic glazes for ceramic industry such as vitreous china, sanitary ware, fire clay shower floors, tableware of soft earthenware and porcelain

**SE.TE.C.**
is specialized in technologies for sanitary ware, tableware and other ceramic articles production

**LIFE CYCLE ENGINEERING**
provides environmental consulting services, offering professional solutions and tools for Life Cycle Assessment (LCA), eco-design, environmental communication and regulatory compliance
Objectives

SANITSER is a LIFE project designed to support the European sanitary ware industry to increase efficiency while achieving a more responsible and environmentally-friendly way of operating.

More in detail, the project had two main goals:

1. to introduce a **significant percentage of recycled materials** into the ceramic blend; thus, contributing to a **urban waste** reduction while lowering industry’s procurement costs;

2. to improve the **environmental performances** of the overall ceramic production process, through energy saving and reduction in CO$_2$ emissions.

<table>
<thead>
<tr>
<th>Objective</th>
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</thead>
<tbody>
<tr>
<td>Reduction of firing temperature of about 100°C</td>
</tr>
<tr>
<td>Reduced costs for primary raw materials and their transport</td>
</tr>
<tr>
<td>CO$_2$ emission reduction</td>
</tr>
</tbody>
</table>
The vitreous sanitary ware (VSW) production typically implies the use of two different ceramic blends, for the ceramic body and for the glaze; the introduction of glass cullet in these blends reduces virgin raw materials use. The use of recycled materials in VSW formulations in place of feldspar and quartz permits to reduce the firing temperature of the ceramic body from 1250°C to 1170°C. The firing curve obtained for the SANITSER slip is of about 17 hours, compared to the conventional 19-22 hours. A new glaze that can be used with the new slip formulation and processed with the new firing cycle was realized with a recycled content of nearly 20%.
**Substitute raw materials**

**RECYCLED GLASS**

The glass cullet adopted in SANITSER originates from an advanced treatment process of glass scraps discarded after the primary urban waste separation process. This glass, which is mixed with impurities, dirt and other materials, corresponds to around 200,000 tons/year, which can thus be recovered.

**OTHER RAW MATERIALS**

Besides glass scraps, other recycled raw materials are used to produce the SANITSER ceramic body. These include ceramic scraps, sand and minerals deriving from the recovery of historical white granite quarries. Moreover, different types of special glasses were introduced into the ceramic glaze formulation, such as boric glass and white cullet glass.
Industrial results

**SANITSER ceramic slip and glaze formulation**

Several laboratory tests were carried out to identify the best-performing formulations of SANITSER ceramic slip and glaze. The final SANITSER slip formulation contains more than 40% of recycled materials and the content of quartz is extremely reduced. This achievement is of the utmost importance from a social point of view, since the exposition to quartz is one of the main safety issues in this sector. The final SANITSER glaze formulation, fitting with the ceramic body, was created containing nearly 20% of recycled glass. It was realized in different colours and using also special antibacterial additives.

**Pilot Plants and Industrial tests**

Three pilot plants were realized during the project: the first for the preparation and treatment of SLG waste (assembled at Minerali Industriali), the second to develop the new glaze formulation (assembled at Ge.mi.ca) and the third to perform the whole sanitary ware production process (assembled at SETEC). After the conclusion of the internal pilot production and optimization phase, 4 ceramic manufacturers (Kerasan, Alice Ceramic, Scarabeo and Ceramica Amerina) have been involved to test SANITSER innovations at pre-industrial and industrial scale. They led to the production of about 2000 sanitary ware pieces.
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Body and glaze composition

Body

<table>
<thead>
<tr>
<th>Category</th>
<th>Traditional Vitreous China</th>
<th>Sanitser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled raw materials</td>
<td>24%</td>
<td>29%</td>
</tr>
<tr>
<td>Ball clays</td>
<td>19%</td>
<td>12%</td>
</tr>
<tr>
<td>Feldspars</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>Kaolin</td>
<td>30%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Glaze

<table>
<thead>
<tr>
<th>Category</th>
<th>Traditional Vitreous China</th>
<th>Sanitser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled materials</td>
<td>19%</td>
<td>16%</td>
</tr>
<tr>
<td>Opacifiers</td>
<td>14%</td>
<td>16%</td>
</tr>
<tr>
<td>Quartz</td>
<td>18%</td>
<td>12%</td>
</tr>
<tr>
<td>Feldspars</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>Kaolin</td>
<td>30%</td>
<td>29%</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>18%</td>
<td>17%</td>
</tr>
</tbody>
</table>

Calcium carbonate is a flux used in the glaze composition to lower its softening temperature.
SANITARYWARE PRODUCTION

Installed and covered magnetical separator in their current position

Drier with connection to existing de-dusting system

Connections within the plant

Minerali Industriali pilot plant

Ball clay dissolving

Firing

Glazing

Setec pilot plant

Tubular mill

Screening machine

Magnetic separation

Gemica pilot plant
Economic achievements

Compared to the traditional technology, SANITSER process allows significant savings of costs related to raw materials and energy consumption.

COST SAVING
Results are referred to 1 kg of sanitary ware product

RAW MATERIALS  up to -15%
TRADITIONAL VITREOUS CHINA
SANITSER

ENERGY CONSUMPTION  up to -10%
TRADITIONAL VITREOUS CHINA
SANITSER

Social achievements

Social aspects related to the new SANITSER process are assessed throughout the Social Life Cycle Assessment (SLCA), a qualitative recognized approach along the whole life cycle based on UNEP-SETAC Guidelines.

High reduction of risk from silica exposure
Environmental achievements

Environmental benefits of SANITSER process respect to traditional technology are quantified through a Life Cycle Assessment (LCA), a scientific and internationally recognized methodology based on ISO 14040 standards.

**RECYCLED MATERIALS CONTENT**

*Results are referred to 1 kg of sanitary ware product*

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Pre-consumer Secondary Material</th>
<th>Post-consumer Secondary Material</th>
<th>Primary Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-consumer secondary material</td>
<td>32.5%</td>
<td>8.4%</td>
<td>59.1%</td>
</tr>
<tr>
<td>Post-consumer secondary material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary material</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL EMISSION OF CO₂ eq**

*Results are referred to 1 kg of sanitary ware product*

- Sanitary ware production (pouring + drying + firing): 2 kg CO₂ eq
- Glaze production: 1 kg CO₂ eq
- Slip production: 0 kg CO₂ eq

-10% reduction in CO₂ eq emissions for SANITSER process compared to traditional vitreous china.
ENERGY CONSUMPTION FOR FIRING
Results are referred to 1 kg of sanitary ware product

-18%

DISTANCES FOR RAW MATERIALS SUPPLY
Results are referred to 1 kg of sanitary ware product

-45%

Web based tool

www.sanitser-tool.com
During the project a web based tool was designed and developed to:
- collect quantitative data according to the Life Cycle Assessment (LCA) approach;
- calculate the main environmental indicators for evaluating the performance of the processes involved at different production level.
Targeted communication and dissemination activities were performed to raise awareness on the project’s aims and outcomes.

For more information about dissemination and networking actions please visit website [www.sanitser.eu](http://www.sanitser.eu).
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**DISSEMINATION AT INTERNATIONAL FAIRS**

Mid-term conference – presentation of preliminary results

SANITSER presented at Tecnargilla fair 2014

Dissemination at CERAMITECH 2015
Networking meeting with ECONOMICK project

Ceramic World Review 108/2014

Ceramic World Review 109/2014
6. **Partnerships**

Four ceramic manufacturers of Civita Castellana (VT) district have given their valuable contribution to the research of the SANITSER project, taking part in pre-industrial and industrial tests, during which they produced about 2000 pieces in 12 different types and models (closets, bidets, washbasins).

Sanitaryware produced during industrial tests using the new slip and glaze developed during the project SANITSER and the new firing cycle lowered by 100°C compared to the traditional one.
7. Further information & Contact details

Project start date 01/07/2013
Project end date 31/03/2017
Project budget 2.3M€
Financial contribution requested 1.1M€

Contact details

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Project Website www.sanitser.eu
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