WAP-WIR Project

Wall panel without resin - replacement of polyester resins, volatile solvents and hazardous pigments with natural stone and glass powders

ecodesign | eco-innovation | circular economy | Life-Cycle assessment | production process | reducing environmental impact

PROJECT DESCRIPTION

The WAP-WIR project springs from the need to reduce the harmful effects of the manufacturing process of stone-like materials. The main project objective was the industrialization of a new process with a fully functional line, with improved environmental performance, such as the reduction of energy and water consumption as well as the advancement of working conditions thanks to the improvement of air quality.

The new tested process involves the use of fine and raw powders, recovered from other production activities, involving different stages of the production process such as: preparation of the functionalizing additives, preparation of the mixture, preparation of the pigmentation system, mixing, casting into the moulds, cure (or quenching) in a controlled environment, demoulding, packaging and final maturation during storage.

The WAP-WIR project was inspired by the positive results obtained by Kersa, a Spanish company, in its LIFE06 ENV/E/000001 project “Resin-free Liquid-Stone Process elimination of ynthetic polluting resisns and toxic solvents used in the production of decorative elements in bass-relief with high artistic contents, substituted by eco sustainable and natural row materials imparting similar effect".

OBJECTIVES

The objective of the project was to create an eco-innovative product to replace traditional decorative wall panels (frames and bass relieves), reducing the pollution from emissions and waste water during the production process through the complete replacement of polyester resins, volatile solvents and dangerous pigments, with polymeric matrix compounds containing powders of natural stone, glass and other recycled materials.

PROJECT PHASES

The project was divided into the following actions:

- IDENTIFICATION OF THE MIXTURES AND REUSABLE WASTE

Since their begenning the project activities gave particular attention to the complex task of identification of the most suitable mixture of raw materials, possible reusable waste and its sources. The first step was the definition of the raw material requirements.

The main components used for internal tests were lime, dolomite powder, sodium silicate, Portland cement, fine sand, pigments, iron granules, rheological modifier and water in different composition.

This phase was the core of the project, since it allowed to identify a mixture of raw materials able to replace the commonly used one, having a high environmental impact.

During the subsequent phases the identified mixture was studied with the aim of making it possible to develop and produce special pieces.

- RAW MATERIALS PREPARATION SYSTEM

The first tests on raw materials were carried out in laboratory. As next step a pre-existing production line for the preparation of materials was modified in order to develop the correct final mixture. After it the mills and suitably adapted raw materials grinding systems were designed, in order to start, as quickly as possible. the preparation of the selected raw materials. Same approach for the material mixing station.

- MOULDS AND MOULD FILLING STATION

This activity began with a study to identify the materials suitable for the realization of moulds, such as steel, aluminum, wood, plaster, silicone, resin. Some information was subsequently evaluated relating to the costs, resistance and the possible realizable forms. Finally, silicone has proved to be the most suitable material for making moulds: even if silicone does not facilitate the evaporation of water and therefore prolongs the drying and hardening times, it has the advantage of being much cheaper, and having a great resistance over time as well as to allow a better demoulding (that is, the extraction of the piece), since it does not absorb, thus simplifying the work and increasing the productivity of the line.

The moulds made in this way are filled through an automated nozzle system and positioned on stacked plates sent to the next processing phase.

- HARDENING AND DEMOULDING STATION

Inside the tunnel for curing (i.e. the process through which the cross-linking of the polymer matrix takes place) and drying in a controlled environment and temperature, the first hardening of the product takes place.

The demoulding phase is carried out manually, in order to satisfy the requested adaptability of the works.

- FINISHING, FINAL HARDENING AND PACKAGING

Thanks to the characteristics of the new mixture, it was possible to eliminate the finishing phase, making the system faster and simplier and adding the opportunity to save costs.

The final hardening is carried out in a covered area, while the packaging of the products takes place putting the special pieces manually into the pre-stamped packages with insertion of polystyrene protections or other absorbent materials, to prevent chipping.

To compare the project achievements with the results of a traditional system, also in terms of environmental indicators, the CURA Consortium (University Consortium of Applied Research), born from the University of Padua and its research group CESQA (Center for Quality Environmental Studies), was contacted. CURA technicians carried out an LCA study, comparing the new process and the new product with the traditional process and product, considering an assessment of the entire life cycle and a mass and energy balance. Starting from the analysis of 4 categories of primary data (Transport of materials, Raw materials used, Product production cycle, End of life of the final products), the impacts of the new product and the related process were analyzed, in comparison with the traditional product and process, in **15 different environmental categories** (climate change, ozone depletion, human toxicity, photochemical oxidant formation, particulate matter formation, Ionizing radiation, terrestrial acidification, freshwater eutrophication, marine eutrophication, terrestrial ecotoxicity, freshwater ecotoxicity, marine ecotoxicity, agricultural land occupation, urban land occupation, natural land transformation, water depletion, metal depletion, fossil depletion). Said analysis was performed with the ReCiPe 2008 method **The LCA study showed that WAP-WIR products have a reduced environmental impact by at least 20% in each category**, except categories "Urban land occupation" and "Human toxicity", due to the products' planned end-of-life disposal in landfil as demolition material because of the presence of cementitious material in the mixture. However,the possibility of recycling the product after grinding, makes it potentially capable of eliminating or greatly reducing this environmental impact. This data is confirmed also by an alternative environmental analysis method, IMPACT 2002+.

At the end of the action, a fully functional production plant was developed, for the production of bass relieves and other special decorative pieces in ceramic-based materials, with a production capacity of 90.000 meters per year.

PROJECT RESULTS

Within the WAP-WIR project a competitive new product was developed, what made it possible to obtain a series of environmental and economic benefits.

Compared to the traditional system, WAP-WIR allows to save about 93.000 m3/ year of methane, moreover it allows a reduction of about 170 tons/ year of CO2 emissions, and avoids the use of 1300 tons/ year of materials of polyester resins, volatile solvents and harmful or dangerous toxic pigments.

Furthermore, it allows to eliminate non-reusable production waste (864 tons/ year), as well as to **reduce water consumption by 63% (approximately 1.270 million liters / year) and energy consumption by 25% (225.000 kWh/ year).** The new system ensures the **complete recyclability of the semi-finished and finished product**, even at the end of their useful life. It is also possible to reuse other wastes from different sectors of the company's production and mix it up to 35% (by weight) in the mixture; finally the improvement achieved in terms of working conditions and air quality at the production site is also interesting.

The economic benefits related to the project achievements can be quantified, with reference to the production of 360.000 special pieces/ year, as follows: € 78.300 for methane savings, € 99.360 for the avoided disposal of solid waste, € 33.750 for energy savings, € 1.524 for reduced water consumption, amounting to a total saving of around € 212.934 per year. This quantitative data refers to the new production line, with a production capacity of 90.000 linear meters/ year, equal to approximately 360.000 special pieces.

The data also refers to the avoided use of approx. 1.300 tons/ year of polyester resins and volatile solvents, which, in the traditional cycle, are partially dispersed in the work environment, at the expense of air quality and working conditions of the employees. Data on the exact quantity is not available, since this production was not carried out internally, and also because these quantities greatly vary depending on the effectiveness of the suction and purification systems.

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Acronym
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Reference Programme
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Beneficiary Coordinator
Ceramiche Gardenia Orchidea S.p.a.

Contacts
Giuseppe Ferrari

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726.329,00

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Beneficiary headquarters

Via Canaletto, 27 - frazione Spezzano
41040 Fiorano Modenese MO
Italy

Region
Emilia-Romagna