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LIFE Project Number

< LIFE10 ENV/IT/427>

SUMMARIZED FINAL TECHNICAL Report

Covering the project activities from 01/09/2011 to 31/08/2013

LIFE+ PROJECT NAME or Acronym

< LEAD-COLOURED LEAD-FREE >

Data Project

Project location	Via Croce n. 80 – fraz. Solignano 41014 Castelvetro di Modena (MO) - Italy
Project start date:	01/09/2011
Project end date:	31/08/2013
Total project duration (in months)	24 months
Total budget	€ 1,730,716
EC contribution:	€ 775,108
(%) of eligible costs	50%

Beneficiary Data

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1. Executive Summary

The “Lead-Coloured Lead-Free” project which was correctly commenced on 01/09/2011 was successfully completed on 31/08/2013, according to the envisaged schedule.

Project title: Replacement of toxic lead compounds by new non-toxic substitutes as brilliant aid agent in polychromatic glazes

Objective of the project

The primary objective of the project was the elimination of the use of lead as an indispensable element for the creation of ceramic glazes with replacement with boron; the aim of the project was to provide a demonstration plant of a demonstration scale for the creation of boron based ceramic glazes instead of lead based ones, overcoming the problems currently associated with the use of the latter substance. In fact boron, during the working phase, is extremely volatile and, without appropriate pre-treatment, has reduced efficacy, which restricts its use for high aesthetic value glazes. The new two-stage process instead commences with the creation of a new type of frit - melting of a dry mixture of raw materials, which is fundamental to obtain well vitrified glazes - without lead compounds but, on the contrary, using boron that is pre-stabilised at a low temperature in a mixture with silica and sodium oxide and only then mixed, in a rotary furnace, with the other components of the glaze.

All these elements thus pass through the realisation of a demo pilot line able to show the industrial feasibility of the use of boron based ceramic glazes, thus completely lead free, while maintaining product quality and aesthetics that are identical to the glazed products with lead based substances.

The process was tested at the factory of the Principal, also with the assistance of a valid company operating in the field of colours for ceramic (Colorobbia S.p.A.) and with the University of Modena. As the Principal is a ceramic company with a solid reputation that has been operating in the sector for more than thirty years, it was able to implement the project without having to request authorisations other than those which it would normally need to operate on a daily basis.

The analyses and characterisations of the results were carried out by specialist external laboratories and by the University of Modena.

To achieve the goal it was necessary to overcome the technological obstacle of stabilisation of the boron and therefore of minimisation of losses during the production process.

The problem was overcome by introducing into the industry the concept of two-stage melting and at different temperatures: during the first melting, the element is stabilised by inserting it into an inert glassy matrix, in the second melting other elements are added, thus obtaining the final frit for creation of the glazes.

These technological actions were also accompanied by an informative mission aimed at disseminating information regarding this novel and useful practice in the field and to encourage and inspire other similar behaviours in the industry in general, as well as supporting the purchasing choices of individuals seeking to focus on products with greater environmental sustainability, while ensuring an improvement, as well as in terms of the environmental impact, also of corporate image and the industry in general.

Outputs

The resulting products are characterised by the possibility of being able to combine two elements of vital importance to the market:

- The absence of lead compounds in the glazes;
- The maintenance of high standards of quality and aesthetics.

Alongside these innovative aspects there are numerous other advantages, environmental, technical and commercial:

Lower volatilisation of boron:
The preparation of a pre-glaze by melting and the fritting of a mixture of low melting temperature composition of the oxide system of boron oxide of sodium oxide of silicon allows maintaining of the temperature at levels resulting in the volatility of the boron being minimal, but at the same time being able to obtain either a fluid phase of viscosity low enough to be cast (overheating), or a semi-solid compound (temperature slightly higher than the eutectic one, reactions not completed 100%) to be added subsequently during the melting of a "base" silicate glass, modified with sodium, calcium, and aluminium. The lower volatilisation of the boron has two important consequences: on the one hand it is no longer necessary to introduce into the raw materials overly excessive mixture quantities of boron compounds in order to ensure their presence in the final glass; on the other hand, the current boron filtering and reduction systems are able to work for longer and need to be replaced/regenerated less frequently. In both cases this translates into a smaller plant and conduction cost in addition to being an important benefit of an environmental nature. From a quantitative point of view, whereas a lead frit with low melting point can contain up to 80% of its weight in lead compounds (in general, the content in modern frits is less than 20%). This corresponds to removal of a proportional quantity of lead. As an example, for a glaze with a low melting point with 45% of lead frit deposited with a density of 0.7 kg/m^2, a loss of use of compounds of Pb equal to 0.315 kg/ m^2 of glazed tile can be estimated.

Possibility of long term storage of the low-melting point frit with a high content of boron
Currently the storage of boron compounds is a problem, given their significant solubility in water and reactivity with other species. The preparation of a high boron pre-glaze, on the other hand, stabilises the boron inhibiting release into the environment where the frit could come into contact with atmospheric moisture or water in general. This will allow production optimisation, creation fillers furnace loaders with optimal fills and then continuing to store the product until it is no longer necessary for the preparation of new glazes. This also makes it possible to take advantage of fluctuations in the purchase price of boron compounds, also used in the fibre optics semiconductor industry, for which demand is growing at a rate of 3.4% per year worldwide and 5.7% in Asia.

Wide range of workability of the new glazes, aesthetic appearance and porosity similar to that of lead frits
The new glazes are defined with a wide range of workability (between 800°C and 1150°C) since they allow the user to realise glazes dedicated to the type of ceramic material on which they will be deposited, intended either for single firing or porcelain stoneware, or even for third firing. This extreme flexibility of the new glazes will derive from the preparation of the pre-glaze with a high content of boron and low-melting whose introduction into soda-lime-silicate glass alters the working points proportionately to the addition and in a predictable manner. This type of behaviour was until now the preserve of only the lead frits which were used for centuries, with good reason, given their high versatility. The new glazes have therefore been made with the aim of replacing lead compounds not only in composition, but also in behaviour and in the field of applicability,

constituting a genuine technologically, qualitatively and economically practicable alternative. The new glazes, in fact, boast an aesthetic appearance and a low open porosity, similar to that of lead frits precisely because they will behave as lead frits during firing and subsequent cooling. It must be remembered that the balance between boric low-melt pre-glaze and soda-lime-silicate glass will also determine the value of the thermal expansion coefficient of the glaze, which will be chosen on the basis of the thermal properties of the base ceramic.

Greater lightness of the tiles
Replacing lead compounds with boron compounds, in addition to yielding substantial benefits from an environmental point of view, also has the advantage of contributing to lightening of the tiles with the new glaze. This reduction can be estimated considering that 0.315 kg/m^2 of lead compounds will be replaced by lighter boron compounds in the presence of lattice modifiers, giving a total of 0.2 kg/m^2 less. The weight of a tile, although of marginal importance for a single residential application, becomes critical when considering multi-storey buildings in which the weight of the tiles, both for flooring and walls and possibly for ventilated external walls, creates a weight on the structures. A lighter tile thus means less static loads, and the ability to create more streamlined structures. This is for the proponent a further commercial lever that facilitates the penetration of new products on the market and the final removal of lead compounds in favour of ceramic glazes.

Cost comparable to current lead frits:
Implementation of the new glazes will involve the use of boron compounds that have lower acquisition costs compared to barium compounds, currently used for most trade lead frits. This savings element will, however, be offset by a more complex preparative action which involves additional grinding and melting compared to a typical production process of ceramic frits. In addition, the new process allows minimisation of the loss of boron in the furnace, with further savings.

2. Introduction

- Description of background, problem and objectives

Description of the technical/methodological solution
The Lead-Coloured Lead-Free project may be, for the sake of simplification, broken down into a number of major steps that were followed in implementation of the design procedure.

- *Identification of mixtures suitable for the development of boric frits* :
  The activities focused on a screening of publications, articles, and technical material available on this topic, a series of trials and melting tests as well as characterisation of the results. In implementing this activity assistance was requested from the department of Materials Engineering and Environment University of Modena and from the company Colorobbia S.p.A. which dealt with the execution of a number of "fritting" tests at their furnaces. Upon conclusion of the activities we were able to select some of the mixtures of raw materials to be used for preparation of the flux powders, with melting at temperatures below 950°C for the boric frit oxide and composition of the aluminium-sodium-silicate glass base, which will be a dust flux additive;

- *Grinding system prototype*: once the mixture of suitable materials was identified several experimental tests of laboratory grinding were carried out leading on to the actual demonstration line. Different types of grinding were examined leading to a choice of a type of dry grinding as it appeared easier to manage in the steps of loading and unloading. We also focussed on screening the grinding bodies, identifying the most suitable material (alumina) and the best mix of bead size, and designing the product screening system, the particle size had to remain below 45 microns. Finally, the action was successfully completed with the identification of grinding times required for the preparation of new raw materials, with the identification of the characteristics of the necessary grinding bodies, with some minor interventions at the testing mill that was adapted for the purpose.

- *Modifications to the melting furnace*: The melting tests were outsourced to speed up the action implementation times. The tests were then carried out at Colorobbia S.p.A., with the presence of our staff and in compliance with the specifications supplied by us, and according to the important instructions from the University of Modena, with which we had a simultaneous partnership.
  Colorobbia S.p.A. melted different combinations of raw materials for us at different temperatures and the results enabled us to achieve the desired result.
  In particular, six glasses with silica/boric oxide base were identified with the variation of the third lattice oxide modifier.

- *Creation of the new glazes*: Starting from the results obtained in the previous actions, Ascot Ceramiche was able to obtain new ceramic frits in which the lead was completely removed in favour of Boron. The preparation of the new boric oxide frit with high workability also took into account of glazes to be applied, the deposition on unfired ceramic bases (stoneware and single fired), the drying, the firing and choice, all factors that could have adversely affected the final result. The analysis of discrepancies, the study of problems of adhesion, of dilatometric compatibility and residual porosity of the glaze showed excellent results.

- *Pilot line:* The action consisted of the final assembly of the pilot line; in this respect appropriate changes were made to existing facilities, with the exception of the melting furnace that was not purchased opting instead for the acquisition of only know-how via external consultancy with Colorobbia: the grinding, the glazing, sintering and the choice were adapted for the purpose. This allowed us to carry out the tests that confirmed the achievement of these objectives.

Expected results and environmental benefits

The main expected results thanks to implementation of the project are:

- ✓ *LOWER VOLATILISATION OF THE BORON:* Two important consequences: on the one hand, it is no longer necessary to introduce into the raw materials mixture exaggerated quantities of boron compounds to ensure their presence in the final glass; on the other hand, the current boron filtering and reduction systems will be able to work longer and will require less frequent replacement/regeneration. In both cases, this translates into a smaller plant and conduction cost in addition to being an important benefit of an environmental nature.

- ✓ *POSSIBILITY OF PROLONGED STORAGE OF THE LOW-MELTING POINT FRIT WITH A HIGH CONTENT OF BORON:* The preparation of a high boron pre-glaze stabilises the substance and inhibits release into the environment where it could come into contact with atmospheric moisture or water in general.

- ✓ *WIDE RANGE OF WORKABILITY OF THE NEW GLAZES, AESTHETIC APPEARANCE AND POROSITY SIMILAR TO THAT OF LEAD FRITS:* The new glazes are defined with a wide range of workability (between 800°C and 1150°C) since they allow the user to realise glazes dedicated to the type of ceramic material on which they will be deposited, intended either for single firing or porcelain stoneware, or even for third firing. This behaviour, very similar to lead based compounds, will enable the obtaining of aesthetic results that are very similar to products treated with lead.

- ✓ *GREATER LIGHTNESS OF THE TILES:*The reduction of the weight of the tiles will be roughly equal to 0.2 kg/m^2.

- ✓ *COST COMPARABLE TO THAT OF LEAD FRITS:* Despite the need for additional grinding and melting of the boron compounds compared to those of barium, which mean higher production costs, the lower cost of the raw materials used and the limitation of losses of boron result in a final cost that is comparable to that of the lead frits.

The main environmental benefits relate to:

- ✓ IMPROVEMENT OF WORKING CONDITIONS: employees who beforehand worked closely with lead, a substance harmful to man, will in future be working with boron, a substance that is not harmful;

- ✓ NO DISPERSION OF BORON INTO THE ENVIRONMENT: the system developed focussed on avoiding the total dispersion of boron into the environment, avoiding dangers for the environment.

- ✓ REDUCTION OF THE AMOUNT OF MATERIALS TO BE PURIFIED AND THEREFORE OF RISKS TO THE ENVIRONMENT.

3. Administrative part

4.1 Description of the management system

Phases of the project and tasks

The project can be divided into 3 different areas of activity with a reasonable degree of autonomy from each other (their own goals and their own staff) even if jointly coordinated by the project manager: *Management activities, technical activities and dissemination activities*.
Each of the above-mentioned activities is divided into different sub tasks:

- Project management in general;

- Monitoring; **MANAGEMENT ACTIVITIES**
- Review;

- Identification of the mixtures for the new boron based frits;
- Grinding plant prototype;
- Modifications to the melting furnace; **TECHNICAL ACTIVITIES**
- Creation of the new glazes;
- Assembly pilot line;

- Dissemination;
- After-Life communication plan; **DISSEMINATION ACTIVITIES**
- Networking.

4.2 Evaluation of the management system

a) The future: continuation of the project + remaining threats

The method used in the management of the project proved to be successful, thanks in particular to the harmony between the members of the board of management and the leadership skills of the Project Manager. The skills of Ascot and its employees allowed implementation of the project without resorting to partners even if external consultants were widely used in the implementation of certain specific tasks which if this had taken place internally would have resulted in an excessive extension of the times; the consultancy organisations were: Colorobbia spa and the University of Modena and Reggio Emilia, engaged at different phases of the project. The use of external consultants allowed us to further increase the solidity of the innovations achieved and allowed Ascot to carry out testing that it would not otherwise have been able to perform. The analysis conducted by the University of Modena was of great importance when shown to our customers, both national and international, that attach great confidence in the assessments carried out by a university.

In Europe the production of ceramics is almost exclusively concentrated in Italy and Spain with some branches in the countries of Eastern Europe; the diffusion of the project within an Italian context thus determined the almost direct dissemination of innovative products for the whole of Europe and beyond, given that many ceramics rely on commercial and productive branches even in developing countries such as China and Brazil. In addition it will not be difficult for other companies to adopt the industrial process developed as the most complex operations to make such treatment possible consisted of the definition of the composition of the boric mixtures, work already undertaken by Ascot; the company will be available to define and support the changes needed for adoption of the process in another company and the study of any other applications of the boron compound glazes, potentially many given the transversality of applications of the glazes.

Many companies should be interested in the innovative process achieved, attracted also by the costs of production of innovative glazes; in fact, with a final cost very similar to that of lead frits, producers that adopt the present technology will have at their disposal an eco-sustainable product with excellent aesthetic characteristics and can therefore pass these features onto the final consumer obtaining additional sales with respect to the norm.

The main barrier to the diffusion of innovation achieved is scepticism of the market: for years valid solutions have been sought to the replacement of lead, while maintaining the same aesthetic quality of the tile and it is clear that the actors in the market are incredulous that finally someone has succeeded in doing so. Ascot should carry out (and is carrying out) a high profile marketing project to be able to overcome this barrier; the support of the European Union, the participation in the project of a University and its ability to distribute samples of the finished product will be able to convince the most sceptical actors, permitting a wide diffusion of technology and a drastic reduction in lead.
The skills of the actors involved in the project and the excellent organisation of the management have led to the achievement of the expected results; Lead-Coloured Lead-Free was able to provide a demo line for the creation of Boron based glazes, completely removing the use of lead. Participants should be satisfied with the results obtained and are currently engaged in the dissemination of results and the process used to achieve them. The dissemination activities began in conjunction with the launch of the technical activities of the project and have consisted of several actions: web marketing, the production of paper based information material, direct contact with customers and stakeholders and the organisation of events. The primary objective of the activities in question was the overcoming of prejudices that the players in the industry might have in adopting new technology as this is a new method of production that is completely unknown. Although it is very arduous to overcome the prejudices that exist, the actions of marketing and dissemination undertaken up to now have aroused the interest of various categories of people in both an academic and industrial context; the greatest number of contacts were perceived during trade fairs where Ascot presented the project; the staff were involved in the explanation following the presentation to a great number of people, some of whom have subsequently contacted the company and requested the video presentation of the project and other material. The dissemination activities will continue even after conclusion of the project.

4. Technical part

5.1. Task by task - description

5.1.1 **Action 2 – Monitoring**

Envisaged start date 01/09/2011
Actual start date 01/09/2011
Envisaged end date: 31/08/2013
Actual end date: 31/08/2013
State of the action: concluded

Activities performed and output

The activities began with the identification of the members of the Monitoring team, their tasks and procedures through which they would work. For this purpose the Monitoring protocol was produced. The members of the monitoring team were identified in the following persons:

- Dr. Filippo Del Sante;
- Dr. Maria Pia Biondi;
- Dr. Simone Manicardi;
- Eng. Matteo della Casa;
- Dr. Alessandro Stradi.

Monitoring sheets were produced for each action, which each manager had to periodically compile in order to keep the entire group informed of the progress of the action and to highlight the activities to which more resources and attention should be devoted.
In addition to the tools described above, the monitoring team met regularly in order to keep all the members informed on the progress of the project, and to jointly address the potential problems that were difficult to resolve (see annex 1 minutes of meetings). For this purpose of great importance were also the informal meetings between the managers of only some of the activities in order to exchange views and opinions on the management of a particular situation.
The action of monitoring ended with the conclusion of the project and made it possible to avoid, during the course of the project, blind alleys and to comply with the expected timing.
During the whole period of the project, the Monitoring team met 7 times, more or less every 3 months; meetings were more frequent in the first part of the project since many issues had to be discussed and organized, while in the last part meetings were held much less frequently since the team's members knew were to focus in order to complete the activities they were responsible of. During the entire project, informal meetings had great importance; informal meetings were held between few activity managers every time it was necessary in order to coordinate transversal activities or resolve problems which have arisen. Meetings were frequent in the first part of the process and less frequent in the last part of it. With informal meetings we refer to exchanges of information and suggestions between managers; since it can take place in any moment and any place it is difficult to quantify exactly how many meetings have been held.

Problems encountered

The professionalism and skills of the members of the monitoring team allowed monitoring to be conducted without any problems arising. The punctuality and accuracy with which the status of progress of the project was updated allowed everyone to remain updated almost instantly on the progress of the work.

5.1.2 **Action 3 – Audit**

Envisaged start date: 01/09/2013
Actual start date: 01/10/2013
Envisaged end date: 31/08/2013
Actual end date: 31/08/2013
State of the action: concluded

Activities performed

This activity refers to the precise moment concerning the drafting of the Audit report by an external auditor for the company even if in reality the documentation that was reviewed had been collected periodically throughout the period of project execution. The activities performed by the staff of Ascot concerned the punctual collection, cataloguing and recording of financial and tax documentation, with evidence of payment and of costs relating to the development of the project. This documentation was then entrusted to the external auditor selected so that the same could carry out all the necessary checks and could compile the Audit Report.
The external auditor that was assigned the task of preparing the Audit Report was Dr. Aufiero Fiore.

Mr. Aufiero Fiore is an independent accountant who has been working in the field for long time. Mr. Aufiero is also an independent auditor registered in the national register of auditors “Registro dei revisori contabili”; registration number: 119825. Ascot decided to contract Mr. Aufiero as external auditor, not only because of his long experience but also because he had already implemented several audit reports for companies who had participated to the LIFE+ program.

5.1.3 **Action 4 - Networking**

Envisaged start date: 01/09/2011
Actual start date: 01/09/2011
Envisaged end date: 31/08/2013
Actual end date: 31/08/2013
Current state: concluded

Activities performed and objectives achieved Commencement of the action was concomitant to the start of the entire project. The principal, already at the design presentation, had identified additional projects with similar and/or related themes, through analysis of the Life "database project", made available by the European Commission, which was monitored for the entire duration of the project, as the projects submitted for the LIFE+ call for tenders were added in the following years. The search for related projects resulted in identification of two initiatives of interest:

- LIFE11 ENV/IT/000036 “Low resources Low Energy” - Ennobling mixture of waste for full low-energy replacement of exhaustible natural resources in building materials output;
- LIFE11 ENV/ES/000549 “REACHnano” - Development of a web based REACH Help Desk to support the chemical safety assessment of nanomaterials

Also the participation at sector trade fairs (Cersaie, trade fair in Orlando and Coverings), the organisation of a promotional event and participation in an event organised in collaboration with the University of Siena contributed to a substantial and important start of information exchange with a number of stakeholders.
Networking was also developed on the internet via Ascot's Facebook page and the "Think-Eco Live-Green" page, a collector on Facebook of Life and CIP projects, which includes information on the operation of the project with photos and videos of the plant and the relevant information produced. Thanks to Facebook, Ascot was able to reach a young audience; in fact the company received requests for information from university students interested in the subject.
A new opportunity for networking was represented by the visits that the Technical Manager, Simone Manicardi, regularly made to Confindustria Ceramica (General Confederation of Italian Ceramics Industry) to stay informed about the progress of technologies, for the purposes of promoting the new environmental technology designed by Ascot and to identify information and suggestions within the Italian and European sphere, thanks to her contacts with the confederation body
Other networking activities were:

- Sending of personalised emails to companies with related or potentially complementary projects in order to create a link between the companies;
- Organisation of a round table discussion between the project managers of related projects;

Of all the companies with which the management discussed the project, 2 in particular showed interest in its continuation: Ceramiche Gardenia Orchidea and Majorca spa; the management in the coming months would deepen the debate with the two companies in order to develop related projects to be achieved jointly or to transfer the technology.
More information related to the networking activities are contained in the attached file "Networking Report".

Action 5 - Identifying the mixtures for the development of new boron based frits

Envisaged start date: 01/10/2011
Actual start date: 01/10/2011
Envisaged end date: 31/03/2012
Actual end date: 31/03/2012
Current state: concluded

Activities performed and objectives achieved

The action was successfully completed with the identification of mixtures of raw materials.
The activities focused on, as budgeted in the application, screening of publications, articles and technical material available on the subject, a series of trails and melting tests and characterisation analysis of the results.
These activities were carried out by the company laboratory technicians and with the help of qualified external consultants.
In particular, the assistance of the department of Materials Engineering and the Environment of the University of Modena, that works on a daily basis with companies in the field of ceramics, that was able to direct the technicians, allowing compliance with the timeframes specified; external collaboration was also requested from Colorobbia S.p.A., a very important manufacturing company of ceramic glazes, to which we commissioned meltings and off-site testing also in collaboration with the University.
During this activity collaboration was also established with Mr. Mariano Paganelli, a chemist already known by the undersigned and key person identified to better co-ordinate the internal activities of the technicians and those of the University and Colorobbia.
The latter in fact enabled us to achieve the rapid result obtained contributing to continuing the project as hoped and confirming the willingness and ability to continue with the activities.
A somewhat uncertain start to the activities by the laboratory technicians led to the Project Manager seeking external collaborations capable of supporting the company during the initial and most delicate phase. This solution proved to be extremely successful, managing to bring together experiences particularly suited to the purpose: the University of Modena in fact brought theoretical skills and the ability to do perform a number of laboratory tests and characterisations. Colorobbia, a company with which the University has also collaborated for a long time for research on materials, helped us to develop the mixtures, performing tests on a larger scale to identify problems and solutions, all under the supervision of the Project Manager and with the assistance of the company technicians.

Problems encountered the first steps taken for this activity were quite difficult, being a relatively new field for the in-house laboratory: we encountered difficulties in

identifying the suppliers of raw materials and in identification of the frit melting parameters etc.
As with any new project, the starting point is always the most critical moment.
The difficulties were overcome through the skill of the Project Manager in identifying externally the right skills for each field of action, approaching first the university, where we found the science, and afterwards Colorobbia which provided us with the necessary experience.

5.1.5 **Action 6 - Grinding system prototype**

Envisaged start date: 01/10/2011
Actual start date: 01/10/2011
*Envisaged end date:*30/06/2012
Actual end date: 31/12/2012
Current state: concluded

Activities performed and objectives achieved

The action began on 01/10/2011 with tests of grinding in jars in the laboratory using mixtures of raw materials identified at the various steps together with the University of Modena.
With regard to the grinding bodies, the consultancy of Prof. Paganelli introduced us to the theory and helped in the programming of the tests.
In fact, we conducted the tests starting from the indications of theoretical research and gradually refining through the practical results.
This has led to the achievement of the objectives of the first phase of laboratory, starting point to begin the phase of wider industrial value.
It was decided to start the action in partial overlap with the preceding one in order to proceed both with the theoretical research and with tests of materials gradually identified as possible for our purpose, occasionally returning in search of indications for changes to the mixture, refining its characteristics.
Once action 5 was completed (March 2012) and the mixture of materials suitable for our purpose consequently identified, we commenced the simulation tests on a wider scale, abandoning the scale of the laboratory to penetrate into the semi industrial "demo" environment.
As such, from the first week of July 2012 we started the first tests of grinding of raw materials identified in action 5, each one individually, for a total of approximately 300 quintals .
These fine and sieved materials were then delivered to Colorobbia to proceed to the frit tests using their melting kilns (action 7) to then return to Ascot for the second grinding.
Each test result was characterised by the University of Modena in order to identify defects and to make corrections for the subsequent test.
The use of wet grinding was envisaged at the project design phase.
During the first tests however we realised that the dry system that we already use or the treatment of other materials is easier to manage during the mill loading phase, during the unloading phase and especially during the washing phase: during trials it was in fact very important that all the residues were removed between one test and the next; this was very difficult with wet grinding due to residues that solidified and that had to be removed with difficulty, with further elongation of the processing times.
In addition, the frit phase requires the introduction of material of the melting furnace with a low percentage of water and as such, in the case of wet grinding, we would have had to dry the material, with a further waste of energy.

Dry grinding instead allows us a simpler removal of the residues, although there have been a number of cases requiring the application of compressed air for the complete removal of the material.
This small change to the system also allowed us to avoid a prior intervention, consisting of the replacement of the inner lining of the mill.
In addition, the second grinding, involving the "frits" returned from Colorobbia after the first melting, takes place in the same mills, dry loaded: although in fact water grinding is compatible with the material, the choice of dry grinding was dictated by the need to deliver to Colorobbia material with almost no moisture, for the same reason given above.
During the tests we tested different types of grinding bodies and alumina was found to be the best material. However, with regard to the diameter of the beads, the experimentation was lengthier and collaboration with the Eng. Paganelli was crucial for the prior theoretic simulation and the solution to the problem.
The last technical step concluded in this action was the product screening system: given that the desired size of the particles had to be approximately 45 microns, a system with a 16,000 mesh sieve proved to be suitable for the purpose.
Finally, the action was successfully completed with the identification of grinding times required for the preparation of new raw materials, with the identification of the characteristics of the necessary grinding bodies, with some minor interventions to the testing mill that was adapted for the purpose.

Problems encountered
The difficulties faced, always at a normal level with reference to an activity that can be traced back to R&S, concerned the interpretation of the results obtained from the tests carried out and the corrective measures that were taken that at times indicated the right path and other times forced us to repeat certain steps.
These difficulties were encountered at the phase of identification of the correct parameters of processing (times and speeds of rotation of the mill), during identification of the characteristics of the grinding bodies and at the study phase of the filtering system.
In addition, the times were extended due to the choice of starting the activities on an industrial scale, attempting individual grindings of each raw material, and this resulted in the need to wash and dry thoroughly after each grinding, both inside the mill and the grinding bodies that had to be extracted and reinserted each time.
All of these small obstacles however were methodically addressed and resolved.

Action 7 – Modifications on the melting kiln

Envisaged start Date: 01/01/2012
Actual start date: 10/12/2011
Envisaged end date: 31/12/2012
Actual end date: 31/12/2012
Current state: concluded

Activities performed and objectives achieved The activity started a little ahead of schedule; this allowed us to observe the sequence of raw material, grinding, sifting and melting in the tests carried out. The tests took place using the systems of the consultant Colorobbia S.p.A. by our technical staff, starting with collection of the process data (times, temperatures).

After the first stage, which in any case involved the internal preparation of the part relating to the production of the frits, with request for specific quotes, the decision was taken to continue with the collaboration already in place with Colorobbia S.p.A., a company that specialises in the preparation of frits and glazes for ceramics.
The tests were then carried out at Colorobbia, with the presence of our staff and in compliance with the specifications supplied by us, with instructions from the University of Modena, with which we have in place another theme relating to this project.
Colorobbia melted different combinations of raw materials for us at different temperatures and the results enabled us to achieve the desired result.
In particular, six glasses with silica/boric oxide base were prepared with the variation of the third lattice oxide modifier; the formulations were carried out by maintaining stable the molar percentages of SiO2 and B2O3 while the remaining was gradually introduced in the form of Li2O, Na2O, K2O, CaO, BaO and ZnO.
The best result was obtained with the Na-glass frit that we used for further melting tests in order to optimise the cycle from the point of view of power consumption and environmental performance (loss of boron.
Also in this case, the best result is obtained with the higher temperature for the least amount of time very advantageous in terms of energy consumption.
The boron base Na-glass frit was then returned from Colorobbia in order to proceed with the second grinding (compare with Action 6) and to obtain the boric glass, base for the creation of the new glaze after a further grinding phase (Action 7).

Crucible meltings of the two formulations were conducted, noting that the one with Na-Glass melts significantly better that the one with borax: the time used for the melting of the compound with Na- Glass is lower than that taken by the glass with the borax.
The ceramic effect that is obtained is instead absolutely the same in the two cases and the Coefficient of Expansion is also confirmed in both cases which for the frit with Na-Glass is 95.2 while it is 94.7 for the other: practically the same.
Industrial melting of the frit that contains the Na-Glass then took place through 3 tests with different times and melting temperatures in order to optimise as far as possible the production parameters of this "glass".
The first test was carried out with the temperature at 1450°C for 60 minutes, the second at 1500°C, thereby speeding up the input of the powders with an indicative residence before the melting of about 50 minutes. Finally, in the last test, the powders were melted at the maximum temperature of approximately 1550°C, increasing even more the rate of introduction of the powders with an indicative residence of approximately 40 minutes within the kiln before exit of the molten mixture.

Temperatures	Melting Times
1450 °C	60’
1500 °C	50’
1550 °C	40’

To maximise preparation of the kiln, the Na-Glass frit was melted prior to the three tests in order to "rinse" i.e. to clean the kiln, removing possible residues resulting from preceding frits.
In all three cases, the presence of the ground frit favoured the melting of the mixture of raw material and as such the residence times were further shortened.
With the use in melting of the Na-Glass, there is an increase of the yields: for the frit with Na Glass in composition the yield is 88.1%, while in the case of the formulation

with borax it reaches 85.7%. As the loss to fire is low, there is a further reduced environmental impact in addition to an increase in productivity as the ground frit favours melting of the mixture that contains it.
In total 600 quintals of frit were melted and it was seen that the best solution (increased productivity) is the one with the higher temperature and therefore the shorter time for the melting of the mixture of raw materials.

Problems found The decision to outsource the part of the activity of meltings to a trusted supplier, namely Colorobbia, minimised difficulties as we were able to exploit the experience of this company in the specific field of action.
The acquisition of knowledge was in any case guaranteed by the participation of our technicians in the performance of meltings and in the evaluation of the results also in collaboration with the University of Modena.
As such, the technical problems encountered were overcome thanks to the appropriate organisation of the tests and to the careful evaluation of the progressive results, implementing the right corrective actions: this was only possible by combining different experiences and different structures.
The experience of management of the Project Manager was instrumental in this case: we resisted the temptation to keep within the company all the know-how for the benefit of a collaboration which has led to a more general growth both for the two production facilities (Ascot and Colorobbia) and that of the academic body (University of Modena); this as a further demonstration of the fact that management believes in sharing results, even while obviously adhering to agreements of a commercial nature.

5.1.6 Action 8 - Creation of new glazes

Envisaged start date: 01/10/2012
*Actual start date:*01/01/2013
Envisaged end date: 30/06/2013
Actual end date: 30/06/2013
Current state: concluded

Activities performed and objectives achieved The start of the action, which was envisaged for October 2012 was postponed until January 2013. This was due to the continuation of the preceding activities. The excellent results obtained with actions 6 and 7 resulted in the absence of deviations in relation to the date of completion of the entire project, also thanks to the best definition of the buffer time.
The action was therefore prolonged until June 2013.

In implementation of this action two main activities were performed: 1. Preparation of a new glaze;
2. Definition of a of grinding/fluidisation process.

Preparation of a new glaze;

The action was carried out with the support of Colorobbia spa and the University of Modena and Reggio Emilia. In definition of the new glaze the starting point was the boric frit already previously characterised (TTO 394) and we proceeded to replace the lead frits present in the glazes. The initial tests were carried out using glazes prepared in the laboratory and ground in the ceramic jar loaded with grinding bodies in ALLUBIT.
The first test performed on the CO1000 product, high temperature glaze normally used in the production of flooring, was to replace the lead frit with the TTO 394 in equal measure.

Given the high reactivity of the boric frit the result obtained proved to be too glossy and therefore subsequent trials took 3 different directions:

1. We varied the ratio of frits in favour of the CERAMIC GLASS
2. Leaving constant the amount of frits we intervened by adding CORUNDUM at the expense of NEPHELINE.
3. The ratio of frits was changed and alumina added.

The second product that was acted on, replacing the lead frit with the boric frit TTO 394 is a dual fired engobe of normal use at the ASCOT plant: the COS 9297.
In this case, the parameters to be reproduced were in addition to the aesthetic and technology aspect of the glaze also with regard to the coefficient of expansion.
This was certainly the most important parameter to be ascertained as the difficulties that are encountered in the production process of white body dual firing are well known in obtaining tiles with a good flatness upon kiln exit and which do not involve the danger of "delayed crazing". The engobe to be changed has good features of this type and thus further tests were required and the various products obtained were subjected to an autoclave at 7 atm. X 2 cycles until a product with characteristics closest to the one to be modified was obtained.

Definition of the process of grinding/fluidisation

Grinding is a fundamental process for the production of ceramic suspensions. Thanks to this process the dimensions of the raw materials are indeed reduced. This involves an increase in the specific surface area and therefore the reactivity of the compound. In addition, during grinding there is homogenisation of the different components and this ensures a uniform behaviour of the glaze/engobe. Finally, a fundamental aspect of the grinding/fluidisation process is the monitoring of the rheology. In fact, thanks to the addition of additives, such as suspending agents or fluidifying agents, it is possible to monitor the rheological behaviour of the suspension. It is essential that the suspension presents optimal rheological properties for the application already in output from the grinding process as this helps to avoid further treatments of the suspension which would lead to an increase of production times and costs, as well as an increase of the process variables.
Both the glaze and the engobe, subject of this study, were ground wet using a discontinuous mill with alumina beads as the grinding bodies.
For optimisation of the process of grinding/fluidisation we employed the consultancy services of Prof. M. Paganelli. The frits and mixtures of raw materials for the grinding were prepared and provided by Colorobbia Italia spa.
The suspensions were ground at a fixed grinding speed of 1000 rotations/hour, and the grinding was extended until obtaining the desired grinding residue (0.5 for the glaze from porcelain stoneware, 3 for the engobe from dual firing).

Engobe for firing.
In order to obtain the optimal result for the specific application, the grinding parameters were varied and a total of five tests were carried out.
The mixture of raw materials was dispersed in water and supplemented with a fluidifying agent, the purpose of which was to reduce the viscosity of the suspension and to promote the grinding process. In addition an antibacterial agent and urea were added to the mixture in order to prevent the formation of micro-organisms, fermentation, as

well as the formation of salts during storage. In this way the stability of the suspension was increased.
At the end of the first grinding test, it was not possible to empty the mill because the suspension was highly aggregated and the formation of a very compact sediment was preventing the outflow of the suspension.
After this first attempt salt of Sicily was added to the original formulation (v02). The salt acts as an electrolyte and varies the Z potential of the suspension, thus changing the forces of attraction/repulsion between the solid particles in suspension.
The addition of the salt was found to be useful, but not sufficient to obtain a suspension with appropriate rheological properties, in fact, the suspension when unloaded from the mill showed a tendency to form aggregates and settle.
The next test (v03) was then performed by increasing the amount of salt. This increase allowed us to obtain a suspension with a good rheological behaviour. This suspension was then tested with a bell applicator and tiles were produced in a test line. The bell lead-free engobe was applied on the fired base then a glossy glaze via bell application and finally a decoration with digital printing. The product was then sintered in a glass furnace. To set the firing curves we requested the consultancy of TTD, as for all the firing tests carried out at this stage.
After firing, the surface of the tiles had a dimpling effect. This defect was attributable to the fast and non-homogeneous drying of the engobe with the formation of areas with different density.
The next test (v04) was carried out by adding clay to the mixture of raw materials. The clay leads to an increase in the stability of the suspension and a different rheological behaviour. The engobe was tested in a test line as in the previous case. In this case after firing the application with digital printing was very irregular and not homogeneous. The defect is due to an excessive fluidity of the engobe, as witnessed by the low viscosity in output from the mill.
The last attempt (v05) was carried out by halving the amount of clay. The engobe thus formed was applied in a production line. The results were satisfactory.

Final glaze for porcelain stoneware.
The grinding parameters of the raw materials were varied and a total of five tests were carried out in order to obtain a suspension with the rheological properties suitable for application using airbrush.
The mixture of raw materials was dispersed in water and supplemented with a fluidifying agent, a glue and clay.
The first attempt of grinding/fluidisation was not successful as a compact sediment was preventing unloading of the mill.
The next step was therefore to reduce the fluidifying agent (v02). This resulted, on the one hand, in an increase of grinding times, on the other hand in a reduction of the phenomenon of aggregation. The suspension was however too viscous and not suitable for the application.
The third test (v03) was carried out by doubling the clay content and re-introducing the fluidifying agent. In this case, the viscosity in output from the mill seemed appropriate for application and so the next step was to perform an application test using airbrush. The application was carried out on a stoneware mix base on which had previously been applied one *smaltobbio* (glazing via digital application) and a glaze by airbrush and three serigraphic applications by means of rotocolor.
The lead free glaze was adequately spread but post firing appeared to be too "dry". Another attempt at grinding was thus attempted (v04). In this case, the amount of clay

was increased by 50% compared to the previous test, while the fluidifying agent content was reduced by 25%. The suspension was also ground to obtain a residue of 0.4 .
The resulting suspension however highlighted a viscosity that was too low. This was attributed to excessive grinding and thus the same test was repeated but stopping at a residue of 0.5.
The resulting suspension was applied as in the previous case, and the results were satisfactory for use in production.

Once optimisation of the process of grinding/fluidisation was completed, the frits and glazes were again examined in depth to test if the process had altered the components, and if stability of the frit in the suspensions obtained was evident.

Problems encountered There were no serious problems relating to the execution of this action, even if numerous tests were performed before obtaining satisfactory results; despite the action being started with some delay in the schedule, the provision of a correct buffer period meant that in any case it was possible to conclude the action within the prescribed deadlines. In the application it was feared that all the types of ceramic support necessary to experiment with the glazes (single fired, dual fired, porcelain stoneware and third fired tiles) would not be available but thanks to careful planning of the production, Ascot was able to avoid this problem occurring.

5.1.7 **Action 9 - Pilot line**

Envisaged start date: 01/09/2012
*Actual start date:*01/06/2012
Envisaged end date: 31/08/2013
Actual end date: 31/08/2013
Current state: concluded

Activities performed and objectives achieved The start of this action was brought forward by 4 months to ensure completion of the works as scheduled in the original project.
A period of relative lowering of orders, then finished at the end of the year, made it possible to divert personnel from normal business operations to dedicate them to this task; the actual interventions took place in August, during a period in which the impact on production was the lowest possible.
We have already started, thanks to the suggestions resulting from the development of tasks 6 and 7, the numerous changes that were necessary for the glazing plants, of sintering and of choice arising from the use of new boron based materials that have viscosity and particle size that is very different from traditional glazes and that therefore need adaptations to the existing plants: these changes had not been budgeted for at the design phase as these types of technical interventions had not been expected and in fact the relevant costs had not been budgeted .
Interventions focused on different departments:

Presses Department
The shape of the molds and the powder loading system was changed as at the stage of firing the boron glazes show a variation of viscosity that was different compared to the lead glazes. The edges of the base were modified in such a manner as to avoid a situation where during the thermal treatment a glaze with excessively low viscosity could seep out, causing problems with the furnace rollers.

Grinding department:
The grinding department did not need further adaptations in this phase but further analysis and optimisation of the process of grinding/fluidisation was in any case required for scale production.
For production of the first tests glazes mixed by Colorobbia spa were used.

Changes to the glazing department:
The use of Boron based glazes in place of lead glazes involved some modifications to the glazing process, since the presence of boron in the frits imparts various properties to the mortar of glazes.
While Boron in general gives a higher chemical resistance to glasses, the high percentage of boron required to match the melting of leaded glazes, creates some problems of solubility in the water when the frit is mixed in water.
This is the reason why the mixing of raw materials containing high percentages of Boron was performed with a dry method.
In any case, when the boric frit is mixed with other raw materials to form the end glaze, it has to be mixed in water to produce the mortar needed for the application of the glaze onto the ceramic tile.
Once the boric frit oxide is finely mixed in water, this can produce a slight solubility of boron, which gives the liquid glaze different rheological properties. The glaze viscosity increases with the passing of time, and the pumps require more energy in order to slide the glaze.
The next step was to adapt the glazing department, both with regard to the stoneware production plant and with regard to the firing production plant.
These operations became necessary as the frit with a high content of boron have a solubility in water that is greater than lead ones, and as a consequence, the suspensions of finely ground boron frits have a high content of ions in solution and a tendency to increase its viscosity over time. It was therefore necessary to make adjustments to the systems, using systems that were mechanically stronger and therefore able to withstand the higher stresses that may occur during the use of boron based suspensions. It was also necessary to install a glazing pilot line with a respective loading group for large formats to be produced with the new frits. These interventions were quite invasive at the plant and thus, for reasons of safety and certification, it was necessary to secure the electrical system and to restore the flooring. In addition, it was necessary to make changes to the digital printers, in order to adjust the print and to obtain the same colour response for applications on new glazes with high boron content.
At a later date these parts were also replaced with components that were more suitable for the new boron frits such as the airbrush nozzles, the bearings of the rotocolor applicators and a number of pipes of the glazing system (with components of stainless steel to provide a greater resistance to suspensions rich in ions).

Changes to the sintering department:
The lead free glazes differed from the glazes previously used containing lead, not only in the chemical composition, but also in behaviour during the firing process. Despite the proven ability to create the same appearance of the final glazed surface, the lead free glazes follow different mechanisms of softening and melting.
Lead was used from the earliest articles in lead developed, thousands of years ago, since it has a very vast range of melting temperatures and determines a long "glass" phase, also called "workability".

The lead gives the glaze a high index of refraction which therefore, makes it relatively easy to embed in objects an appearance of shine and brilliant colours.
Ascot has replaced lead with boron, which has a good flow, but that reaches the melting point much earlier and develops a much lower refraction index. The boron frits, however, have levels of mechanical and chemical resistance that are higher, but show surfaces and colours that are less bright and require a drastic change in the profile of the firing temperatures, since their behaviour is completely different to lead glazes.
For all these reasons, it is not possible to use exactly the same equipment used for the lead glazes for industrial production.
The key part of the production line that needed to be changed was the firing furnace, especially with regard to the double firing production site, such as the glazes (chemical components), the timing of firing (temperatures), as they are very different from the single firing system of the tiles.
To be as efficient as possible, the industrial firing furnace for ceramic tiles was designed to correspond in the manner as close as possible to the timing of firing planned.
This means that the furnace is built in sections devoted to specific parts of the firing cycle. Each section can be equipped with burners or fans, depending on whether the section has the function of heating or cooling. But the sections of heating and cooling are not equal either. The heating sections of the preheating differ from the heating sections of the firing. In the same way the cooling section immediately after heating differs from the final cooling section.
The structure and nature of the refractory lining of the furnace also differs from section to section.
In order to adapt the existing firing furnace to firing of the lead free glazes it was necessary to arrange a thorough restructuring of the firing furnaces which involved at least the following steps:

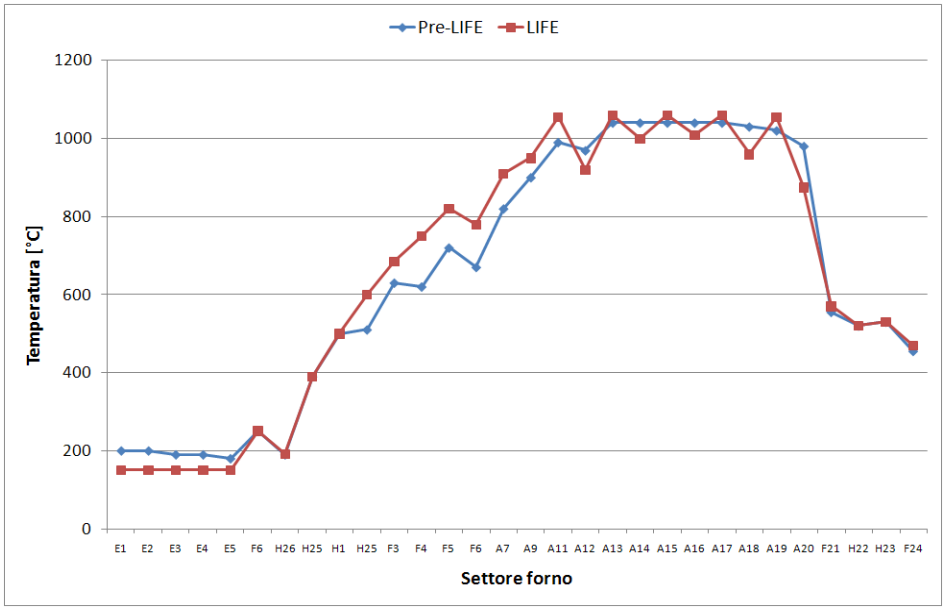
- Reconstruction of the ceiling of the firing sections
- Reconstruction of the walls of the firing sections
- Reconstruction of the pavement of the firing sections
- Replacement of the existing cylinders with cylinders of highest density aluminium

These actions will require the use of new:

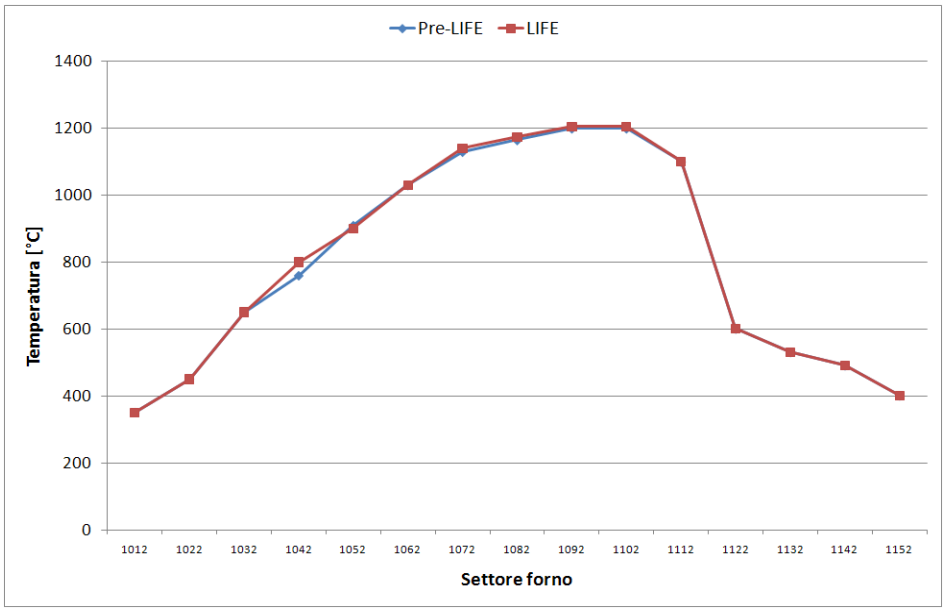
- Bricks for refractory walls
- Bricks for refractory ceilings
- Panels in refractory fibre
- Refractory felt
- Refractory plates
- Refractory wool fibre
- Refractory seals
- Refractory blakite concrete
- High-density aluminium rolls

The sintering department necessitated, in addition, the adjustment of the sintering parameters. In fact, although the final result obtained with the boron frit is comparable with that of the lead frits, the former required a sintering curve that was significantly different. To obtain the gloss level typical of lead frits it was necessary to treat the boron frits at slightly higher temperatures, also, to prevent excessive overheating of the base, the temperatures were not maintained constant at the maximum temperature, but the high temperature zone has a fluctuating temperature profile. This could cause problems of thermal stress on components normally used in furnaces. Furthermore, it should be

considered that the volatilisation of the boron, being very contained, could vary the environment inside the furnace and give rise to particular chemical attacks on the structures and insulators. For this reason it is desirable to have a plant with a high chemical stability as well as being resistant to high temperatures.
In the stoneware production plant this phenomenon is much less pronounced since most of the thermal energy provided is used for sintering of the base; thus the replacement of normal ceramic rollers with specific rollers for high temperatures and aggressive environments is sufficient.
The sintering plant of the glaze on fired support was, on the contrary, modified more in depth as in this furnace the only component that is sintered is the glaze and thus the heat cycle is specifically designed for the frits in use. Given that the boron frits have a different thermal behaviour it was necessary in this case to replace both the rollers with rollers with better performance and also all the internal walls of the furnace.



Sintering curves for dual fired glazed plant.



Sintering for stoneware plant.

Changes to the choice department:
Another department which was adjusted to the new lead free frits was the choice department. In fact, in order to be able to adequately analyse the tiles and to avoid reduction of the tiles of first choice with a consequent increase in waste, a new generation line of choice was installed. In addition, new loading ramps for interfacing the new system with the existing line was installed.

To validate the pilot plants for the production of tiles with lead free glazes tiles were produced using the pilot lines.
On 2/6/2013 approximately 600 square meters of double fired tiles of size 25x75 cm were sintered (25 mq are still at disposal at Ascot's plants".
A lead free boron glaze was applied on the fired base using a bell application. A final glaze was later applied using a bell applicator and ultimately digital printing for the final decoration was performed.
On 18/6/2013 almost 1000 square meters of porcelain tiles size 30x60 cm were sintered (25 mq2 are still at disposal at Ascot's plants, the rest has been distributed as sample).
One *smaltobbio* (glazing via digital application) and a glaze by airbrush were applied onto the dried substrate, later through rotocolor 3 serigraphs were applied, and finally, the final lead free glaze was applied by airbrush.

Problems encountered no problems were encountered.

5.1.8 Action 11 – After LIFE communication plan

Envisaged start date: 01/09/2013
Actual start date: 01/09/2013
Envisaged end date: 30/11/2013
Actual end date: 30/11/2013
Current state: concluded

Activities and objectives achieved at the end of the project the Project Manager along with the Dissemination Manager carefully examined the marketing activities and the results achieved by each of them. The aim was to identify the most effective activities for the promotion of Lead-Coloured Lead-Free following the conclusion of the project, in order to concentrate all the resources in that direction and to draw from it the greatest possible advantage. The actions were evaluated in terms of requests for information from contacts. It was clear that the actions that best generated requests for information were those based on direct contact between the project manager or the sales staff of the company and the customers of the company or new people that had shown an interest in the project. The dissemination manager therefore developed a dissemination plan focusing on strengthening of this instrument, providing at the same time explanatory support tools for personnel.
A detailed explanation of the post LIFE dissemination activities, that will be implemented for a minimum of 3 years from the date of conclusion of the project, is located in Deliverable 5 "After-Life Communication Plan".

Problems encountered no problems were encountered in the definition of the After Life Communication Plan. The Dissemination Manager was in fact well-informed on the status of the communication measures implemented during the project, which is the reason why it was not difficult to identify the most suitable route to effectively continue the marketing actions. Furthermore, it is thought that having the tangible results of the project (samples of frits, glazes and tiles), it will be easier to attract the attention of possible persons or companies interested.

Deliverables & Annexes
After-Life Communication Plan – Deliverable num 5 After Life communication plan

5.2 Evaluation

The program has been able to achieve important results not only from an environmental point of view but also from a technical perspective; the commitment and skills of the staff of Ascot and the external advice provided by Colorobbia and from the University of Modena and Reggio Emilia have enabled us to achieve important goals such as:

- *Melting process in two stages*: in the first stage is obtained a glass with a low melting point and a high content of boron, using temperatures to minimise the volatilisation of the boron. The second stage involved the melting of a glass "base", soda-lime-silicate, to which will gradually be added the first glass prepared in the form of powder.
- *Minimising the loss of Boron from the furnace:* A great step forward both from a technological point of view, because until now it was necessary to use special filters for the boron, to be replaced/regenerated frequently, and from an environmental point of view because emissions of boron into the environment are drastically reduced.

Alongside the most important results, the methodology of work applied has enabled us to achieve significant results:

- *Possibility of long term storage of the low-melting point frit with a high content of boron* Until now the storage of boron presented large problems due to the high solubility in water. The preparation of a high boron pre-glaze, on the other hand, stabilises the boron and inhibits its release into the environment where the frit could come into contact with moisture or sources of water, also allowing its storage for long periods of time.

- *Wide range of workability of the new glazes, aesthetic appearance and porosity similar to those of lead frits; the new* glazes are defined with a wide range of workability (between 800°C and 1150°C) since they allow the user to create glazes dedicated to the type of ceramic material on which they will be deposited, intended either for single firing or porcelain stoneware, or even third firing, thanks to the preparation of the pre-glaze with a high content of boron, low-melting, whose introduction into soda-lime-silicate glass will alter it working points proportionately to the addition.
- *Increased lightness of the tiles*: This reduction can be estimated considering that 0.315 kg/m^2 of lead compounds will be replaced by lighter boron compounds in the presence of lattice modifiers, giving a total of 0.2 kg/m^2 less. A lighter tile thus means lower static loads for buildings, and the ability to create structures that are more streamlined, in addition to lower power consumption for their transportation.
- *Cost comparable to that of the lead frits;* mainly linked to lower cost of the raw material which more than compensates for the increase of procedures to be used for the production of the tiles.

Further aspects of high innovation are not only found in the composition of the new frits but also in the production cycle which is applied:

1. Weighing raw materials;
2. Mixing and grinding raw materials;
3. Melting of the mixture at eutectic composition at temperatures below 950°C;
4. Natural cooling and grinding with cut of 35 micrometers and obtaining flux dust;
5. Weighing of raw materials of the frit body: silica, wollastonite, kaolin, calcium carbonate, sodium feldspar, zirconium;
6. Melting in rotary furnace of the prepared mixture, until achieving a high viscosity fluid;
7. Additive with lithium carbonate and dust flux obtained previously;
8. Fritting;
9. Grinding of the frit and adding of other components to form the glaze;
10. Application of the glaze on the base;
11. Firing and final choice;

Given the results obtained, fully in line with the objectives and timelines budgeted for, Ascot is undoubtedly satisfied with the methodology used. The initial planning of the activities to be carried out and the goals to be reached have been shown to be perfectly in line with the capability of the company and has led to obtaining the desired results. In implementation of action 5 "**Identifying the mixtures for the development of new boron based frits",** Ascot deemed it appropriate to use Colorobbia as external consultant as this had a better knowledge than Ascot of the Boron based systems. This situation proved to be of the utmost importance to the staff of Ascot that, having had the opportunity to assist the staff in Colorobbia in the activities undertaken, were able to complete their know-how which before had only been partial.

Ascot has realized a treatment process able to manufacture Leadless glazes. We define the findings “process” and not “pilot plant” since Ascot has implemented a system which make use of mostly existing equipments. This aspect is very important since it allows the fast

transfer of the technology to other companies. The major modifications refer to the grinding system which has been adapted based on boron's properties.
Ascot has widely tested the process and defined the best parameters for its working. The tests conducted have shown that it is possible to sinter almost 1000 square meters of porcelain tiles size 30x60 cm which is a very important results in terms of the industrialization of the process, since it showed that Ascot can produce more than the 500 mq2 of tiles, the quantity foreseen at the beginning of the process. The only production limit is the productive capacity of the grinding system which could be exceed in the case we insert in the process more grinding systems or if we develop a system to increase its productiveness without affecting the final products' characteristics. 50 mq2 of porcelain tiles manufactured with the new system are still at disposal at Ascot's plants (25mq of porcelain tiles and 25 mq of double fired tiles), the rest has been distributed as sample to clients and interested people.

FUTURE ACTIONS
The project "Lead-Coloured Lead-Free" has shown the effective possibility to build leadless tiles implementing a new environmentally friendly process which is able to produce up to 1'000 mq (upper limit reached). The process is functioning correctly, therefore Ascot is already working for replacing lead tiles with leadless tiles.
The steps to be implemented in order to achieve the complete replacement of lead tiles refer mainly to two departments:

- Sales department;
- Production department.

For what it concerns the first step, Ascot's sales teams are trying to foster the sales of boron based products. At the moment, they have succeeded conquering some customers but sales are still not sufficient to justify the building of a dedicated plant. The objective in the next years for the sales team will be the increase of Boron based products to a level which fulfil Ascot's productive capacity.
At the moment the maximum productive capacity of leadless tiles is 1'000 mq, however if the technical staff succeed in the increase of the grinding system's capacity, Ascot would be able to increase also the total productive capacity. The grinding system is, in effect, the only equipment which has been deeply modified; since, at the moment, Ascot can count only on one grinding equipment with a maximum capacity of 1'000 mq, the objective of the technical staff in the future will be the increase of the grinding productivity or the building of a new grinding system.
Ascot is willing to implement such actions, however the decision whether to do it or not depends on the sales ability of its salesmen and the financial availability in the next years. The forecasts for the years 2014-2015 appear positive, the entire Italian economy should reach positive results in 2014, if the actual trend would be so, Ascot would have enough money to implement a whole dedicated plant for the production of leadless glazes on a larger scale.
Concluding, if leadless glazes products succeed to penetrate the market and enough money are available, Ascot will industrialize the whole plant. At the moment, however Ascot has started the production of leadless tiles and it is about to start the selling activity.

– Compare the <u>results</u> achieved against the objectives

Task	Foreseen in the revised proposal	Achieved	Evaluation
A 1	Report Presentation to the European Commission	Yes	No difficulties were encountered.
A	Update on the status of progress of	Yes	Of fundamental importance in

2	the project, its objectives and the respecting of timing		the decision to bring forward the beginning of action 7 and 9, and to allow the relative timing of the overall project.
A 3	Preparation by an external auditor of the Audit report	Yes	Difficulty in identifying an auditor with a good cost-benefit ratio.
A 4	Establishment of contacts with interested parties upon commencement of networking with Ascot	Yes	The main sources of contacts were the trade fairs and events in which Ascot participated/organised
A 5	Definition of the composition of the mixture and outcomes regarding characterisations of the specimens	Yes	A good success with the help of the University of Modena, Colorobbia and Dr. Paganelli, that sped up the time and helped to obtain the results sought
A 6	Completion of the grinding plant	Yes	No particular problems were identified. It is inclined towards dry grinding.
A 7	State of progress of the changes to the melting furnace	Yes	A good success thanks also to the advice of Colorobbia in the creation of meltings
A 8	Creation of glazes containing Boron	Yes	The action was successful without any particular problems. It started late due to the time required to finish actions 6 and 7.
A 9	Implementation of the pilot line complete and functioning	Yes	No problems were encountered. The action began earlier than planned to ensure the conclusion of the activity within the preset times.
A 10	Implementation of effective dissemination activities	Yes	The dissemination activities carried out led to the achievement of results.
A 11	Drafting of the Post Life Communication Plan	Yes	No problems were encountered in definition of the post Life communication plan.

5.3 Analysis of long-term benefits

In this section please discuss the following:

1. Environmental benefits
    a. Direct / quantitative environmental benefits:

The environmental benefits are related to the elimination of the use of lead in the production of ceramic glazes replacing it with boron, a metal not harmful for human health or of risk to the environment. Lead is a poisonous material that if inhaled (in the case of lead powders), ingested or held continuously in contact with the epidermal tissues can cause numerous

diseases, including: lead poisoning, nephropathies, cholic abdominal pain, anaemia, fertility problems for women etc…
The complete removal of lead from the production cycle of glazes, means ensuring to the labour force employed in manufacturing functions, a safer environment, free from potentially harmful substances for the health of the employees; the most obvious result in the short term will be the decrease of absences due to illness, while in the long term there will be fewer cases of diseases linked to exposure to lead.

The elimination of lead also determines a positive effect on the environment consisting of the absence of risk of loss of the substance. Given the harmfulness of the material in the event of loss of lead into the environment, damage can be substantial, ranging from contamination of animals and plants, from contamination of water reserves to harm to humans. Despite the fact that the transport systems and the provisions on the treatment of lead take into account the danger of the substance, accidents or extraordinary events can always occur through which lead is poured into the environment with disastrous effects on the flora and fauna.

Despite Boron not being a dangerous substance, Ascot has nevertheless focussed on providing a system that limits emissions into the environment of this element. Boron, in fact, volatilises at relatively low temperatures (700-900°C) and as a result, the inaccurate preparation of boric frits could mean the emission into the environment of large amounts of Boron. Ascot has found a solution to the problem, by implementing a new melting process in two stages whereby that involving the boron is conducted at low temperatures thus minimising its volatility while that at high temperatures is conducted for a shorter time with the addition of a glass molten with a frit and thus already with a glass.

The environmental benefits can thus be traced back to the elimination of the use of lead and the minimisation of emissions into environment of boron, while maintaining an excellent quality of the glazes and of the tiles.

b. Relevance for environmentally significant issues or policy areas

The field of reference for the Lead-Coloured Lead-Free project is the ceramics industry, a notoriously sustainable industry. Ceramics companies in fact use large amounts of raw material and energy in their production and emit into the environment large amounts of CO2 and other fine dust. It should also be considered that most of the ceramic production takes place between Italy and Spain and that the largest industrial district of the world is concentrated in the area where Ascot operates, namely Emilia Romagna. In 2010 the Italian production of ceramic tiles involved a share of 387.43 million square meters of which 81.00% of the national production was carried out in the provinces of Modena and Reggio Emilia, with an impact on the national total of 79.49% for the direct activity and 91.27% for third parties (source: statistical surveys Confindustria Ceramica). At a global level, approximately 70% of the tiles produced contain lead glazes which means that in the province of Modena and Reggio Emilia alone approximately 219.7 million square feet of glazed tiles are produced. Emissions of lead compounds per kg range from about 0.01 g to 0.1 g and the average weight of a square meter of a tile and porcelain stoneware is approximately 20 kg which means that for every square meter, in the best case scenario, approximately 0.2 g of lead compounds are released into the atmosphere that are equivalent to 43.9 million g of lead compounds released into the atmosphere of the provinces of Modena and Reggio Emilia every year.
It is therefore extremely important to preserve the health of the population living in the surrounding areas of the district, using all the strategies necessary to lower the levels of

pollution and the use of toxic substances. The project of Ascot fits well into this vision, allowing the elimination of a substance that is very harmful to both human health and the environment, namely lead.

2. Long-term sustainability
   a. Long-term / qualitative environmental benefits

At a global level, the overall production, at the end of 2010, was equal to 503.11 million square meters, deriving from porcelain tiles for 224.5 million square meters (44.63 %), from single fired tiles for 90.1 million (17.90 %), from technical porcelain for 120.8 million (24.02 %), followed by single firing for 46.2 million (9.17%) and 21.5 million from the category 'other products' (4.28 %) (source: statistical surveys Confindustria Ceramica).
If we consider only the production of European glazed tiles (941 million square meters X 70% = 658 million square meters) we obtain a level of emissions of lead compounds that is extremely high, equal to 131.6 million. If we then consider the world production of tiles of 9,350 million square meters, the level of annual emissions of lead compounds is very high (Source: own date and D. Stock: World Production and Consumption of Ceramic Tiles, Tile Today #73, 2011).
Ascot aims to disseminate the technology developed at least in Europe, through marketing and communication activities that first of all show the actual need to abandon the use of lead in the production of glazes. Since the project has devised a way to eliminate lead and not to reduce its emissions, the adoption, at European level, of this technology would mean a reduction equal to 131.6 million g per year of emissions of lead compounds.

Ascot has come up with an innovative method to produce lead free glazes thus in fact the innovative product made can be adopted not only for any application that involves the use of ceramic glazes but with the necessary arrangements and the necessary modifications they can also be used for the production of other types of glazes that are not strictly ceramic.

   b. Long-term / qualitative economic benefits

The economic benefits that can be obtained by this project are mostly linked to the cost of production of boric frits. Boron has a lower market price compared to other lead free materials such as barium, which causes considerable savings in the purchase of raw materials. Given that the manufacturing process of Boron is slightly more complicated, the producer of the boric frits will support production costs that are slightly higher compared to the production of other types of lead free frits. The result is a production cost that is very similar when comparing boric frits and lead free frits. If, however, we consider the fact that the melting point of boron is very low, a factor that determines energy savings, and that with the new technology developed we are able to store the material for a long period of time, putting the company under the conditions to exploit price fluctuations on the market, we obtain a final lower price.

Another very important economic benefit for Ascot, for the sector in which it operates, and for the industrial district in which it is inserted, is the production of knowledge. Thanks to the study and experimentation made, Ascot now possesses innovative know-how that it can exploit as a competitive advantage when dealing with other companies that are part of the sector. The competitive advantage achieved will push competitors to realise other technological and environmentally friendly products in order to compete with Ascot. This circle of production of knowledge and technology, which also involves a number of

Universities, will serve as a driving force for the relaunch of the ceramic industry, in crisis due to the low cost of competition foreign, and of the Italian economy.

c. Long-term / qualitative social benefits

The social benefits that can be achieved by this project consist mostly of the following effects:

- Improvement of the working environment and decrease of diseases related to its exposure;
- Damage reduction linked to the dispersion of lead into the environment.

Lead is a poisonous metal that can have serious effects on human health. In the course of time, attempts have been made to remove lead from as many applications as possible since it has been found that it can be the source of a number of diseases in humans including: nephropathies, cholic abdominal pain, anaemia, fertility problems for women etc… The removal of lead from ceramic tiles, therefore, would not only improve the working conditions of labourers protecting them from potential risks to their health but would also avoid putting at risk the health of millions of people that use these tiles in their own homes. Its removal would thus avoid all the problems related to contamination of the environment by a non-biodegradable and poisonous material such as the poisoning of animals or plants and the pollution of water sources.

3. Replicability, demonstration, transferability, cooperation

Ascot has produced an information campaign for the project and an action of networking not only to provide communication of the project, but also to search for companies to adopt the technology developed. In the second case, Ascot will be fully available for transfer of the technology and to support the changes to be implemented to make the system operational with even larger volumes.
As the innovation achieved regards glazes, the project, at least theoretically, would be transferable to any type of application that uses crystal frits, such as for example bathroom accessories. Ascot is therefore available to define, together with the company concerned, the modifications to be made (for example relating to applications) so that lead can also be suppressed in other applications. Ascot will also seek to identify other types of potential uses, in addition to the ceramic industry, even if they are not easy to identify; for the purpose of carrying out this task it will seek external assistance, such as interviews with knowledgeable characters i.e. connoisseurs of different industries capable of directing the work of Ascot.

The replicability, portability and application of the technology developed will be always sought after not only nationally but also at an international level since there are no particular restrictions that keep the technology relegated only to the national context. Communication activities were carried out in two languages (Italian and English) in order to reach an even broader public. By utilizing, in addition, the international sales network of the company Ascot will be able to reach and study as far as possible each potential foreign application/localisation.

As a result of the implementation of the networking activities, we have identified two companies that appear to be very interested in the technology: Ceramiche Gardenia

Orchidea and Majorca spa. The companies in question are among the most important ceramic enterprises in the sector and transfer to them of the technology would ensure adoption of the same by at least as many companies in the sector, worried of losing competitiveness.

4. Innovation and demonstration value: Describe the level of innovation, demonstration value added by EU funding at national and international level (including technology, processes, methods & tools, organisational & co-operational aspects);

The funding received from the European Union has been of fundamental importance for implementation of the project in question. The last few years have been particularly difficult for the entire ceramic industry, characterised by a reduction in turnover and a relocation of the markets for the sale of goods, increasingly geographically distant from Italy, with the consequent need to restructure the commercial and productive equipment. In a period such as the one described, it is not always easy to find the strength and the courage to invest in research and development. The assistance of the European Union was not, however, only financial in nature; the European Union is a worldwide symbol of guarantee and safety; therefore, being able to state that the project has the support of the European Union is already synonymous with reassurance for customers that could potentially adopt it.
The Life program, moreover, is not only recognised in Italy but also across Europe, another factor that helps the dissemination of the project beyond the national boundaries.
The European Union has not only allowed Ascot to realise the project that otherwise it would not have been able to pursue, but indirectly also supports the dissemination of the same via the affixing of the Life logo.

5.4 Dissemination issues

Envisaged start date: 01/09/2011
Actual start date: 01/09/2011
Envisaged end date: 31/08/2013
Actual end date: 31/08/2013
Current state: concluded

There were mainly 3 objectives of the dissemination activities of the project:

- Dissemination of the results of the project;
- The greater involvement of the public in environmental issues;
- The dissemination of the LIFE+ program.

The public purpose of the disseminative activities consisted for the most part of producers of glazes and ceramic tiles and in general industry operators, public and environmental agencies, universities and the general public of people interested in the subject.
There were numerous and heterogeneous tools used to achieve these objectives to better fit the different target audiences.

In the application the planned activities were the following:

Events

Reference public	General public	Specialised public
Number of participants:	National	National
25-75 participants	1	2

Communication means

Type of communication medium	No.
The project web site: average number of visitors per month	50
Articles in the local press for the general public	2
Specialist articles	2
Audiovisual products	1
Audiovisuals presented at events	1
Trade fairs participated in	2
Posters of the project	6
Banners at the trade fairs	2

Publications

Publication type	No. Published	No. of copies
Layman's report	1	1000
Flyers	1	1000
Brochures	1	200
Posters	4	8

5.4.1 Dissemination: overview per activity

- *WEB SITE*: A short time after commencement of the project, Ascot opened on its web site a section entirely dedicated to the project "Lead-Coloured Lead-Free" and the Life program. The section was translated into 4 languages (Italian, English, French and German) as the objective of the company was to contact a European public. The section was structured in such a way as to keep the public concerned constantly updated on the progress of the project. A section "photographs and videos" was also created by means of which it was possible to view a number of photographs of the plants and the components of the plant and to view the clips of products.

Objectives and feedback

The section dedicated to the Life project, well organised and well thought out from a graphic point of view, is proving of great success; just think that at the application stage 50 visits per month were envisaged, while we were able to achieve 14'281 visits between September and December. The web site also offers the opportunity to get into contact directly with the project manager to obtain more in-depth information about the project. The fact that a number of requests for information have been received through this portal leads us to believe that the section dedicated to the Life project has proved to be more than adequate.

- *FACEBOOK*: Ascot provided news of the project through its Facebook page (https://www.facebook.com/ceramicheascot?fref=ts) posting information, photos and videos relating to the project. The Facebook channel is very important as it allows reaching of a young audience that is not usually interested in the ceramic environment. Ascot on Facebook boasts more than 326 friends and followers that sporadically place on its bulletin board a number of posts of the company increasing exponentially the visibility of the information provided by the company; the video relating to Lead-Coloured Lead-Free was reproposed on its board by 11 different people.
  Ascot was also requested to propose on the page" Think-Eco Live-Green " (https://www.facebook.com/thinkecolivegreen) information about the status of progress of the project and the results achieved, together with videos and photos and the company was happy to participate. "Think-Eco Live-Green" is a Facebook page where the information is gathered on a number of projects implemented through the Life and Cip programs. Participation in this page is very important as it allows us to reach out to an audience interested in these types of projects and that follows with participation the innovations proposed
  Using these tools we were able to increase the project visibility and attract the attention of the public interested in industrial innovation and environmental issue themes.

  Objectives and feedback

  The use of Ascot's Facebook page is providing excellent results in terms of visibility of the project both in Italy and internationally, in fact, the posts relating to Lead-Coloured Lead-Free are published both in Italian and in English. The interest shown by the public is considerable, so much so that for certain posts we identified various shares (11 in the case of the video related to the project). The page Think Eco Live Green is also helping us in the work of diffusion of the project, on a target of different people. While followers of the Ascot page are in fact interested in the activities of the company, the followers of the page Think Eco Live Green are interested in general in projects of industrial innovation, both in Italy and abroad. The success of the strategy through the Facebook channels has proved effective, in fact, we have received a number of requests to obtain more information about the project especially from a young audience.

- *ARTICLES:* an informative article was published on the project "Lead Coloured Lead Free" in the magazine "*Persone&Conoscenze*". The main target of the article are the entrepreneurs and managers in an attempt, in addition to providing news of our

project, to provide evidence regarding those categories that even a medium-sized enterprise can realise innovative environmentally friendly projects.

A second article was produced that will be published in February for the specialist magazine "Ceramic World Review"; given the high skills of the audience to whom it is addressed, the article was written in collaboration with the University of Modena. The article can be viewed in annex 10 "Pubblicazione_Febbraio2014_Ceramic World Review".

Objectives and feedback
The aim of the article that will be published in the specialist magazine is to point the spotlight of the scientific community on the project of Ascot; for this reason, the article will be written jointly by the University and the company, while the article published in the daily newspaper aimed to attract the attention of the general public. The obtained results are difficult to quantify but given the large number of readers of the newspaper, we believe we have reached a large number of people.

- *TRADE FAIR*: despite advances in technology and the new opportunities for online interaction, trade fairs are the places in which it is easier to create connections between companies and where it is possible to find new customers. Trade fairs are also the ideal place to show off a technological innovation, given the conditions of presenting it simultaneously to all the relevant major players in the industry. Unlike the tools available on the internet, in addition, the interaction is physical, between the customer and the representative of the company; in such conditions there is usually more time to address in depth the topics and find meeting points between the parties. For these reasons Ascot decided to participate in several trade fairs of the sector and on those occasions to present the project Lead-Coloured Lead-Free.
  The trade fairs Ascot participated in are:
  - Cersaie 2011 held in Bologna from 20 to 24 September 2011;
  - Cersaie 2012 held in Bologna from 25 to 29 September 2012;
  - Coverings 2013 held in Atlanta from 29 April to 2 May 2013.

  The trade fairs selected represent the two most important events during the year for the players in the field of ceramics. Cersaie is the most important international trade fair for the ceramic industry, an appointment not to be missed given the quantity and quality of the contacts that can be created, and also a large window on Europe. Coverings is an equally important appointment in the American and Asian panorama. Thanks to the presentation of its project during these two trade fairs, in fact, Ascot was able to promote Lead-Coloured Lead-Free personally to the main global players of the ceramic market.

  Objectives and feedback
  The main objective of the participation in the trade fairs was to provide information about the project and the Life program and to establish contacts with people interested in the project. Ascot is considered to be very satisfied with the results of the trade fairs: 90% of the promotional material printed was distributed on those occasions and the staff on site were able to establish numerous contacts with interested people, some of whom requested afterwards further information about the project and to be kept informed on its development.

- *FACE-TO-FACE COMMUNICATION*: all the managers involved in the project worked to ensure the project was promoted outside. The idea was to exploit the network of contacts of the manager and the recognition they enjoy to effectively disseminate the project and to use word of mouth within the ceramic district. Not only did managers carry out this activity but this was also taken up by some of the vendors that had been entrusted with this task in addition to their normal duties to test its efficacy.

  Objectives and feedback
  The objective of the project was to exploit the personal knowledge network of managers and marketing personnel to implement word of mouth and to increase the number of people requesting information on the project and therefore the opportunities to create collaboration agreements. The activity proved very effective and the most important contacts were received from this channel, thanks to the knowledge of the project manager; Ceramics Gardenia Orchidea spa and Majorca spa expressed a desire to analyse the project more in depth in order to assess possible interactions with Ascot or the definition of a new project which starts from the conclusions of Lead-Coloured Lead-Free .

- *EVENTS:* Ascot on the occasion of the 20th anniversary of the Life program, participated in the event organised by the University of Siena entitled "*Una passione naturale*". On that occasion the company had the opportunity to present its project to an audience of professionals from the academic and the industrial world, even in areas other than the ceramic environment.
  Ascot also organised an information event at its facilities on 25 July 2013, during which, after having given an explanation of the operation of the innovative industrial process, also gave the participants the opportunity to see the system operating directly and touch first hand samples of the product. This final event of the project was very important for dissemination of the project because it provided the opportunity for the company to show the public the excellent quality of the products produced without the use of lead glazes. The invitation to participate to the event organized has been sent to 46 people, 24 participated to the event; we think this is a positive result since more than a person over two showed interest in the project.

  Objectives and feedback
  The key objective was to create a space in which it would be able to give detailed explanations on the operation of the project. The first event that was held was provided on half the project relating to the proposed objectives and the state of progress, while during the second event it was possible to show off the pilot plant in operation and to present some samples of the product. Ascot is satisfied with the outcome of the event, in fact there were 24 people who were active and involved in the explanations.

- *PROMOTIONAL PAPER BASED MATERIAL*: Ascot, in the role of Marketing department, is committed to carrying out different dissemination of material to be distributed to customers and people potentially interested during the trade fairs, events, or meetings with the management. Several flyers, brochures, posters, and a layman's

final report were produced explaining the project. Despite the fact that today computer based information tools are tendentially favoured, brochures and leaflets, especially if well made, continue to have a great appeal for customers; we noticed, in fact, that during the trade fairs customers willingly gathered the flyers and brochures offered to take them back to their companies The posters also played an important role especially when used during the trade fairs and events, acting as catalysts of attention; many people paused at the stand during the trade fairs that Ascot participated in to understand better the object of the project.

Objectives and feedback

The objective was to attract attention by distributing the printed material during trade fairs and events or on other occasions. The objective is considered achieved in that all the material that was planned to be produced was made and all the printed copies were distributed, in particular were made:

- 1 Brochure 200 copies distributed;
- 1 Layman's report 1000 copies distributed;
- 4 Notice Board 8 copies printed;
- 1 Flyer 1000 copies distributed;
- 2 Posters 4 copies printed;
- 1 totem;

- *AUDIOVISUAL:* An interview video relating to the project of Dr. Simone Manicardi by "TRC" was produced, the local broadcaster in the province of Modena. In the interview the manager explains the operation of the project, showing some of the steps of the processing, and mentions the support received from the Life program. The channel chosen often focuses on news of the events that affects the ceramic world, given the importance of the sector in the province of Modena. Projection of the video thus insured Ascot high visibility within the Emilian ceramic district. The video can be viewed online through various channels: Ascot's web site (http://www.ascot.it/en/fotografie-e-video/), You Tube (http://www.youtube.com/watch?feature=player_embedded&v=ii_M8bzyx-g) , Ascot's Facebook page (https://www.facebook.com/CeramicheAscot?fref=ts) and Facebook page Think Eco Live Green (https://www.facebook.com/ThinkEcoLiveGreen). The option of receiving the DVD of the clip was offered to those who requested it at zero cost. We have not realized other audiovisuals since the interview done by TRC satisfies the needs of visibility and explanation. Our customers who have seen the interview said that they liked it because of the freshness and clarity of the explanations; we have therefore decided to realize a DVD with the interview to be distributed upon request and make the Audiovisual available online.

  Objectives and feedback

  The main objective was to disseminate the project with a tool that could reach a wide and heterogeneous audience. For this purpose the airing of the interview on TRC (TeleRadioCitta), was very important, a channel discreetly followed in the province of Modena.

- *LIFE LOGO AND STICKERS IN THE COMPANY :* Ascot also committed to creating a new letterhead with the Life logo and the name of the project. The letterhead is used for countless communications, in this way Ascot is able to provide knowledge of the project and of the Life program to all the people with whom it has relations. If the instruments described up to this time had the objective of informing the public outside the project, and possibly creating links for its widespread use, with the affixing of Life stickers and placing of the Life flag in prominent places of the company, Ascot aimed to stimulate the interest of its employees, even those who were not involved in the project. Knowing that they are part of a company that focuses on and is concerned about the environment inspires pride and a sense of membership in employees and helps to create a better working environment.

  Objectives and feedback
  The main objective was to arouse the curiosity of the internal staff and of customers with the placing of non explanatory references on the letterhead and on the plant so that they could be encouraged to ask for more information. The objective may be considered achieved in that our staff increasingly found themselves in the position of providing explanations regarding the project Lead-Coloured Lead-Free and almost all of our internal staff are aware of the project and the Life program.