THE NEW REVOLUTION

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1. INTRODUCTION

The two most important milestones in the development of industrial ceramic floor and wall tiles in the last thirty years have undoubtedly been:

- The single-deck kiln.
- The glazes required for fast single-firing technology.

1.1. THE SINGLE-DECK KILN.

The single-deck kiln changed the manufacturing concept of ceramic floor and wall tiles completely by enabling more direct and uniform tile firing in the kiln, eliminating most of the thermal inertia due to the large refractory masses in the previous generation of kilns, the tunnel kilns, which were needed for transport, tile supports and burner insulation. The single-deck kiln raised energy transfer and enabled very accurate firing control. It allowed:

- Changing from cycles often longer than 12h to cycles of even less than one hour, in the worst of cases.
- Making sufficiently large tile sizes to meet both past and present market demands.
- Developing ceramic floor tiles with new aesthetic qualities and technical parameters appropriate for each use.
- Manufacturing both floor and wall tile in a single firing.
- Enormously lowering energy costs by only consuming the energy needed to fire the pieces, but not to heat enormous refractory masses.
- Automating processes owing to much less handling, with the ensuing labour savings.
- Harmonizing qualities by achieving much more uniform firing conditions.

The above were but a few of many consequences.

1.2. THE GLAZES.

All the advantages contributed by the new single-deck kilns would not have been feasible without new families of glazes with revolutionary formulation concepts, able to provide the tiles with appropriate quality in these reduced firing cycles.

To be able to produce ceramic floor and wall tiles in a single firing, new glazes were needed that were quite different in formulation from those of the previous double-firing or long cycle, which enabled surmounting the great technical difficulties caused by the reactions that take place in the sintering of tile bodies and in the body interface with the glaze.

It is not the same to fabricate a small-size ceramic tile as it is to manufacture the large-size tiles that can be made in single-deck kilns. The stresses inherent to the whole thermal process are quite different in both cases, being much more important and unpredictable in the latter. This was why it was also necessary to develop new glazes for both floor and wall tiles, which would allow making these large sizes. The ability to fire ceramic tile without being bound to enormous thermal gradients inside

the kilns thanks to the new single-deck kilns, the optimization of ceramic body compositions, availability of new families of glazes, and design and implementation of devoted application techniques, cleared the way for large sizes, which have enormously extended the commercial possibilities of our ceramic products, both in floor and wall tile.

Ceramic floor tile was born with the challenge of achieving the technical qualities that would enable overcoming the loss of surface quality caused by wear on exposure to continuous abrasion by the elements moving across it, i.e., to scratching, produced by elements of greater hardness, or the opening of possible inner porosity, which allows dirt to lodge inside these pores, with the entailing degradation of the tile's surface appearance. The development of dry glazes, grits and granules, has enabled achieving the aesthetic qualities of natural stones, marbles and granites, which were needed from a decorative point of view, while responding at the same time to the technical demands mentioned with regard to loss of surface quality by abrasion. This led to the fabrication of the famous PEI V ceramic floor tiles, nowadays far outstripped, all of which contributed to their success.

These two milestones have been pivotal in the development of modern industrial ceramic tile world-wide, accompanied naturally by other technological advances (adaptation of ceramic body formulations to the new technological demands, new application systems, milling facilities, presses, automations, rotary screen printing, plant computerization, robots, etc.), which have followed each other in the course of these last thirty years.

2. THE NEW REVOLUTION

The unquestionable attraction of ceramic material undergoes continuous renewal and ennobling with modern technological production systems, a continuous evolution that in the course of recent years has driven parallel advance in stylistic research and technical research, whether focusing on machinery or materials.

The last three or four years have witnessed new production technologies that enable manufacturing ceramic floor and wall tiles, but especially floor tiles, with aesthetic and technical characteristics unlike those ever made before. These products are fundamentally made with dry glazes and pursue two main objectives:

- Having an appropriate product for any construction space.
- Having aesthetic and technical characteristics that make them indistinguishable from natural products such as rocks, red stone, marble, granite, etc.

in short, attempting to make different products from those currently marketed.

Products are involved, fabricated by processes that are already colloquially known as:

- DOUBLE CHARGE
- DOUBLE PRESS

Attempts to introduce dry glazing have been made in the past, because of the unquestionable advantages this affords, but the problem had only been solved in a very limited fashion, as such attempts were limited to the development of new anhydrous glazes implemented in a conventional process. In contrast, the solution proposed here is much more far reaching and is based on designing a new process around the concept of dry glazing. This is possible because materials and production stages are substantially innovated, while using the technological premises of a traditional process, a key element to industrial dissemination.

The double-press process, just like the double-charge process, stems from the perception that the set of factors on which the competitiveness of the industrial ceramic tile manufacturing sector depends could be considerably improved. The production process at issue will enable:

- Reducing the energy and water needs of the process.
- Shortening the complex lines for transforming raw materials, with a notable reduction of space in manufacturing contexts.
- Optimizing process lay-out, improving all aspects of production, such as quality, simplicity of the processes, products made and labour conditions in the workplace.
- Reducing the amount of waste material arising during processing, mainly flue gases and sludge, with the ensuing reduction in waste treatment and/or disposal costs.
- Obtaining new totally differentiated products from traditional products.

The environment is a high-priority issue in areas with a high concentration of factories, whose flue gases and sludge emissions, if inappropriately treated, would irreversibly harm the territory.

For this reason, the prime mission of organizations in charge of safeguarding the territory is to encourage companies to equip themselves with these technologies, requiring them to respect a series of limitations on harmful emissions. Stringent regulations are thus being put in place, stemming from the bad situation in certain areas of heavy great industrial concentration. This has led to great pressure by public opinion, which is steadily becoming less tolerant with those that, despite having the possibility of acquiring technologies that reduce hazardous emissions, nevertheless pollute the environment.

In view of this situation as well, the design of a production system that offers beneficial alternatives from an ecological standpoint and improves labour safety, while simultaneously reducing the hazardousness of harmful emissions such as flue gases or sludge, has been considered of great interest. This, in addition to the other advantages already set out above.

It has been necessary to fine-tune each manufacturing stage with the new methodologies, while also fine-tuning specific products, glazes and frits, which assure obtaining a superior quality finished product from an aesthetic and technical point of view, characteristics that provide a glimpse of possible uses in other fields of application beyond building construction.

Each of these processes is briefly described below.

2.1. THE DOUBLE CHARGE

For quite some years, various proposals have been around in the market of mechanisms capable of fabricating ceramic tiles by means of this procedure. Developed in principle to be able to manufacture and decorate technical porcelain tile (water absorption below 0.05%), these systems are now also used for dry glaze application. There are different procedures, but the most widespread consists of introducing into the press cavity, when the filler carriage enters, a first charge of base spray-dried powder (which may be uniform or a mix of several previously proportioned colours), and at filler withdrawal, a second charge by different methods. The various filler charging systems and technological towers in the market are quite well known.

Depending on the methods used, this second charge can give rise to various effects. For example, if a belt with an incision of the desired design is used, moving at the same speed as that of the withdrawing filler, it lets a certain amount of material fall on the previously deposited base spray-dried powder, reproducing the design cut in the belt, a design that changes because the belt is longer than the tile.

Systems of grids and hoppers are also used to introduce different colours in the second charge, to apply designs on the base spray-dried powder. Other procedures are also available in the market for performing this decoration work, such as robotized systems, rollable acetate rollers, etc., while different materials can be used to obtain the desired effects, from micronized colours to more or less coarse flakes, spray-dried powders coated with various colours, etc.

Furthermore, the compositions of these decorative particles can vary, and may be of coloured clays or glaze, matching the characteristics of the body, so that after the whole piece has been pressed, subsequent firing of all the components together originates no defects caused by pronounced differences in fusibility or coefficients of expansion.

When glazes are involved, the chromatic wealth and different effects are much greater than when coloured clays are used, and they allow obtaining very attractive aesthetic characteristics of great commercial interest.

A process innovation is involved that has immediate implications for the product, from both a technological and aesthetic point of view. Whatever the type of product made: trims, natural stones, majolica, etc., the result is quite astounding. The degree of similarity with natural models is so great that it even surprises the best trained and most experienced technicians.

In addition to the technical and aesthetic component, this process allows manufacturers to shorten the long wet glazing lines and reduce related glaze preparation departments, while avoiding effluent pollutants and the typical rheological problems of wet applications, as well as providing considerable savings in the quantity of glaze to be applied. Therefore, in the plants of the future, manufacturers will find a solution that enables them to save space in their factory halls, avoid technical problems and pollution, achieving automatically controlled lines, thus reducing production operating costs and, in particular, enabling them to make a new product.

The main disadvantages of this method are, in the first place, the loss of production output at the presses, which logically, on having to perform more operations during charging, run fewer cycles per minute. In the second place, there is the poor definition that is obtained, and thirdly, the restricted versatility in the decoration, so that the types of finished product are normally limited to the field of rustic products. In any case, even with these limitations, it is a perfectly valid procedure.

2.2. THE DOUBLE PRESS

Trying to overcome these limitations has led to the development of the double-press method, which consists of forming the piece at low pressure in a precompactor, to decorate the resulting piece in a small application line of glazes or micronized colours, or other clay products, in which it is even possible to apply screen prints with rotary machines, or in any case, using inks with high solids content, subsequently pressing the decorated piece again in a second press at the definitive pressure. In this second press, the relief that is desired can be engraved in the tile, which affords the possibility of having the decoration, previously made even with high definition on the flat piece, penetrate into the sought relief.

These decorating options, together with the possibility of introducing colour and even of a grained appearance in the mass, allow us to make ceramic materials with completely natural effects, in which the appearance of the top part of the ceramic tile and the appearance of the bottom part, are in harmony, producing an integral tile, in which body and glaze no longer go their separate ways, but form a whole.

Taking into account that the products thus made are decorated flush to the edge, and that the machining process is becoming increasingly widespread, this allows avoiding the grid network effect of traditional ceramics. This enables these ceramic products to occupy a wholly different commercial space from the traditional one.

The different stages involved in the Double-Press process are described below, which basically depend on the type of product to be made and on the aesthetic wealth and technical features to be contributed to the final piece, which can notably alter the levels of tile finishing, investments, etc.

2.2.1. Stage 1: Precompaction

The purpose of this first stage is to compact a charge of spray-dried clay powder at low pressure, in such a way as to form the ceramic tile so that it has the minimum green mechanical strength required to enable transport and decoration of the piece between the two presses, but with maximum formability, so that it can subsequently be pressed under standard working conditions without problems of delamination, etc.

This first step can be performed with low tonnage conventional presses or other forming systems such as electric presses or current precompacting rollers.

The difference with respect to the traditional process is that this operation is conducted at a far lower pressure than the pressure applied in the presses that are generally used.

In this stage, a wide range of decorating possibilities is already available, as it is possible to use Double-Charge systems in the first press, or use heterogeneous

charges of coloured spray-dried powders, introduce robotized systems for the surface charge or the through-body charge, etc., as well as providing the versatility of being able to have a completely smooth or structured piece, before the decoration between the two presses.

2.2.2. Stage 2: Glazing and decoration operations between the presses

In this operation, the various desired individual decorations are applied to the surface of the piece, which may or may not be structured.

In this stage it is possible to apply materials ranging from spray-dried glaze powders, spray-dried flakes or glaze flakes, coloured spray-dried powders with the latest advances in dry decoration machines, to microgranules, etc., or we can even decorate by wet application with a high degree of definition, without causing problems in the second press, due to the high solids content that wet screen prints have and the high degree of absorption that characterises the precompacted tile.

In this step it is very important for the tile to have appropriate mechanical strength for decoration, especially when decoration occurs by contact between the machine and the tile.

This process phase largely determines the aesthetic possibilities of the finished piece, which is why many manufacturers try to have different types of machines or even different lines between the two presses, to increase the range of decorating possibilities and hence enhance the versatility of this type of facility.

2.2.3. Stage 3: Second Press

After all the necessary decorations between the two presses have been performed, the precompacted tile must be introduced into the second press, which will finally compact at standard levels of pressure, contributing the typical standard bulk density and mechanical strength characteristics that are achieved by traditional processes.

In this process, special systems are normally used that allow introducing these precompacted pieces into the cavity of the second press without breakage, at appropriate speeds so as not to lose productivity.

Note that in addition, relevant preliminary studies are required to ensure that the dies of the second press will absorb the after-pressing expansion, which the tile undergoes after the precompaction stage, without any problems.

The parameters of the second press need to be controlled in a special way so that problems of dissociation of the applications and decorations conducted between the presses are minimized, caused by the de-airing that the tile undergoes when it is re-pressed.

Aesthetically in this stage it is possible to finish the piece with a totally smooth or structured surface, according to given product needs.

2.2.4. Stage 4: Drying of the ceramic tiles

The purpose of this stage is the total removal of tile moisture. The importance of achieving such drying resides in the fact that during firing in the kiln, an excessive

presence of water would cause chemical reactions with the other chemical compounds that are present, leading to a low quality product from an aesthetic point of view (owing to the presence of visible defects) and from the standpoint of physico-mechanical characteristics, e.g. mechanical failure due to rapid moisture evaporation. Such phenomena would give rise to rejects or scrap. The dryer also serves to heat the pieces to approximately 90ºC, to facilitate subsequent wet glazing, if this is desired.

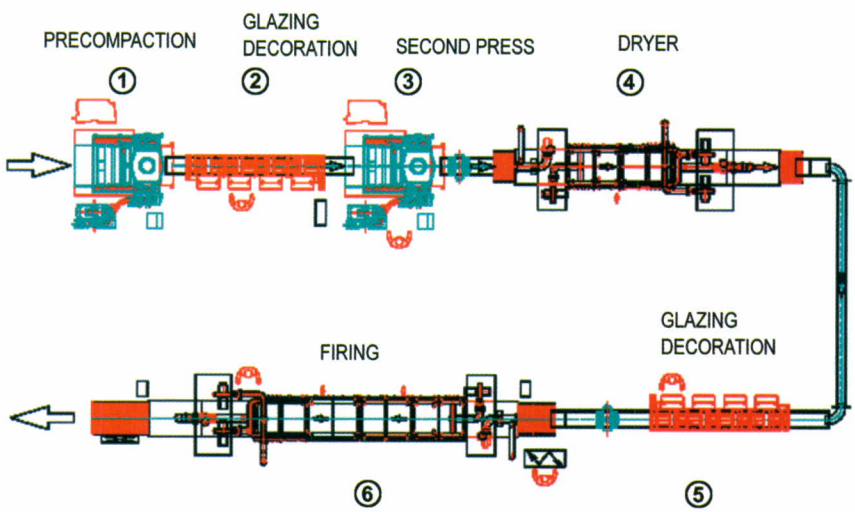
In double-press or double-charge processes, and also when wet glazing of the tile after pressing is not required, the dryer can be eliminated as an independent machine, since it is no longer necessary to heat the piece before the kiln, to eliminate the water contributed by wet glazes. Dedicating the first modules of the kiln to the removal of 2.5-3% moisture from the body suffices, which represents an additional advantage of this type of manufacturing.

2.2.5. Stage 5: Subsequent Applications

At this moment of the process we have a tile that is formed, compacted and decorated in a single body, even reducing the problems of interfaces between the different layers that can cause so many problems in traditional processes. From this point on, we have a world of possibilities to further decorate the pieces with the decorating machines at present available in the market.

2.2.6. Stage 6: Firing

This last operation, just like the foregoing ones, is critical to obtaining good product quality. This operation is conducted in a fast cycle at high temperature (1200°C) with a view to obtaining finished pieces characterized by low water absorption.



As advantages of the "double-press" production process, among other features we may highlight:

- Tiles are decorated after the first forming. That is to say, if so desired, the piece can display a flat surface, so that there are therefore no problems when it comes to screen printing. However, tiles are given their definitive form (possibly with low relief) at the end of the production process, thus providing

the possibility of producing pieces decorated with high definition simultaneously with relief, with the entailing aesthetic enhancement.

- On the other hand, the second press allows glazes to integrate with the body. Thus, glazed pieces are obtained already prepared for firing with mechanical strength identical to that of the unglazed product. This operation makes the piece less prone to mechanical defects due to the movements that precede firing.
- There are no wastes, glaze losses or waste treatment costs because the application can be performed dry throughout. With this system, any powder material not deposited on the piece is recovered by an automatic system in the same application machines. This provides notable savings for the ceramic companies, together with improved environmental control, eliminating the need to have a milling section in the company.

The above leads to:

- Savings in investments on transport and preparation of these materials; in particular mills, pipes, pumps and tens of meters of glazing line and corresponding labour can be eliminated from the production cycle.
- Savings in investment for the treatment or cleaning system, which is smaller because of the reduction in wastes.
- Glazing lines can be shortened; dry application requires no drying time after each application phase and can be performed in rapid succession. Dry glaze application can be fully automatic, whereas the wet process does not allow this. It is in effect readily understandable, that it is much easier and more efficient to control a short production line of 20-40 linear metres than a 100-150 m line.
- Savings owing to the significant reduction in glazes during processing.

Further to be noted is the advantage regarding the environmental impact of wastewaters. The wastewater produced in ceramic plants (mostly originating from washing operations in the glaze preparation and application section) needs to undergo a treatment process.

Characterized from a chemical point of view, some wastes may contain:

- Dissolved and suspended heavy metals (mainly Pb and Zn).
- Suspended solids (clay, sand, frit rests, generally non-soluble silicates).
- Dissolved anions (fluorides, chlorides, borates).
- Traces of organic substances (screen printing vehicle and glues used in glazing).

For waste treatment, facilities are normally used based on physico-chemical treatment, combining:

- Reactive alkalis (normally lime, also caustic soda, dissolved in water).
- Inorganic coagulant.
- Organic flocculant (anionic polyelectrolyte of high molecular weight).

It is important to note that the fundamental limits of cleaning systems are their inefficiency in relation to boron and boron compounds.

Consequently, the water that leaves these physico-chemical systems generally conforms to the quality criteria established by law, except boron. In order to remove boron, it is necessary to perform other treatments. These treatments can include:

- An ion-exchange process, using special resins that selectively exchange boron anions.
- Membrane processes (reverse osmosis).

These are reliable but very expensive processes for ceramic tile manufacturers.

It should be noted that the environmental impact of ceramic processes, with regard to the "water assets", is not only due to the extraction of water from the ambient, but also to the consumption of clean outside water.

The new systems hardly consume water, or consume water in much smaller amounts, as they are fundamentally dry applications.

It is therefore clear that a revolution in production processes is involved compared with traditional processes.

It needs to be stressed that double-charge and double-press processes, as well as traditional glazing lines are not mutually exclusive, but quite the opposite: they are COMPLEMENTARY.

In practice, double-charge facilities are found in the forming process in double-press lines, for subsequent completion of possible applications with a traditional wet glazing line.

Once again, it is to be highlighted that TRULY DIFFERENTIATING products are obtained, not new models, because in this case the aesthetic possibilities, technical possibilities and marketing possibilities differ. In a word, products that contribute productivity to the value chain, products with better commercial prospects and therefore of profit are being sought.

2.3. CONDITIONING FACTORS

This new revolution can only materialize with:

- New mentalities that envisage the future, in terms of product, not of model, willing to implement these new technologies, ready FOR THE CHANGE.
- The technical and financial capacity to be able to produce these at an appropriate cost.
- The mindset and financial-economic capacity to market them suitably.

In effect, if we find ourselves before a new product that is contributing aesthetic and technical solutions to many constructive spaces, which today's traditional ceramics fail to reach, we shall need different marketing systems. This new product can not be marketed through the same commercial systems that today serve to sell current floor and wall tiles, with all their goodness and virtues, but also with the problem of falling prices, the result of excessive competition.

Traditionally, ceramic tile manufacturers have tried particularly to make new products that would distinguish them from their competitors. Through more or less

rudimentary marketing systems, they established the difference in terms of price and value. This was possible because the technical and technological differences between different companies from the same country, and even more so between different countries, were very great. Little by little, technological differences between companies from the same country, and even between those of different countries, have steadily diminished. It is evident that there are and always will be companies with a totally differentiated product from their competitors, but these are relatively few and they generally have the best marketing systems.

At present there are a great many companies in the same country or different countries, which are able to make commercially very similar products. Therefore, as there is no or almost no product differentiation, the only two existing commercial weapons are:

- Price
- Marketing system

The scheme that summarizes the concept set out above is as follows:

Reality demonstrates that when the new priority of marketing has not yet been adopted and put into practice, the result is a price war on a brutal global level that seriously impacts company results. Few companies have differentiating marketing systems that allow them to defend reasonable prices.

It is evident that if these new products, deriving from these new technologies of this new revolution, have no different marketing systems, which on the one hand adapt to the new spaces for which they are destined in building construction, and on the other, are unable to highlight and promote the new product concept, they have no future.

Only the company that realises it stands before a new product, for any building construction space and with better technical and aesthetic characteristics than natural products like stones, granites, etc., and whose mindset is one of change, while also having certain technical and financial possibilities, will succeed in manufacturing it, selling it and extracting the corresponding economic benefit from the operation.

At this point, we could perhaps cite Philip Kotler[1], who during his last lecture delivered in Madrid last June, stated that "product differentiation is becoming constantly harder to achieve. Internationalization offers fewer opportunities because good markets are saturated and in the weak markets there is no money. New products unfortunately fail more often than they succeed. Price cutting does not work because the competition matches this. Raising price does not work because the differentiation is not sufficiently strong to support this. Cutting costs has eliminated most of the fat, but now there is a great risk of affecting the muscle". Will not these new products be

a good opportunity, perhaps a unique one at this juncture, to attain the necessary differentiation and diversification towards new constructive spaces for ceramic tile?

Once again, we frit, glaze and ceramic colour manufacturers are contributing decisively to these changes, working closely with the machinery builders, which are ultimately the ones that have invented these new production systems described above, acting as bridge between machinery builders and ceramic tile manufacturers, by the following activities:

- Making appropriate designs that enable optimizing the possibilities of each of these systems.
- Creating the necessary new families of glazes and acquiring the necessary equipment for their manufacture: microgranules, spray-dried glaze powders, flakes, coloured micrograins, microspheres, etc.
- Constructing pilot plants so that machinery builders can test their new creations in semi-industrial conditions, enabling them able to adapt these to the new types of glazes and designs, so that the client – the manufacturer – can try out the whole system before deciding on a new work methodology, knowing what to expect as regards investments, costs, productivities, operation feasibility and type of end product to be marketed, making it possible for the manufacturer to test its market before making any significant investment.
- Contracting, training and maintaining a pleiad of experts for performing all these tasks, not only to enable fine-tuning the necessary final models, but also to improve the machine and glaze prototypes in close collaboration with clients and machinery suppliers, carrying out joint projects with the three stakeholders.

The foregoing involves considerable investments in terms of time and money, which requires a high measure of faith in the future.

3. FUTURE OF THE FRIT, GLAZE AND CERAMIC COLOUR SECTOR

If we refer to innovation, new technologies, new products, i.e., really to change, such a dynamic sector must adapt to the new circumstances and drive this change, as it has done in many ways before in the course of the last twenty years.

To be able to implement the above, four parameters condition the future and will do so even more with the passing of time:

- Productivity
- Marketing
- Diversification
- Human resources

3.1. PRODUCTIVITY

The continuous drop in prices of ceramic glazes has been a constant feature in recent years. The sector appears to know no limits or checks in its prices. We all realise that when supply exceeds demand, as occurs in times of crisis, prices fall. But this

sector is special, because in times of plenty, e.g. as was the case two and three years ago, prices also fell, without any apparent cause to justify this. In this context, there is only one solution: raising productivity above the rises of competitors, understanding by productivity every action or decision that enhances the value chain up to the end product, that is to say, to the finished piece. Not only specific actions in costs are therefore considered, but whatever enables increasing the added value of the products that our clients eventually sell.

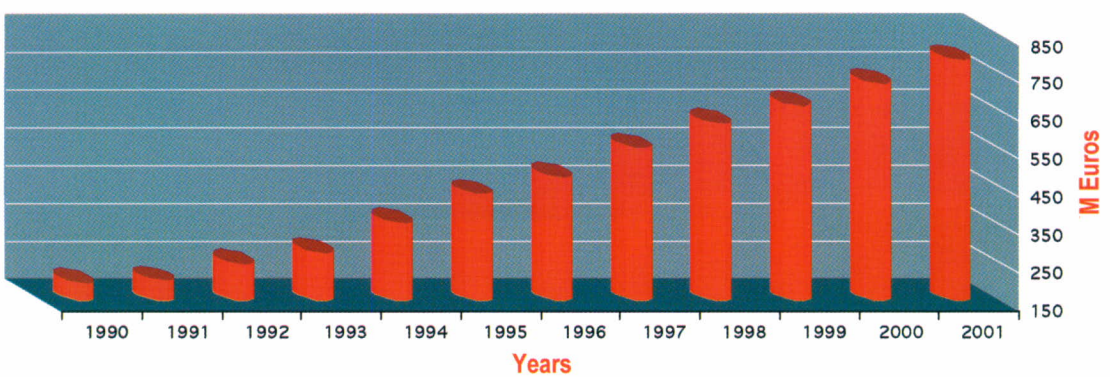
The purchase of raw materials, upgrading of production facilities, search for new types of glazes, more economic formulations, better and more efficient systems of client assistance, new designs, etc., are fundamental elements of productivity. Moreover, in every case, a great amount of R+D+i (research and development plus innovation) is needed, because otherwise it is not possible to achieve the levels of productivity that the markets are demanding. However, having sufficient R+D+i requires strong investment of a financial nature and in human resources, and in the course of recent years this frit, glaze and ceramic colour manufacturing sector has striven for such innovation, with excellent R+D+i departments that have naturally meant considerable economic and human investments.

3.2. MARKETING

Products can not be marketed in any world market, unless we have systems that effectively take companies to their clients, with a view to satisfying each of their needs. This requires internationalizing the companies, which the sector has generously striven towards, and at the moment, if not all the companies, at least the major firms are found in the main world markets, competing on a global scale.

This has been one of the most important achievements of the sector and one that has without any doubt facilitated the spectacular development witnessed in the last ten years[2], as the following graph shows, which plots the evolution of turnover in the frit, glaze and ceramic colour sector in this period:

Evolution of sales in the Spanish frit, glaze and ceramic colour sector



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
(M EUROS)	198,34	205,22	248,11	278,96	357,13	434,87	479,44	555,93	621,04	667,19	726,31	789,35

Graph 1. Source: ANFFECC - Spanish Association of Frit, Glaze and Ceramic Colour Manufacturers.

It is furthermore evident that this has been achieved by dedicating copious human and financial resources.

Again citing Kotler[3] from his book La Nueva Competencia , "... the objective of a company is to create clients, the only centre of profit is the client. A company has two, and only two functions, marketing and innovation. Marketing and innovation produce results, all the rest are costs... ","... we have to be prepared to receive stimuli from consumers and to reduce response times....","... to decide if it is convenient to act with aggressiveness to gain market share or to economize... ","... before cutting price, create value... ","... close unproductive sales branches ... ","... cut back on unproven promotional programmes and strategies ... ","... use advertising money for public relations or product development..".

Furthermore, Michael Porter[4] in his lecture "Destructive Competition and Strategic Competition", warns us, "... strategy has nothing to do with poetry, fantasy or lyrical outbursts... ""... competitive strategy and internationalization make up the modern vision of strategy... "," .. Inappropriate administration mentality. The expression – focusing on the client – is misinterpreted as attending to all the client's needs. A successful company satisfies the client's requirements that are the company's business, not all of them..".

And thus it is possible go on and on writing about marketing. Everybody must draw his own conclusions, taking into account the situation and circumstances of his company. It is in any case clear that it is necessary to duly adjust the commercial systems and networks, and this also involves dedicating very important financial and human resources.

3.3. DIVERSIFICATION

Product diversification has been a constant in the sector. Glaze and ceramic colour manufacturers are continuously developing new glazes and new types of glazes that enable obtaining the products sought by our clients and new ceramic products. Suffice it to mention:

- Products stemming from the new technologies, as we have seen above.
- Plak'Up®, a new crystalline glassy product that covers the commercial gap between industrial glass and crafted glasses.
- Glazes and colours for decorated glass and fusing processes, industries in a period of strong growth, as may be observed in the increasing use of glass in the world of decoration and construction.
- Glazes for roofing tiles and facing bricks, which are able to respond to steadily growing demands for sophisticated finishes also in these ceramic products.
- New families of glazes for dry decoration of tiles applied in a traditional glazing machine, by means of a whole series of methods in constant development, which allow us to decorate low reliefs.
- Etcetera.

Developing new products that signify diversification can only be done with appropriate R+D+i structures, and naturally dedicating very considerable investments to these.

3.4. HUMAN RESOURCES

The rapidity of the technological, economic, and social changes, etc., causes companies to set up increasingly flexible and versatile facilities, resources and organizations. For this, qualified, intelligent and innovative people are needed, with a spirit for surmounting obstacles, capable of adapting to change. Otherwise, companies will age, fail to adapt to change and be condemned to failure.

The key to success in all the foregoing parameters lies in the persons, the intellectual capital of each of the companies. It is probably the most important intangible asset that the company has.

Personnel, the resource of human capital, must necessarily possess these qualities:

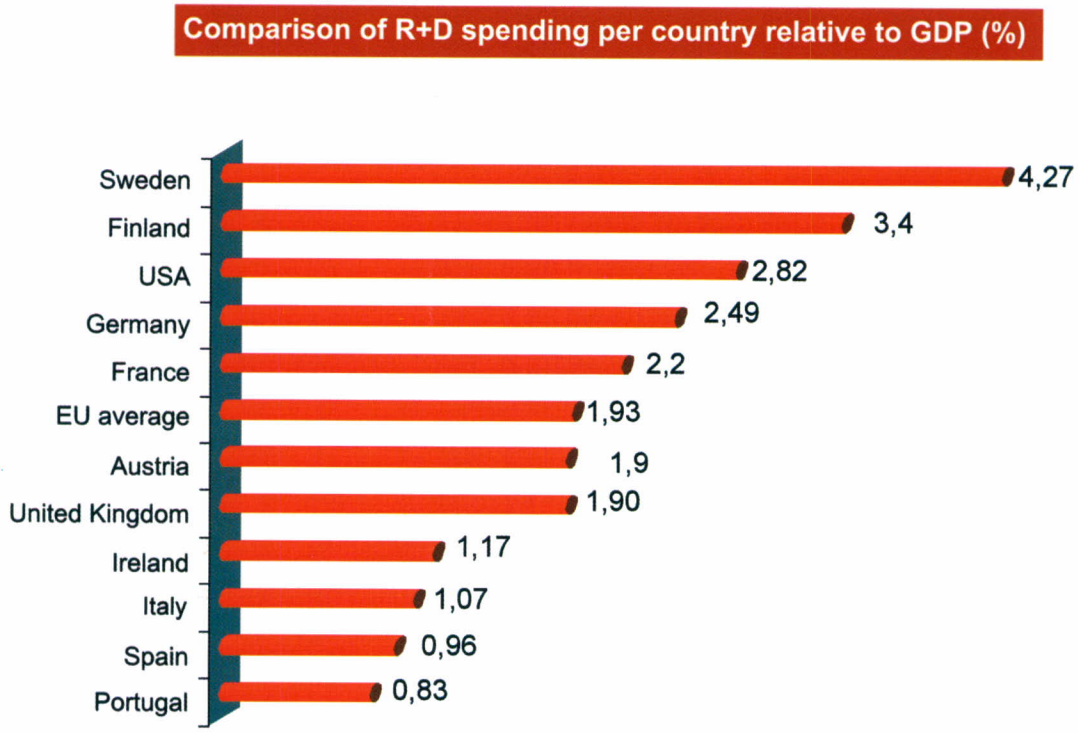
- Human Quality
- Capacity for work
- Appropriate training
- Initiative

However, these qualities are insufficient to enable addressing the new reality, and the speed with which new challenges arise. In order to address these new challenges, companies need to have talented workers who, in their field of work, develop the knowledge and experience that the company needs.

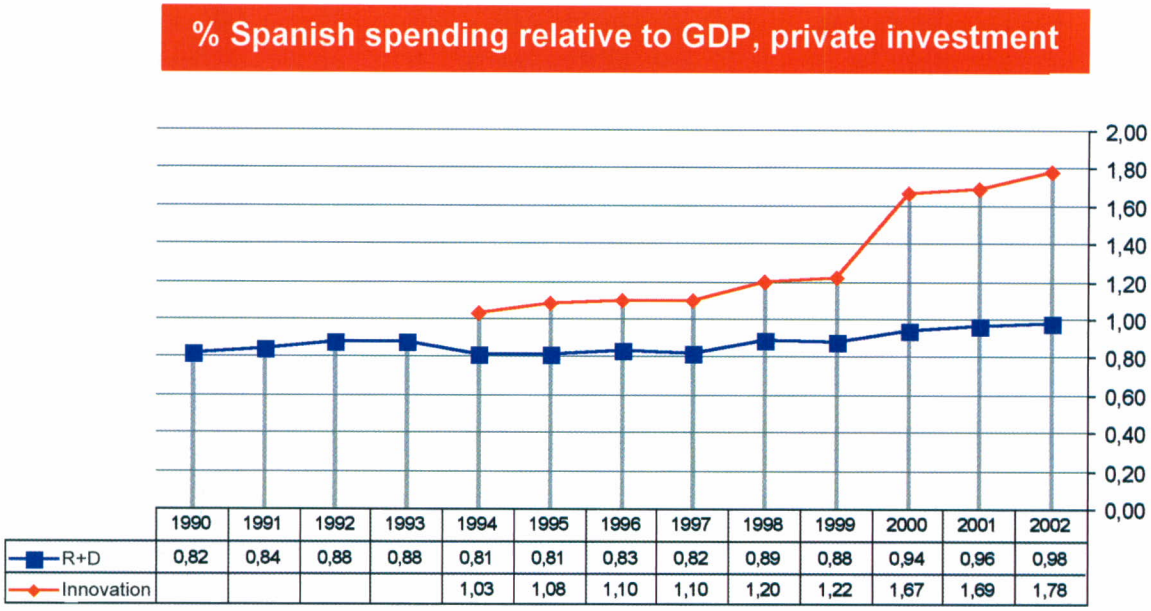
On the other hand, the company must succeed in satisfying its workers. Their motivation, economic conditions, promotions, social and medical services, etc., are a few of the aspects that form the internal labour relations climate in our companies, and which we must be perfectly acquainted with. Companies that do not foster the internal labour climate lose their workers, impoverish their intellectual capital, market value and internal efficiency.

The future depends on all the persons that work in the company, led by managers who know how to motivate and direct a homogeneous and qualified group of people.

If we really think that the future of glaze and ceramic colour manufacturers is largely conditioned by the foregoing parameters, the first conclusion to be drawn is the need to have sufficient financial and human resources to supply the investment and R+D+i resources that are needed. Spain devotes 0.96%[5] of Spanish gross domestic product (GDP) to research, development and innovation (R+D+i), which is not quite half the European average (1.93%) and far below that of certain other European countries, such as France (2.20%), Germany (2.49%) and Italy (1.07%). In the European Council of Barcelona (March 2002), the objective was set of earmarking 3%[6] of GDP for R+D+i by 2010. An extraordinarily ambitious objective, but one that will be very hard to achieve.



Graph 2. Source: Ministry of Science and Technology. Data relative to 2001.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
R+D	0,82	0,84	0,88	0,88	0,81	0,81	0,83	0,82	0,89	0,88	0,94	0,96	0,98
Innovation					1,03	1,08	1,10	1,10	1,20	1,22	1,67	1,69	1,78

Graph 3. Source: INE. R+D statistics 2002.

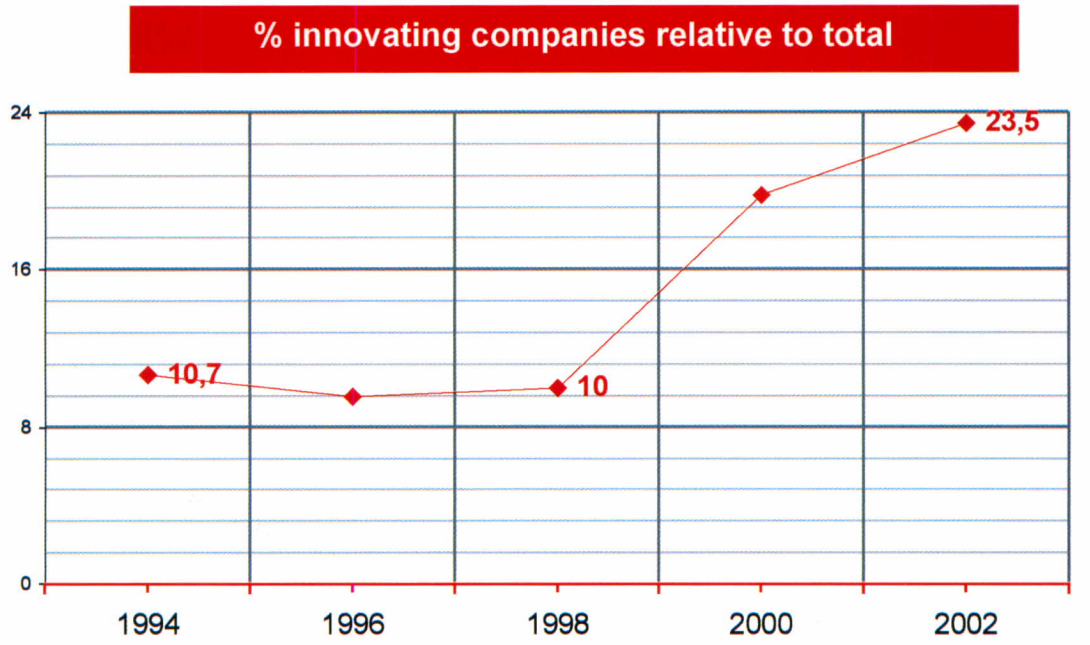


Gráfico 4. Source: Ministry of Science and Technology.

Only private enterprise can cover this research deficit. Company R+D spending in 2001 was 3,392 million euros, which was 54% of total R+D expenditure in Spain. Despite increasing by 65% since 1995, research spending by Spanish companies continues to be lower than the average in the OECD (69.5%). In the Valencia Region, 0.6% of GDP is spent on research and development.

It should be noted that the Spanish National Plan for Research, Development and Innovation (R+D+i) for the four-year period 2004-2007, recently passed and launched by the Ministry of Science and Technology, contemplates funding of 9,200 million euros[7] just in the first two years of its implementation. The main objective of the plan is to raise the present figure of 0.96% of GDP to 1.22%[8] for R+D spending and foster greater participation of the companies in the programme, paying for 56% of the cost, hoping to raise R+D+i spending to 1.4% of GDP by 2007[9].

A company will not have sufficient economic and human resources, if it fails to make reasonable profits, appropriate to the needs of every moment.

The President of ANFFECC, the Spanish National Association of Frit, Glaze and Ceramic Colour Manufacturers, Carlos Gozalbo[10], stated that in the decade 1990-2000, the companies from the sector lost up to 53% of their economic profitability, based on figures from the study "Evolution of the Economic and Financial Yield in the Frit, Glaze and Ceramic Colour Sector"[11] conducted by University Jaime I lecturer, Luis Martinez Isaac. According to this study, the yield has slid from 31.92% in 1990 to 14.7% in 2000, and the profit margin has fallen from 18% to 11%.

These figures are highly worrying because the fall in company profits is immediately reflected in the resources earmarked for R+D+i, producing smaller technological advance, worse marketing structures and poorer human resources, and fewer possibilities of diversification. In short, we believe the future of our sector is threatened by the drop in average profit in the sector.

4. FUTURE GROWTH

Ceramic colour and glaze manufacturers will grow provided the production capacity of their clients increases and they are able to generate financial resources for this, which is at the moment quite problematic. If foreign clients are concerned, it will be necessary to increase or extend their internationalization, which means establishing companies that produce all that is needed to attend to these markets, companies established in sometimes very distant countries, with idiosyncrasies and peculiarities quite different from ours. This is a far from easy task, and as we have already mentioned, it requires copious investments both from a material and human point of view. Nowadays, it is quite unthinkable not to have highly qualified Spanish personnel, permanently located abroad in other countries. To train and have these persons available are difficult and complicated tasks, which require financial investment, and what is even more costly: time.

If what grows is the domestic market or other markets in which it is not necessary to have companies that produce the entire product range, company locations in Spain will need to be extended. Identical considerations apply in this case as in the ones reviewed previously, so that financial and human resources will also need to be available.

The activity of any company produces jobs and revenue for the State, through City Councils, Regional Authorities or the State Revenue Service. The larger the company, the more jobs it generates and the more taxes it pays in absolute terms. A company is a legal person and as such it has the obligation to live together in relation to society; the company is indebted to society and is obliged to return to society what is beneficial to society. However, it also has the right to have the Public Authorities create a favourable environment for it to develop. We are not referring here to subsidies or fiscal benefits, or to any other type of aid, which essentially, if looked at closely, somehow disguises the potentiality of the company in generating financial resources, because it never knows if this type of aid has facilitated business successes or has simply improved the bottom line.

We are referring to the need to have appropriate land for locating our companies. In the province of Castellón, there are industrial areas equipped with all the necessary structures, developed by joint action of the relevant Authorities and private initiative. What is now required is legislation on environmental and land development issues, with appropriate fiscal treatment, which will facilitate investments.

It is evident and beyond discussion that any industrial activity must respect the environment. This is no doubt whatever regarding this matter, and it is logical and consistent with the foregoing that the frit, glaze and ceramic colour manufacturing companies should have the corrective equipment to enable them to treat the arising gas, water and solid waste emissions of the industry. However, it is equally logical and consistent that the limits set by Law to assure the quality of these emissions should be reasonable and in accordance with the available techniques, but that they should not respond to desires, albeit obviously legitimate, for an excellent environmental quality, which may be impossible to attain with the available techniques, or can only be achieved at an unfeasible cost for the companies.

With regard to taxes, suffice it to say that for businessmen, they are always high.

5. CONCLUSION

We stand before the start of a new milestone, which will without any doubt lead to a new revolution in industrial ceramics, for which the frit, glaze and ceramic colour manufacturers must develop appropriate products with the R+D+i effort that this entails. The implementation of these new production technologies that allow making new products will only be possible if the appropriate mentality is at hand, as we have set out above. These new technologies are not only destined for the two global benchmarks, Italy and Spain, but they will also be reaching, and possibly faster than expected, the manufacturers of other countries as well. The frit, glaze and ceramic colour manufacturers shall need to be ready to collaborate with all their clients, in order to put into practice these new technologies with their glazes and colours. This can only be done if sufficient financial and human resources are available, and this will not be possible if the average yield in our sector continues to fall.

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