History of the natural cement industry in Marseille region, France

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Abstract

In the nineteenth century, Marseille was already an established industrial town and had a significant urban development. Its business provided it with a large amount of raw materials of all kinds and its port allowed the carriage to multiple destinations. At that time, the traditional render with lime and yellow ochre sand predominated; however, a new type of facade finishing appeared, "the cement-render". Mainly composed of natural cement and sand, these other renders were used on stone facades. The production of cement originated shortly before 1840, when Hippolyte de Villeneuve Flayosc and Tocchi founded the first factory. Sealed plates placed on walls in cement-render have allowed the identification of more than twenty patents of facade builders, cement manufacturers or craftsmen. These new companies offered a raw product but also a skilled workforce. Therefore, one company owned at the same time the production factories and the implementation companies. The models were chosen from a catalogue and executed by their skilled workmen. Numerous houses or buildings of Marseilles were covered with this type of coating. By their specificity, their colour and texture, these facades are a real cultural and architectural heritage of the city of Marseille and deserve an adapted conservation methodology.

Keywords: natural cement, Marseille, facade ornementation, industrialization, nineteenth century.

1. Introduction

In 1756 during the building of the lighthouse in Plymouth, John Smeaton realised some tests of setting with various limestones, seeking to develop a lime that would be able to resist to weathering. He concluded that those which contain a high proportion of clay give a better set and hardened under water. He was the first to observe the natural hydraulicity of certain limes. Shortly after, James Parker discovers a argillaceous limestone that was able to set under water after it was heated (Bosc, 2001). In 1817, Louis Vicat developed the theory of hydraulicity. He revealed that the set is linked to the proportion of clay in the stone, in the process he identified the compounds responsible for this setting and determined their respective amounts (Avenier, 2007). In 1828, he described natural cement as a product developed from limestone containing 27 to 30% clay that may be used in the same way as gypsum plaster (Royer, 2004). Following his work, many cement plants emerged in France, England, Europe, Russia, the USA and Canada. Due to the manufacturing process, the first industries were developed in areas where sedimentary deposits had favorable compositions (Baron, 1982).

Natural cement is a generic term comprisingof a large diversity of materials similar to each other but with differences dependant upon the origin of the natural stone from which they are developed. In France, the term natural cement is preferred to the term Roman cement. This has the advantage of being historically accurate and allows a focus on the difference between it and Portland cement which is itself artificial (Pallot-Frossard, 2007).

Natural cement led to the use of a new kind of facade finition in Marseille. These ochreous renderings were mainly applied on masonries of rubble stone on facades which had been decorated with only horizontal joints. Stone blocks may have been simulated, crowned with moulded cornices, or more or less
complex carved ornamentations. The coating of these facades were made with a natural cement based mortar, mass-coloured and tended to imitate stone facades. At the same time, damaged stone facades were also covered with this render. The option of cement renderings were presented to a building owner within a catalogue; the companies which started to use this new coating represent one of the oldest forms of industrialisation in the building trade. Historically natural cement was named according to the place of manufacture or its producer.

This historical study aims to improve our knowledge on these natural cement-renders which are an important but yet overlooked part of the architectural heritage of Marseille and its region. Today many of these facades require restoration work. The production of natural cement in the region ceased and information about the process became lost. Some masonry companies have chosen to remake a modern coating of lime or artificial Portland cement, mass-coloured, for restoration work. Renderings are sometimes only “patched” and repainted. The facades show a more uniform character due to the fading of the textural effect of cement renderings. In all cases, the original renderings which were an important part of landscape of Marseille, were lost. It was essential to better understand the material in order to propose an appropriate restoration methodology and to deepen the history of these cements, their manufacturing process and the localisation of the factories, their producers and finally their applications.

2. The natural cements in south-east of France: Marseille “cement city”

One of the first cement factories established in the region was founded at Roquefort-la-Bédoule in 1835-1836 (Delesse, 1856) by Hyppolite de Villeneuve-Flayosc (1803-1874). He was the engineer in charge of a mining service in the Bouches-du-Rhône and the Var in the nineteenth century and often collaborated with the engineer Esprit Tocchi (Thomas, 1990). This factory is no longer in existence.

In architectural terms, Marseille experienced a particularly rich building campaign under the Second Empire. From 1860 onwards, the city was revitalising its centre through the construction of major buildings and the construction of many public buildings. Public commissions play a major role in the revival of decorative architectural (Marciano, 2005-a). The ornamental sculpture and décor experienced a new golden age with these revival buildings copying the traditional ornamentations of the ‘hôtels particuliers’.

Three main types of facade are characteristic of the architecture of Marseille. The lime and sand rendering protected by a limewash is typical of the oldest facades. Stone facades with stones coming from the region or the town itself were built for the houses of Marseille. Finally, the artificial stone facades or natural cement facades reflect the period of industrialisation in the region and the democratisation of the use of natural cement (Marciano, 2005-b). This new material is widely used for facades in Marseille because of its low cost, the availability of a skilled workforce and its speed of execution.

3. Manufacturing steps

In the Marseille area, quarries are located in two kinds of relief: on slopes and in plane and are either mines or open cast quarries. The open cast quarries are preferred in the south-east of France due to the lower cost of their exploitation.

Ideally, the factory is adjacent to the quarry. However, sometimes just the ovens are built nearby the quarries whereas the grinding and packaging are made elsewhere in a more remote place. Nevertheless the companies prefer to have the factory close to the quarry in order to decrease handling and transport costs.

The tools for the extraction of limestone are the pickaxe and the jumper bar. The blocks are crushed with a vapor grinder. These vapor machines are also used to pump water from the phreatic layer because large amounts of water are required to make cement. The grinding workshops are generally located a few kilometres from the kilns, close to the energy source.

The major cement producers use decauville railways running on a narrow gauge track up a slope to bring the limestone to the kilns (Thomas, 2000).

The coal is the only product incorporated to the raw material during the burning. The required amount depends on the limestone quality (Blanchard, 1928). Concerning the factories of Roquefort-la-Bédoule,
the coal was sourced from the mines of Gardannes which are very close. In some cases, the cement producers also owned the coal mines to reduce the costs of the fuel. The burning of the extracted stone is made in a kiln that is filled up through the top. The raw material and coal are alternatively introduced to form a succession of layers. The fire burns the limestone and the resulting product is collected from the bottom of the kiln. Several kilns are still visible in Marseille region [Figure 1].

Figure 1: Current state of kilns at Roquefort-la-Bédoule - copyright: LRMH  
Figure 2: Current state of quarry of Roquefort-la-Bédoule - copyright: LRMH

The early kilns are intermittent and may accept stones of various sizes. Continuous or running kilns are used later; with these stones have then to be calibrated and used in the required amount. They allow for an increase in productivity and reduce the cost of the combustible. As early as 1870, due to the increasing industrialization, factories were fitted with kilns arranged in series (Berthout, 1993).

4. Location

In the region, cement production was initiated just before 1840. It experienced high productivity and growth initially in the municipality of Roquefort-la-Bédoule which is the cradle of production. La Valentine is another geographical center which counted for the majority of the production of natural cement. In 1896, there were 21 cement factories in the region with 321 workmen employed in these plants. The lime, cement and plaster industries combined employed 1039 people in 1896 and 1495 in 1906. Two million three hundred and twenty three thousand tons of cement were produced in the year 1880 and four million five hundred thousand in 1906 (Masson, 1930). Roquefort-la-Bédoule is a small city of the Bouches-du-Rhône department located between Cassis and Marseille in the South of France. The provenance of the limestone for both kinds of cement produced in Roquefort-la-Bedoule is the geological strata of the lower Cretaceous (Neocomian age in Delesse, 1856). Some outcrops of the Bedoulian (lower Aptian) and Neocomian were exploited for the manufacture of natural cement. Not far from the small locality of Fourniers, a superposition of marly limestones, limestones and pyriteous marls interbedded with limestone [figure 2] can be observed. Not far from Fourniers hamlet, a superposition of clayed limestones, limestones and marls containing pyrites intercalated with limestone strates can be observed [figure 2]. The level is precisely dated thanks to the identification of the ammonites fauna (Guieu, 2008).

The hamlet of La Valentine is located between Aix-en-Provence and Marseille in the village of Saint Savournin which is surrounded by fields and forests. Many cement producers were settled in this city and in particular at the hamlet of La Valentine. A Fuvelian marly limestone was extracted from local quarries.

5. Producers

Throughout the 19th century, the cement industry was one of the most important industries in the cities of this region; cement produced here was often exported, for example, to countries within South America and North Africa by ship from the harbours of Marseille and Cassis. Many producers were in operation at this time and it is not possible to present all of them but some of the most significant are detailed in the following.
5.1 *Albert Armand & Cie*

Albert Armand & Cie produced cement under several different names and is the owner of the trademark Désiré Michel. Albert Armand & Cie owned two factories in the region. The first, located at Valdonne produced natural cements of Valdonne under the Désiré Michel trademark. A second, at Roquefort produced cements of Roquefort-la-Bédoule. These cements were used in the region of Marseille and were also exported abroad.

The production of the Ciments naturels de Valdonne began in 1851. The factory had fourteen kilns and eight mills which produced forty thousands of tons of cement a year. A laboratory with a small chamber for chemical tests and a room dedicated to physical tests had been integrated in the factory. The products were packaged either in bags or in barrels. The barrels were marked on the bottom with a stamped label indicating the name of the producer and the grade of the cement. The bags were closed by strings with lead seals engraved with the trademark of the company [Figure 3].

The Factory of Valdonne produced three types of natural cement.

![Figure 3: Examples of stamped labels and lead seals - Copyright: C. Thomas](image)

The “Ciments de la Méditerranée” (cements of the Mediterranean) Number 3 stamped red had a setting time which is qualified as semi-slow, varying from 20 to 30 minutes. It was burnt to a very high temperature and was suitable for various interventions: sea works (balises, lighthouses, etc.), sunny outdoor works (façades, buildings restoration, etc.) and the building of vaults and bridges (aqueducts, etc.). This cement was also used on many façades in Marseille.

The “Ciments Romains de la valentine” (Roman cements of La Valentine) Number 4, stamped yellow, were cements capable of semi-slow-setting (setting time from 15 to 20 minutes). The composition of this high grade cement was based on overburnt pieces. Its strength allowed a reduction in the thickness of structures within buildings. It was used for the coating of masonry and for the building of retaining walls.

The Ciments romains de la Valentine” (Roman cements of La Valentine) number 5, stamped green, came from the same provenance but was burnt at a lower temperature. The set was quick to semi-quick, from 5 to 10 minutes. This cement was specially suited to hydraulic works e.g. to stop a leak.

Another product from Albert & Cie was the “Ciments naturels de la Bédoule” (natural cements of La Bédoule) which were derived from specific quarries and was produced in a factory located in the Roquefort area. Slow-setting, semi-slow-setting and very quick-setting cements were made from the extracted limestone. The plant comprised of five kilns and four mills which produced fifteen thousand tons of cement per year. They were exported to many countries including Spain, Italy, Greece, Turkey and even South America.

This factory produced the blue stamped “Ciment Romain de Roquefort” which had a very quick set, from two to five minutes according the ambient temperature. This cement was mainly used to build vault masonry but also for the casting of façade ornementation. Indeed it had higher strength quality than gypsum plaster and was more suitable (Collectif, 1894).

The society Désiré Michel is held by Albert Armand & Cie. The neoclassical façade of its headquaters, located in Marseille is presented as a representation of the knowledge of the society. It was built in less than 3 months in 1858 (Dubreuil, 1989). The cement was used for the building, the render and the decor. Désiré Michel put forward the plastic properties of this material which was not yet well known and underlined the technical performance which would have not been possible with the usual and conventional materials.
This society presented its façade catalogue [figure 4] as an achievement of the skill of its workers. This is one of the first industrialisation processes in the building industry. Désiré Michel published also many brochures which advertised the advantages of this cement: The façade of the church of the French Mission, Tapis vert Street, proved that it was possible to copy, using cement, all the patterns of the most decorated monuments. This ornamentation was carried out upon a building wall without any destruction of the wall and without other modifications excepted the change of openings. The expense of this work was barely a fifth of what it would cost if the same facade had been made with stone.” (Désiré Michel, 1862) [Figure 5].

![Figure 4: Plate from the catalogue “Works with Désiré Michel’s cement: Church of the French Mission – before and after the intervention of the company” - copyright: BMVR](image1)

![Figure 5: Current state of the church of the French Mission, Marseille - copyright: LRMH](image2)

Désiré Michel saw a very large public success. Most of the houses realised by the Compagnie des Ciments de la Méditerranée (Company of the Cements of the Mediterranean) are a variant of the house located at the number 23, allée de Meilhan. Its architecture corresponds to a typical model of the buildings of Marseilles in the 19th Century, with three windows and a cement based ornamentation. In his catalogue, Désiré Michel calls this facade “more decorated ornamentation, type 2”. These stereotyped ornamentations will participate to the eclecticism of the architecture in Marseille.

5.2 Romain Boyer

Romain Boyer owned three factories in the south-east of France. They produced different grades of cement: a higher quality Valentine cement, semi slow-setting, an ordinary Valentine cement, semi-slow setting, and a “ciment romain de Roquefort” (Roman cement of Roquefort), quick-setting cement.

M. Romain and M. Boyer had created in Roquefort-la-Bédoule the largest cement factory of the village in 1885 close to the Hyppolite factory of Villeneuve-Flayosc. This factory had two large buildings dedicated to the production including the housing of the director, a chapel, little workshops to make cement tiles, offices, big bassins, kilns, a well and a water cistern (Berthout, 1992). A sawmill and a cooperage were also settled in this locality. Barrels were directly used for the cement packaging and its export in order to reduce the handling and the costs linked to the post production.

The Cement “Ciment Romain de Roquefort” had a yellow “limeswash” shade. Its setting time was two minutes just after its manufacture and between five to eight minutes within the 2 weeks after application. It has to be noticed that the factory of Raymond Boyer produced also on customer request a special natural and quick-setting cement (ciment prompt naturel) with a setting time between twelve and fifteen minutes.

These cements were used for sealing works and for urgent repairs of water pipes to which they provide instantaneously the required etancheity. Concerning the ornamentation, it was used to copy balusters, supports, handrails, decorative mouldings, or even for facades.

Customers were also able to request materials for specific types of work for which the company would send the suitable type of cement (Collectif, sd-a). The factory of Romain Boyer produced 100 000 tons of cement per year whereas the production for the whole departement was 370 000 tons.

The factory of de Villeneuve, was in operation until 1937.

5.3 Others
Many other cement producers had been established in the region, such as the Carvin fils company (collectif, 1865) which produced natural cements or L. Michelis fils, who specialised in cement, plaster and artificial stone work or the Cailhol family, society of Achard & Cie, D. Jouffrey, André Frères & Cie, B. Barielle, Joseph Biagini, etc (Collectif, sd-c ; Collectif, 1869).

6. Applications

These cements have a large and various range of application ranging from rendering to façade ornamentation. Until the nineteenth century, lime mortar coloured by natural yellow ochre was largely used for rendering. During the 19th century, the use of cement-renders (enduit-ciment) increased and these new products were more and more applied on façades. A new type of enterprise appeared which included the production factory and teams of craftworkers able to apply the products. Patterns were selected in catalogues and realised by skilled workmen. High technicity for mixing and applying this type of cement is required by any craftsman who has to use this material. If the application is not carried out in time, due to its short setting time, the cement cracks and shows a low adhesion to the substrate.

From a general point of view, natural cements have several applications: they are used for urgent underwater works, façade rendering and decoration and buildings restoration. They are also useful for the realisation of vaults, drains, aqueducts or a set up under water where a quick-setting is an advantage. They make possible the building of beacons, lighthouses and undersea hydraulic works. The craftmen use them to plug a leak or to stop a source.

6.1 Cement-render of façades

For the cement-render applied on the façades of Marseille the colour of the mortar is due to the natural colour of the stone and the sand added in the mix. Other materials such as the crushed brick, gravel or stone chips may be included in its composition and may influence its colour. From a historical point of view, this type of rendering comprises part of the architectural identity of Marseille.

Figures 6-7-8 : building, street of Aubagne, Marseille : cement_render and moulded pieces of architecture - copyright: LRMH

Few features of stone architecture may be suggested in some façades by engraving the fresh mortar (a fresco) e.g. to make horizontal lines which simulate the joints of a dimensional stone masonry [Figure 6]. This is a common finish on of these façades in Marseille. Sometimes, more complex forms may be depicted such as imitations of dimensional stones or roof cornices, sculpted pieces of medallions, keystones or any other ornamentation which ennoble the stone façades [Figures 7 et 8].

Concerning its implementation, 3 coats are applied for external renderings. The first layer is made of coarse sand, the second with a finer sand and the last one is finely sieved. The sand from Montrédon\(^1\) is added to the mix for rendering. It is usually used for the second and third coats.

This layer is homogeneized and finished by an operation called frétasse in French.

\(^1\) Locality in the south of Marseille
In general the cement-render is used with one part of sand for two parts of cement when it is used to build masonry which is exposed to wet conditions. For buildings in dry or hot environments, the suitable mixing is two parts of cement and sand without any other addition of compounds.

These façades coated with cement-render are numerous in Marseille and its surroundings. Nevertheless it is sometimes difficult to identify them and particularly to distinguish them from stone façades or façades coated with a simple lime based mortar. The signed plates of the cement producers and the catalogues are very helpful to make an exhaustive inventory.

6.2 Cast stone facade

Another type of façade appears: façades made with artificial stones, also called cast stone (fausse pierre or pierre factice in French). These are easily recognizable by the larger size of gravels and stone chips added to the mix.

6.3 Rocailles

The term rocaille refers to a set of artificial elements to reproduce the reality in the form of a trompe l’œil. In general, the rocaille style has a romantic vocabulary and uses vegetable and mineral forms.

The invention of cement allowed the development of a rustic and pittoresque architecture following the architecture of a rustic garden treated with natural materials such as wood and stone from the 17th to the beginning of the 19th century. The rocaille Art reached its peak at the end of the second empire. The low cost of the material and working men is a new way of treating both the architecture of the facade and garden by artificial materials to imitate wood, stones and rocks, vegetation. The decorative elements are inspired by the ruins, baroque forms, popular culture and Nature. Most of the decorative patterns are carved and drawn in the fresh cement based material. A very good knowledge of the material behaviour and a mix of skill and fast execution are required to carry them out. Some repetitive patterns are moulded. The rocailles are afterward coated by coloured paintings to accentuate the trompe l’oeil effect.

Stanislas Cailhol, born in 1814, is one of the first known rocaille craftsmen from Marseille. Jean-Baptiste Mora, François Rebuffat, Issorel, Gaëtan Amoletti, Philippe Ughetto, surnamed Philippe de Saint-Julien or Philippe le Rocailleur or Marcelin Jouve were active craftsmen in rocaille art in the region (Racine, 2001).

The craftsmen in rocaille art have participated to the large use of naturel cement. They used it in all its forms: bonding cement for the structure, finely carved cement and moulded cement. However, the use of hand-carved cement or the hand-moulded cement for decorative purpose in facades or parks was only a transitional phase between the discovering of Portland cement and the invention of reinforced concrete. The activity of these craftsmen did not last more than two or three generations due to the improvement of the industrial techniques.

7. Signatures

By signing their façade, the natural cement craftsmen claim a specific status. During the 19th century, the signature became stronger and was progressively replaced by a trademark. It played also an advertising role. The signatures are usually symbolized by specific plates made of enamelled metal, mortar or engraved in the render itself [Figures 9 and 10]. Three kinds of signature may be acknowledged: those of the major cement producers, minor companies and anonymous people (Collectif, sd-b).

Figures 9-10 : Plates of cement producers in Marseille, copyright: LRMH.
8. Conclusion

The facades coated with cement-renders constitute a cultural and architectural heritage of the city of Marseille due their specificity, colour and texture. The development of these natural cements in the south-east of France is closely linked to the history of the architecture of Marseille during the 19th century. At this time, new urbanistic standards allowed the use of this material for hydraulic works as well as for very fashionable rocailles and cement renderings. These different uses of cement gave rise to a local cement industry, close to coal mines. The transport and handling costs were reduced. The new industry played a part in the development of the towns around the factories. The produced material was not only used locally in the region but was also exported abroad. Evidences of its use are still visible as far as South America or North Africa. Their appellations can be linked either to their technical applications, their location or their architectural applications. Like Michel Désiré, a new form of business was born: the producers now have a skilled workforce and catalogs of achievements that can be ordered. This is the first evidence of serial architectural production that was applied on facades whom some still bear the signature of the company that performed the work. This study about the production of natural cements shows that their properties are for a large part linked to the mode of burning. This industry has progressively declined during the 20th century and stopped definitely before 1940. It has thus coexisted with the cement Portland industry for a long time. Know-how and local skilled handcraft may explain why Marseilles retained Natural cement rather than changing to the Portland cement option.

For this historical study, thirty-five sources of information and fifteen archive deposits were scrutinized. Tens of cement types were inventoried. Three ancient industrial sites and one ancient quarry were visited. These features show how important was this industry in Marseille until the end of the 19th century. The collected datas and the visited sites highlight an important industrial and cultural heritage for Marseille and its surroundings. It is the first step of a research program which aims to determine an appropriate restoration methodology of this cultural heritage yet unknown. Thereafter scientific investigations have been conducted on natural cement based mortars sampled on Marseille façades in order to characterize clinkers and hydrated phases.

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