REVENGE OF THE BRICK

Fifteen years ago, with the advent of the "new economy", brick and mortar businesses embodied the ancient world. But the energy transition has just turned the tables: the construction sector is going through a phase of unprecedented innovation. And the industry of brick and tile is at the heart of this revolution – a revolution which focuses on the energy performance of buildings but also on the life cycle of materials.

"I just bricked my smartphone," "they were on the tiles last night"... terracotta bricks and tiles are so much part of our landscape that they have a place in our everyday expressions! Nevertheless, it is difficult to imagine how much these traditional materials have evolved with the course of all industrial revolutions, including the most recent ones.

People visiting the tile and brick factories of today are often surprised. Modern robotized and automated manufacturing lines; furnaces baking materials at 1000 °C with an accuracy to within a few degrees, while "spouting" enough material to build more than one house per hour – are light-years away from the image of a product mistakenly deemed to be so traditional!

Yet continued innovation and investment efforts are indeed what spurred these materials to recent success.

Over the past 10 years, the terracotta brick gradually dethroned the concrete block as the leading material for house walls construction. Competitiveness has played an important role: the extremely precise machining of bricks has shelved traditional mortar laying in favor of the so-called "thin-bed" method, which is much faster and economical for on-site installation. But mainly,

thermal performance is what has made a difference. With a sophisticated honeycomb structure, brick has become a good thermal insulator: with the same thickness of 20 cm, thermal resistance has been multiplied by four in just six years. These advances were particularly timely, coming just at the time the Grenelle Environment Round Table, in 2007, gave a strong impetus towards greater energy efficiency in buildings in France.

And in fact it is precisely a new revolution, that of energy and environmental constraints, which is poised to radically change the picture for the building industry. Aren't roofs soon to be entirely made of solar panels? Aren't the three little pigs of tomorrow going to be rewarded for choosing a wooden or straw house – light, fast to build, recyclable or even biodegradable – instead of a brick house – heavy, baked with fossil fuels and destined to become future rubble? Aren't the golden days of clay tiles and bricks behind them?

New requirements: the French example

In the course of a decade the concept of energy efficiency has once again become central in Europe, and it is gradually gaining momentum in the world. The building industry is at the forefront here: in France, housing and services buildings have engulfed 68 million tons of oil equivalent (Mtoe) in 2011, i.e. 44% of final energy consumption in the country – far ahead of the transportation sector (32%) and the industry (21%). At European level, this proportion is estimated to be of 40%. Such energy consumption directly translates into greenhouse gas emissions, even though wood-burning and nuclear or renewable electricity play a moderating role in this respect. It is estimated that 26% of CO2 emissions in France and 36% in Europe come from the use of buildings.

As is often the case in the highly regulated field of construction, energy efficiency targets lead to new standards. In France, the new requirements are embodied in particular by the 2012 version of the Thermal Regulation standard (RT 2012, succeeding to RT 2005).

This brand new regulation in many respects marks a veritable disruption. One has to go back to 1974 to find a comparable change, with the first obligation, in the wake of the first oil shock, to insulate housings.

The figures speak for themselves. The energy consumption threshold for heating and cooling, hot water, lighting and ventilation has been divided by three. Measurement is now carried out in primary energy (a form of energy available in nature before any processing): one electric kWh is thus multiplied by 2.58, whereas one wood KWh is counted as zero.

Another small revolution: the energy consumption threshold is now global (50 KWh/sq. m/year for homes), instead of being defined element by element as was previously the case, when standards specified the minimum thermal resistance for a wall, a window, etc. For manufacturers, this new method of calculation allows for the ability to make trade-offs. For instance, to install electric heating, which is very economical to buy but proves to be disadvantageous in the long run in terms of primary energy, the manufacturer can choose a frame particularly well insulated thermally which will greatly limit the need for heating.

Of course, the use of renewable energy becomes mandatory for RT 2012 homes, in the form of solar panels, wood stoves or heat pumps. Fortunately, safeguards have been implemented concerning photovoltaic panels – the idea is obviously not to hide insulation defects behind a so-called “positive energy” by covering roofs with solar collectors. This is clearly a point that should be vigilantly kept in mind to prepare the Positive Energy Building, which is billed as the future standard for 2020.

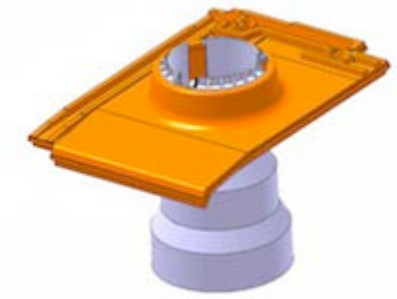
What is original in the French experience is that the preparation of RT 2012 has given rise to an intense and patient co-operative venture with the entire industry. In 2007, the voluntary and private BBC label (Low Consumption Building) foreshadowed future standards. Thousands of buildings have thus voluntarily been used as practical field experiments, allowing players to prepare for change. An extraordinary movement of innovation has resulted from this, which in many cases exceeds “vanilla” regulatory requirements: in terms of the energy consumption of housings, for example, we hear more and more about actual performance obligation, whereas regulation is still carefully limited to compliance which is merely calculated a priori.

A revolution in the tile and brick industry

For material producers, seeking to extend their offer to cover constructive systems has become cliché. The automobile sector is

often cited as an example versus a building industry often criticized for its indifference to the overall quality and the archaic production methods that make the purchase or renovation of housing unaffordable for many families. But concretely, how does this translate in the field?

One can understand what is at stake with the example of socket tiles. This special clay item, present on many tiled roofs, is used as an exhaust for the mechanical ventilation systems in housings. It is installed by a roofer, but it is usually an electrician who connects the air ducting to the tile. And at this point, all too often, it's DIY time! If the socket tile has not been positioned in the right place on the roof, the electrician has to change its position himself. He may have to twist and pinch the duct to succeed in this connection, at the risk of limiting the flow of ventilation – thus degrading the quality of the air in the house – and of course increasing the power consumption of the fan. In the worst case, nothing at all is actually connected and stale air remains trapped in the attic.



This kind of fantasy is no longer tolerated in RT 2012 homes, which are airtight and in which ventilation plays a key role in the comfort and health of the occupants. Terreal was at risk to see ventilation outlets start being installed through walls instead of through roofs for example, and therefore to see its socket tiles sales gradually decline. So our R&D center, venturing out of its traditional clay-based skills, developed a plastic sleeve that allows

an easy, secure and efficient connection between ventilation and the socket tile.

In fact, building materials such as tiles or bricks made of clay often have outstanding “natural” performances, being strong and durable, and this speaks of concealed treasures yet untapped. On rooftops, for example, great efforts are being made to recover solar energy using a few square meters of photovoltaic and thermal panels. Yet, on a tiled roof, each and every tile receives this energy and heats up naturally thanks to sunlight. So, working on the physical properties of tiles, Terreal has designed a device that recovers this heat to power a thermodynamic water heater. Thanks to this simple, robust and maintenance-free system, all the roof tiles perform as solar collectors and people save up to 20% on their hot water bills. The manufacturer can thus meet the threshold of 50 KWh/m2/year thanks to a very economical solution. The icing on the cake is that such a system is totally invisible and the aesthetics of tiled roofs are fully preserved. So, in a sense, the clay tile has made it possible to reinvent the wheel.

For the R&D engineers of a company like Terreal, what a change it was to have to venture outside the classical expertise realm of incremental improvement of existing products! It was a shift towards an entire philosophy of openness that the company embraced in 2010. Now, every year, Terreal receives center dozens of foreign visitors in its R&D center – architects, design offices, researchers, manufacturers, project supervisors, builders – and forms many scientific and industrial partnerships. Even social sciences are invited into our engineering world: Terreal is an integral part of an original positive energy social housing project, for which teams of sociologists will help tenants control their energy consumption in a sustainable way. Our common interest: to actually offset the energy bill of tenants, while limiting expensive and fragile solar panels on rooftops to a strict minimum

– the traditional tiled roof still being by far the most economical solution, both in construction and maintenance.

These changes go well beyond the usual scope of R & D. All departments within the company are concerned. Purchases, logistics and quality must manage new flows of components that are incorporated into our systems but are purchased outside – by contrast, in our clay department, 98% of the tonnage entering our plants is made of the clay and sand that we extract ourselves from our quarries. Marketing and sales forces of course are first in line to answer queries from artisans, traders, and design offices, and to present them with the company's new offerings. As soon as 2010, for example Terreal set up a training center to practice the airtightness of buildings – one of the strong requirements of the RT 2012 norm which is verified on each site – to contribute to the preparedness of craftsmen and builders in dealing with this key point.

Embodied energy

These revolutionary changes are not limited to the premises of our factories, far from it! A company like Terreal, which positions itself in the market for buildings energy efficiency, must itself have an exemplary production process. This is where the "embodied" or "gray" energy of a building plays out – that is to say, the total energy used to manufacture, transport and assemble the materials used to build it. A comprehensive 2009 study by CIMbéton, a French association for information on cement and concrete, showed that for a low-consumption single-family detached house, this embodied energy is equivalent to about 30 years of consumption by residents for heating, lighting, hot water and ventilation. The more homes become energy efficient, the more pressure on manufacturers to improve their own energy efficiency!

France is a pioneer in Europe regarding this vision of the “life cycle” of buildings. More than 2300 categories of construction products and electrical equipment in the country are now subject to comprehensive environmental analyzes that are freely available to any user and are more and more systematically verified by independent experts. This approach has now been scaled up at European level to translate into standards for the Union.

It is worth noting that clay products have nothing to fear from such transparency, quite the contrary. For example, clay tiles, a local material produced in modern and efficient plants, have a CO2 impact comparable to that of natural slates currently imported from Spain, South America or China.

As for concern for energy saving, is not new in the clay industry, in which this item amounts for about 20% of production costs – making it second only to labor. The CO2 quotas system introduced in Europe in 2005 reinforced this motivation – with terracotta, most of the CO2 emissions derive from the combustion of natural gas in our dryers and in our furnaces, which for instance differentiates us from cement, where decarbonation is prominent in emissions.

In a factory that runs in 24/7 continuous operation, operational control is the base for all progress. A rejected defective product means as much wasted energy. And so it is everyday actions and the skilled reflexes of our production and maintenance teams that avoid over-consumption. Between 2009 and 2011 Terreal has conducted systematic heat balances in all its plants. Process engineers have been hired on the field to control technical and operational improvement programs. And our R&D experts are heavily involved in running the internal network: since 2012, an intranet platform facilitates mutual assistance, training, and the sharing of good practices.

An approach that is necessary, but not sufficient: while energy savings are indeed to be acknowledged, they are still modest, on the order of 2%. Are further technological improvements possible so as to save even more?

Again, by stepping outside of the job, Terreal identified some interesting ideas. In a terracotta factory, a large part of the thermal energy used is later released at low temperature in the smokes of dryers and furnaces. However, chemical and food industries have developed recovery systems for inherently trapped heat that we can apply to our process. With this technique, we aim to reduce by 25% the natural gas consumption of a large tile factory.

As for product baking, which requires temperatures of up to 1100 ° C, the idea is to replace natural gas with biomethane or synthesis gas produced from organic waste. These are projects where technology is not the only issue at stake: a biogas methanation project based on cow manure, for example, creates new regional solidarity between our factory which will consume biomethane, stock farmers who will provide manure, and farmers who use the remaining digestate as fertilizer. Our business already has strong local roots owing to its raw material, clay, that we extract in the immediate vicinity of our sites, and to our products which are primarily distributed regionally. Now, even our power will be generated on site from local materials.

With all these projects, we are confident that we will successfully reduce our consumption of fossil fuels by 25% by 2020.

Technical progress thus remains the driving force of our business, placing the issue of energy efficiency at the core of our products as much as at the core of our industrial processes. The three little pigs will no doubt continue to prefer brick!

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