

PERSPECTIVE IN SCIENCE AND TECHNOLOGY FOR THE DEVELOPMENT OF NEW MATERIALS IN CONSTRUCTION INDUSTRY IN MEXICO

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Abstract

The present article presents a perspective regarding science and technology in Mexico in the mid and long terms, where the situation of new construction materials in the construction industry is specifically studied; this with the objective of learning the trends and the most probable future scenarios of development of new materials for the new requirements in the construction sector in Mexico. This document may be highly interesting for architects, builders, engineers, who are the constructors of tomorrow and on whom the responsibility to select, evaluate and apply current and future materials must lay.

Keywords: construction, development, construction materials, science, perspective, technology.

1. INTRODUCTION

Nowadays, science and technology in Mexico is still developing, even though there are high-quality scientists it is necessary to have quality infrastructure that responds to the generation of new knowledge applied to new technologies which are able to cover the new needs regarding construction and new materials, in our case. This study opens with a brief description of a perspective referring to science in Mexico, so as to have a panorama that describes the central topic in this work, development and application of new construction materials in an immediate and distant future.

2. PERSPECTIVE IN THE MID AND LONG TERM OF SCIENCE AND TECHNOLOGY IN MEXICO

The advancement in science and technology in Mexico is seen in the long run as it is necessary to achieve better organizational and institutional structures in charge of developing the activities of generation and promotion of science and technology; likewise, increase the production of high-quality

human resources to take up the research tasks and apply new knowledge, regulations and legislation on science, and last but not least, determinate the expenses in relation to technological development and generation, application and diffusion of science in every sector, with a sustainable approach, as it is recommended by the National Plan of Development (*Plan Nacional de Desarrollo, PND*), in its chapter on sustainability (PND, 2007).

The study of the future scenarios of science and technology in Mexico must be carried out depending on the area of specialty, taking into account for each scientific field events and situations that might occur within them and that might affect their development and evolution. In this work we will take into account some future scenarios referring to an area or axis of scientific “tasks”, regarding the generation and application of *new materials* in the industry in general, to later particularize on the sub-area of *Construction*.

Below, several situations which must be analyzed in order to study the scenarios in relation to science and technology are shown from a general approach.

- Needs of the system of Science and Technology in Mexico, such as infrastructure.
- Lines of generation and innovative application of Knowledge linked to the emergent needs of the country.
- Sustainable development in every field of knowledge.
- Networks of science and technology research centers.
- Specific topics on science and technology.
- Indicators of education, economy, social development and politics in Mexico.
- State of development of basic science.
- State in the development of applied sciences.

By means of these situations of analysis a number of scenarios are estimated regarding science and technology in 15 to 30 years' time, as it is showed below (Analítica Consultores, 2006):

Year 2015

- The national expenditure on technological research and development is estimated at 1% of GDP; research in Mexico is organized in such manner that the basic or priority necessities to

improve the inhabitants' quality of life are attacked. Thereby, research on new vanguard materials is put aside in public sector.

- The private sector influences on a heavier manner technological development than the public one; in the private sector it is estimated that the development of new materials only increases in the most demanding industries, where construction is one of them.
- A half of the new public universities is consolidated and carries out important percentage of science and technology in Mexico. As for education and its outreach with industry it is estimated that public universities carry out circa 50% of the research and development on new materials for construction in Mexico.
- The enrolment in basic sciences careers (physics, chemistry, mathematics, biology) reaches its lowest levels in 20 years. The enrolment in careers related to science and material science engineering, on the contrary, reaches its highest point in 20 years.
- Broader scientific knowledge of the local and endogenous kinds is being generated; the case of generation of new materials made of waste reaches its highest volume in 20 years.

Municipal officials are obliged to provide more technical solutions of existing collection centers of waste materials. They are also responsible to organize themselves territorially in order to close all existing illegal dumps and to prohibit new ones, to set up collection services more efficient, to optimize household wastes, to lead researches in close collaboration with universities and laboratories, to develop existing and new sectors of "sorting, recycling, treatment and valorization", to face the fast evolution of the society (Abbaoui and Djemili,2012).

Year 2025

- A severe national crisis of energetic resources breaks out; the index of materials that require extensive processing noticeably decreases and their cost increases 200% (such as polymeric materials: PVC, polyethylene, polystyrene, polyurethane, etc).
- In order to belong in the National System of Researchers it is necessary to work in national and international networks, carry out high-quality technologic developments and transfers both at local and international levels. Research on new compound materials is an "opportunity niche" to perform technological developments and file patents.

Year 2030

- The depletion of the oil reserves prevents science and technology from being a priority in the country; it is a contradiction that because of oil depletion, science and technology are not priority in the country, on the contrary they will have to find new sources of energy and in general a better use of natural resources, such as solar light, wind, water, soil, etc.
- Funding for science and technology will be 1.30% of GDP, being the most part from private source.
- Investment on science and technology is decentralized, 30% for the capital of the country and the rest for the States.
- A national program of scientists and technologists is created in order to move them to the less developed zones in the country.
- A half of the graduated doctors in Mexico work in the country.
- Eighty percent of the electricity of the country comes from renewable and alternative sources.

3. PERSPECTIVE OF DEVELOPMENT OF NEW MATERIALS IN CONSTRUCTION INDUSTRY

Currently, industries and companies that want to grow have to develop new and better services and products; and the ways to achieve it can be summarized in two: firstly, through a suitable technologic management to make competence between companies more efficient (Delgado, 2008); and secondly, applying the activity of research into a determinate industrial or entrepreneurial sector. For example, in the power generation industry where methods and techniques of designing and managing modern services therefore must to be changed in order to respond to the actual needs of the clients or industry (Zamfir, 2013).

This perspective, equally based on the construction of scenarios projected from present facts, is shown for a period of 15 and 30 years, specifically for the part of material development, directly or indirectly linked to construction industry. Said scenarios composed of several future events estimate a great deal of interest in the evolution of the area of new material development in Mexico (AnalíticaConsultores, 2006). The information which in the present work was processed and taken, considers materials only destined for the construction industry, considering as well the most important events of said scenarios, shown in the supportive document (Analítica Consultores, 2006).

Between 2015 and 2030

- The first spintronic devices¹ of nano-metric dimensions are developed, which are useful for applications in computing systems. Development of spintronics of nano-metric dimensions to be used in intelligent buildings in the subsystem of computing installations and intelligent control.
- Technologies to store hydrogen as energetic vector are developed. Use of hydrogen energy in numerous processes of electricity production in different applications in construction industry.
- The first dendrimers² are developed as skeletons for photovoltaic cells. Development of vanguard photovoltaic systems making use dendrimers to be applied at buildings.
- The first made-in-Mexico nano-transistor is produced.
- Compound materials, called cermets³, of high quality and usable in connections for building structures are produced.
- New variations of ceramic materials are developed for application in construction of buildings, mainly in structures and envelopers of buildings.
- Intelligent materials of the “shape memory” sort for applications in components of buildings and special installations.
- The use of high-quality semiconductors in the production of intelligent windowpanes for buildings is commercially applied, as well as the fabrication of windowpanes that can control filtration or reflection of sunlight and self-cleaning glass (Institute for Nano Scale Technology, 2009).
- The use of ceramic-matrix compound materials mixed with ceramic fibers is standard practice in the construction of buildings.
- In Mexico circa 50% of the plastic generated in the country is recycled.
- The panel of researchers in material science in Mexico is ten times larger than that of 2005.
- The first made-in-Mexico nano-computer is produced.

¹Spintronic refers to materials used in new transistors based on compounds of polymeric matrix.

²Dendrimer is a multi-functional poly-(amidoamine) material as that can be used, for instance, in cancer therapy.

³Cermet is a material of ceramic base or matrix with a mixture of metals or alloys.

Figure 1 shows the advancement of ceramics, via compounds, and their importance in the future for engineering and construction materials (Hernández, 2001). It is observed that ceramic-matrix compounds are those with a more promising future.

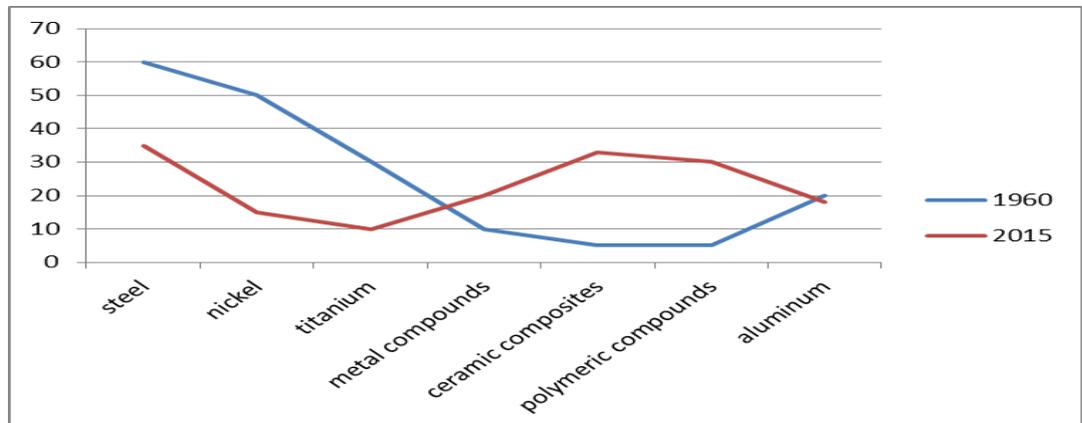


FIGURE 1 - ON THE EVOLUTION OF THE CERAMICS VIA COMPOUNDS AND THEIR IMPORTANCE IN THE IMMEDIATE FUTURE (SOURCE: ROLLS ROYCE LDT).

4. CONCLUSIONS

It is concluded that in around 15 and 30 years' time, material science and technology will contrast in some events such as the priorities in social development in Mexico, nevertheless, at the same time there will be numerous advanced and innovative technological developments which will solve quotidian situations in industry as a whole, and in particular in Construction and Architecture. The events for said scenarios will comprise the following: Particularly, in the sector of construction and architectural materials, new compounds for new applications will appear; for instance, compound derived from the mixture of ceramics and metals, called cermets, with applications in structural materials, mainly connectors, it is also the case of shape memory materials, and with other uses in applications as thermal and acoustic insulators; similarly, the use of recycled-plastic materials substituting wood in some applications of construction, sealers and paints that do not retain heat will increase; in relation to ceramic materials, they will have broader acceptance since they are relatively easy to produce and recycle. Natural-fiber compound materials mixed with polymers will be more used by the day, especially as insulating materials. Concrete, currently the most widely used material in the world, will still be used, yet in many a variants, incorporating in its mixtures different additives and aggregates to solve new necessities in construction (WBCSD, 2008), even with the incorporation of nano-metric particles. In 15 years' time it is very likely that in Mexico there will be a regulation on green or sustainable construction,

and thereby we have to use ecological materials with low ecological impact, which the regulation indicates, on a regular basis.

Based on the previously exposed and on the expectations for the future, we the architects in Mexico must be prepared to design sustainable architectural spaces, however, in a similar manner design, prepare and apply the construction materials which the new buildings, new needs and new commitments of the future construction industry and architecture will require.

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