Patent Information in Concrete Corrosion Research

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Key words: patents; information: concrete reinforced corrosion; corrosion protection; additives.

RESUMEN. Los documentos de patentes son una fuente de información muy importante y se utiliza conjuntamente con la literatura no patente, incluyendo la referenciada en el Science Citation Index y en otras bases de datos. Como está establecido, una solicitud de patente debe ser posteriormente publicada. Un estudio estratégico del desarrollo de las invenciones en un campo dado se realiza a través de la información de patentes. En este artículo se utiliza el Sistema Automatizado para la Vigilancia de Patentes (SiVigPat®) para estudiar el desarrollo de las patentes internacionales relacionadas con la corrosión del concreto y su protección. Se observa en este campo un incremento de las solicitudes de patentes desde 1989. Las bases de datos procesadas corresponden a Estados Unidos, Canadá, Japón y otros países. Las patentes relacionadas con la corrosión del concreto y su protección fueron clasificadas en: *monitoreo*, protección electroquímica y aditivos. El mayor número de solicitudes de patentes están relacionadas con aditivos químicos. Se obtiene un completo estado del arte en este campo al analizar las diferentes clases de aditivos, métodos de protección de protección electroquímica y los métodos de *monitoreo*. Existe una tendencia al incremento del número de patentes relacionadas con la protección electroquímica y los métodos *monitoreo* de desde 1984. Las firmas e inventores que poseen más invenciones han sido estudiadas. Se identificaron los países que tienen mayor número de solicitudes de patentes. Conjuntamente con otros estudios de tendencias obtenidos a partir de diferentes aspectos, se puede obtener una orientación completa para que la investigación pueda ser realizada, mejore la calidad de los resultados respectivos y realce su novedad.

ABSTRACT. In addition to recent literature published in journals included in Science Citation Index and other bibliographic database, there is a very important source of information in patent databases. As it has been established, a patent application should be made before any publication. A strategic study of the development of inventions in a given field of research can be made through patent information. In this paper the authors used an Automated System for Patent Surveillance (SiVigPat®) to study the development of international patents concerning concrete corrosion and protection. An increase of patent application has been observed since 1989 in the field of concrete reinforced corrosion and protection. Databases processed were from the United States, Canada, Japan and other countries. Patents related to concrete corrosion and protections were divided into three main classifications: monitoring, electrochemical protection and admixtures. The highest number of patent application is related to chemical admixtures. When all the different types of admixtures and methods for electrochemical protection, as also monitoring methods are studied, a complete state of the art in the field is obtained. A tendency to increase patents concerning electrochemical protection and monitoring methods is observed since 1984. The corporations having more patent numbers and the authors and their activity have been studied. The countries involved in patent application have also been studied. Along with another study of trends in the different aspects a complete orientation of the research can be made, it improves the quality of the results to be obtained and enhances its novelty.

INTRODUCTION

Patent documents contain legal, economic and technical information. An analysis of this information allows obtaining valuable information to evaluate a Research-Development project or program, to carry out competitive intelligence studies and technological surveillance. During the life cycle of a project, an efficient use of patent information is very importantThe use of intellectual property information allows the following studies.[1-6]

- Analysis of the state of the art and the market.
- Evaluation of the relative scientific and technological situation respecting competitors and the patent folder and surveillance of the patent rights.

Due to the importance of intellectual property, some software has been developed on this subject. Software is used to manage intellectual property, prepare patent documents and carry out analysis of information of patent documents with added value.

As an example of the utility of patent information on corrosion research the field of concrete corrosion and protection has been selected. Concrete is the most widely used building material in the world. Concrete reinforced corrosion causes high economic losses. Buildings have also a very important social function.

To reduce concrete reinforced corrosion is a very important subject in all countries. Toward this objective, it is important to make a correct diagnosis of the problem (monitoring,

inspection) and the use of adequate protective measures. The most common protective measures in the case of concrete are the use of admixtures (substances that added on concrete composition), coatings and electrochemical protection (including also electrochemical extraction of chlorides, realkalinization and so on). Some other protective measures can be also used, such as a correct design. Based on this characteristic of concrete corrosion the patent information was classified in three fields:

- Monitoring
- Electrochemical protection
- Admixtures (including inhibitors and coatings)

The objective of this paper was to study the development of international patens concerning concrete corrosion and protection.

MATERIALS AND METHODS

Patent documents Data Base

The search of information was carried out in the free access data bases of patents from Internet.

- Esp@cenet Database.[7]
- Canadian Intellectual Property Office (CIPO)[8]
- United States Patents And Trademarks Office (USPTO)[9]

Automated System for Patent Surveillance SiVigPat®, version 3,0[10]

Software *SiVigPat®,* developed at Center for Scientific Research, Havana, allows to process patent information extracted from free databases on Internet and to obtain graphical and tabular results.

The search strategy was based on:

Search object. Concrete corrosion, protective measures and monitoring.

Search objective. To evaluate the state of the art in this field, as well as to carry out competitive intelligence studies with the information obtained.

Strategy 1. Preliminary search of patents by key words.

To carry out the search of information was used the key words: concrete corrosion, concrete corrosion inhibitor, concrete corrosion monitoring and concrete corrosion electrochemical protection taking as universe the recoveries of the documents of patents, for a better precision in the number of obtained patents.

All documents were processed by SiVigPat®, creating a general database. The documents were processed to determine the main owners, inventors and the international classifications of patents (IPC) of more incidences.

Strategy 2. Search of patents by inventors and owners:

To carry out the search were selected the names of the owners and inventors with more incidence from the results obtained in the database of patents processed from the search carried out according to the Strategy 1.

Strategy 3. Later to the analysis of the results according to the international classification of patents (IPC) was carried out a complete search of the sub classifications of more incidences.

RESULTS AND DISCUSSION

All documents obtained from strategies 1, 2 and 3 were analysed and selected. Documents not directly related to the field of interest were eliminated. The final selection was of 222 patent documents. It was detected that there is some duplicated documents (44), because they were presented in more than one country. The final number was 178 patent documents.

It can be noted that those years 1989 (12), 1995 (16), 1998-1999 (15) and 1997 (19) show the higher number of patent requests (Figures 1 and 2). The number of patent request for years 1997 to 2002 can still increase, because some offices only published those already approved (in USPTO there were only processed approved patents). As can be seen, an increase in the innovative activity was detected on 1989. This tendency continues since 1997.

It can be seen that the biggest number of patents is dedicated to admixtures, that is, substances diminishing corrosion of rebar, this is due to the method application facility. Monitoring and electrochemical protection have a very similar development with time (Fig. 3). The film admixture includes corrosion inhibitors, coatings and other protective mediums except electrochemical protection.

An increase in patent application dealing with protection by inhibitors has been reported recently [1995 (12), 97-99 (10)] in such a way that a strong innovative activity is observed.

Respecting patents concerning electrochemical protection and increase in innovative activity is observed since 1997. It is important to notice that some patents include electrochemical protection and the use of inhibitors at the same time. Corrosion monitoring tendency is also slightly increasing with time.

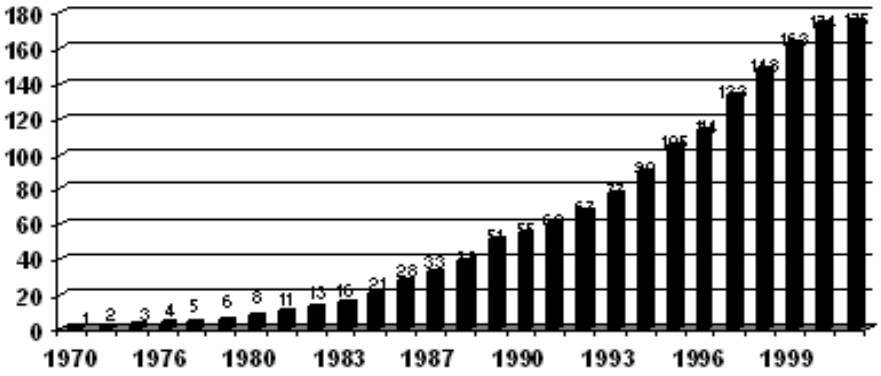

Fig. 1. *Patent number according priority date.*

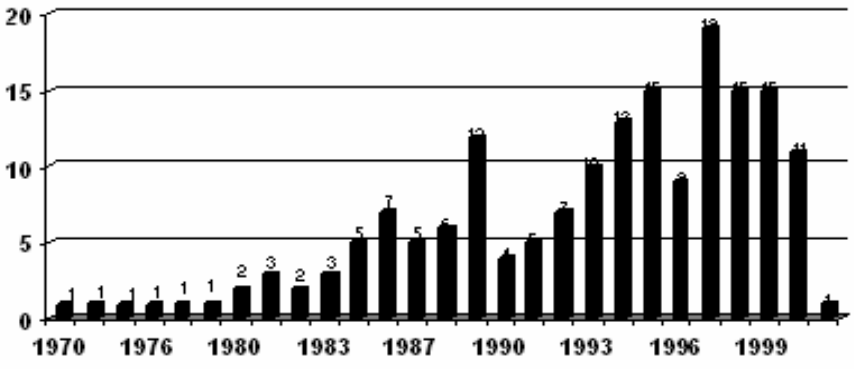

Fig. 2*. Patent number according priority date.*

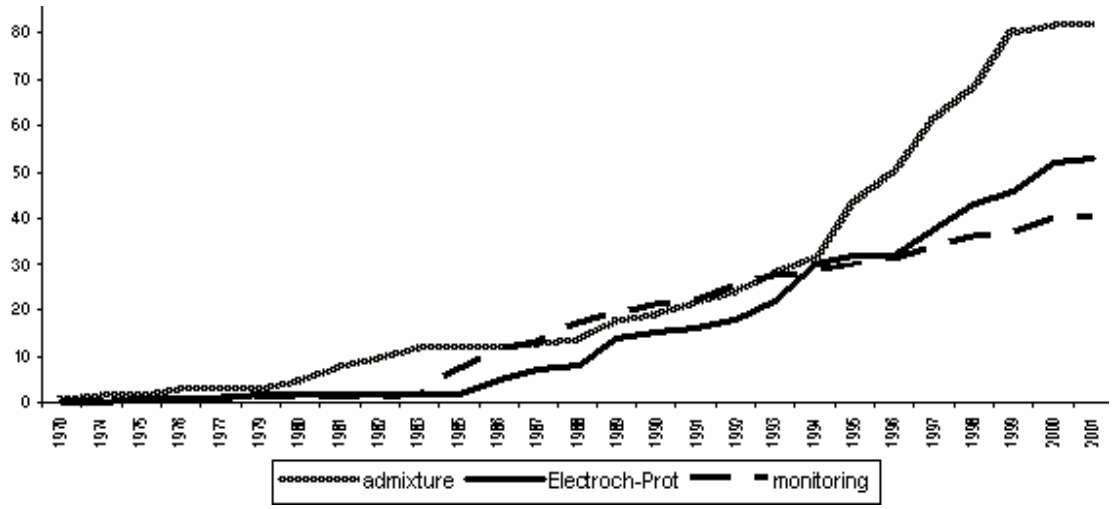

Fig. 3. *Tendency to innovation in the selected fields.*

In general, research is continuously growing in the three fields selected. It means that research projects can be carried out without problems.

The highest number of patents (Fig. 4) corresponds to the IPC: C 04B (lime; magnesia; slag; cements; compositions thereof, e.g. mortars, concrete or like building materials; artificial stone; ceramics), C 23F (non-mechanical removal of metallic material from surfaces) y G 01N (searching or analyzing materials by determining their chemical or physical properties) y C 09K (materials for miscellaneous applications, not provided for elsewhere).

An analysis of the number of applied patents shows that IPC: C 23F 13/00 (Inhibiting corrosion of metals by anodic or cathodic protection) an to C 04B 41/60 (of only artificial stone) corresponding 16 applications.

The highest number of patents corresponds to CORTEC CORPORATION (Fig. 5). The authors with the highest number of patents applications presented: Miller John, Miksic Boris, Burge Theodor, Vennesland Oystein and others (Fig. 6).

In the case of authors and owner the first name of the patent document has only been taken into account.

The priority application (country where application was presented by first time), the origin application (original country of the owner) and destiny country (countries where applications were presented) with the highest number of patents are the United State and Japan (Table 1).

CONCLUSIONS

An analysis of patent's information with added value in the field of concrete reinforced corrosion and protection has allowed knowing the state of the art and tendencies in this field. It allows using the results in competitive intelligence, corporate intelligence and project management.

An increase in the innovative activity in this field was detected in 1989. This tendency continues since 1997.

The higher number of patents corresponds to the IPC: C 04B (46), C 23F (37) y G 01N (30) y C 09K (15) and the highest number of patent application is related to chemical admixtures.

The authors with the highest number of patent applications pre-

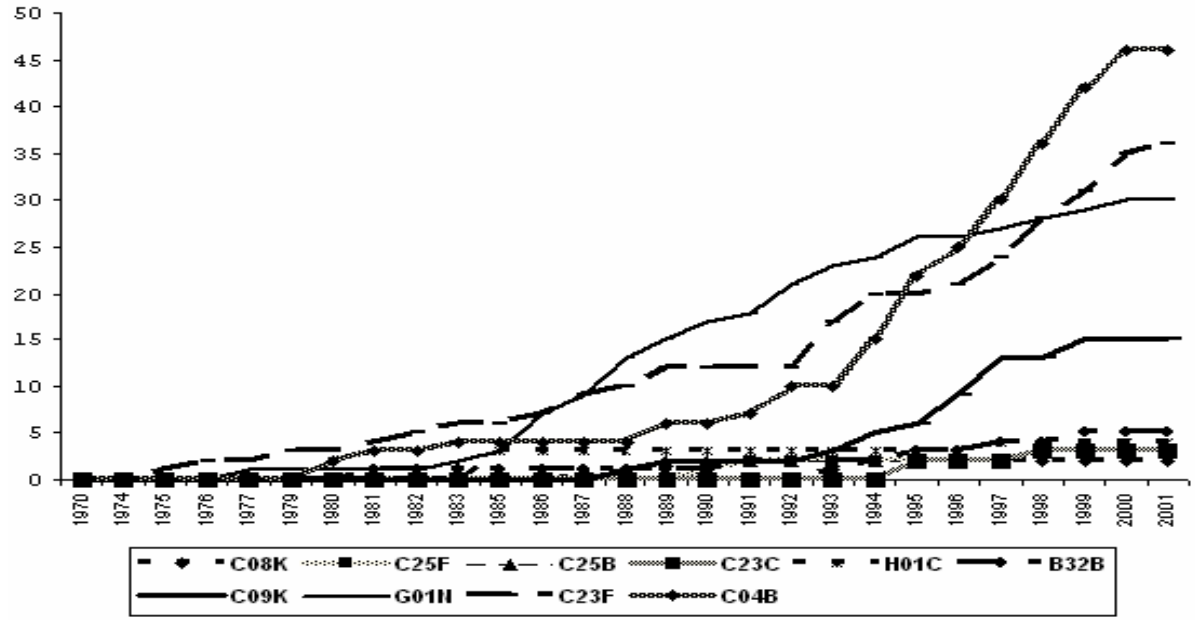

Fig. 4*. Distribution of patents applications according to the IPC.*

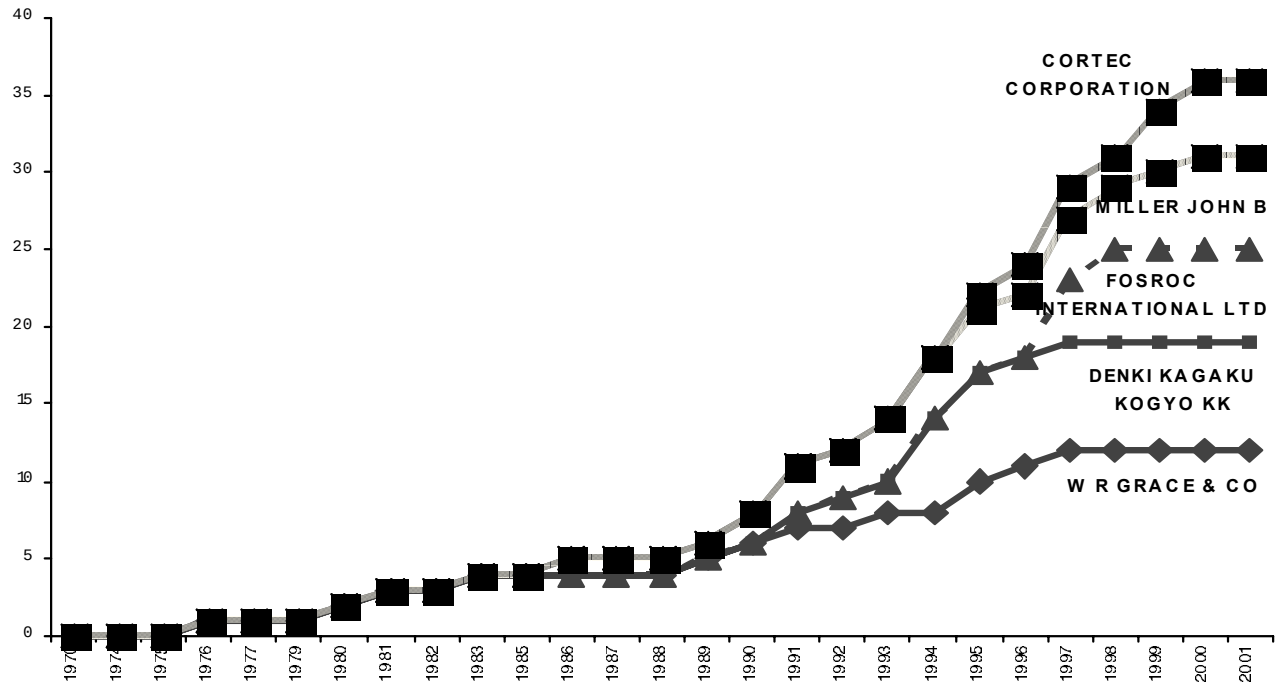

***Fig. 5**. Distribution of patents applications according to the owner.*

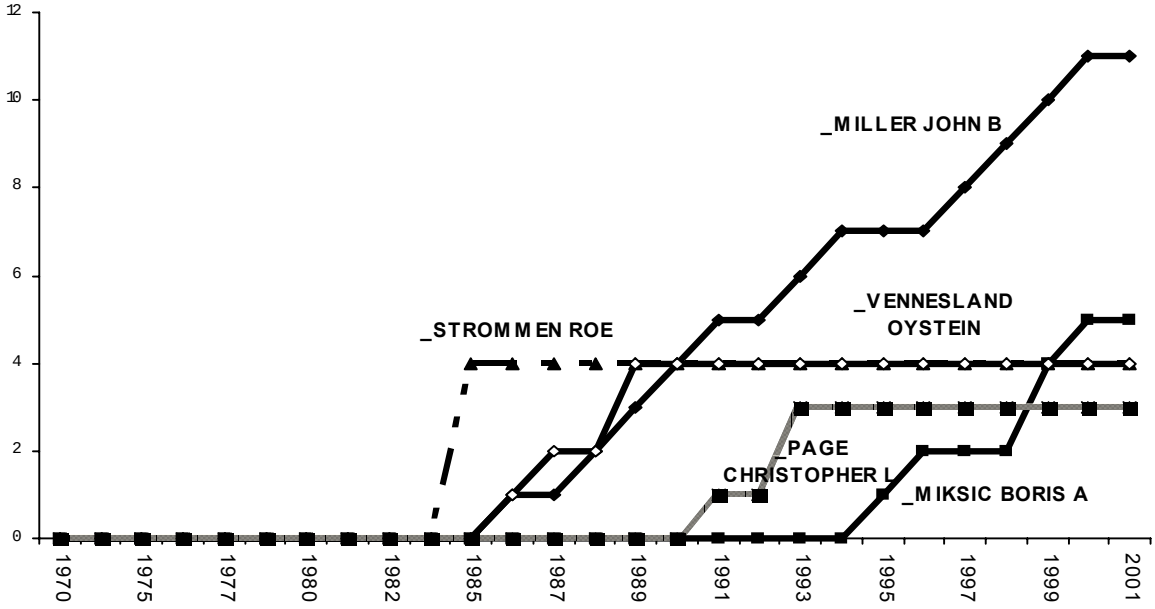

***Fig. 6.** Distribution of patents applications according to the inventor.*

sented: Miller John B, Miksic Boris, Burge Theodor, Vennesland Oystein and others.

The results obtained show the usefulness of the Automate Surveillance System (*SiVigPat*®).

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Table 1. Patents applications according to priority, destiny and origin country.

Priority country	Invention	Destiny country	Invention	Origin country	Invention
US	86	US	118	US	90
JP	35	JP	42	JP	35
GB	18	GB	19	GB	15
CH	7	WO	19	NO	10
DE	7	EP	17	DE	6
NO	4	CA	13	CH	5
WO	4	DE	8	CA	4
FR	3	CH	7	FR	3
CA	2	NO	4	WO	1
ES	1	AU	4	IT	1
AU	1	FR	3	FI	1
CZ	1	CZ	3	ES	1
DK	1	DK	1	EP	1
AT	1	DT	1	DK	1
EP	1	AT	1	AU	1
FI	1	FI	1	—	—
IT	1	HU	1	—	—
—	—	IT	1	—	—

US Estados Unidos JP Japón GB Gran Bretaña DE Alemania
FR Francia CA Canadá IT Italia CH Suiza
ES España AU Australia CZ Checoslovaquia HU Hungría
DK Dinamarca AT Austria NO Noruega FI Finlandia
EP Oficina europea patentes WO Tratado de cooperación y patentes