

Technological Trends for Clean Production in Coal Mining in Colombia

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Abstract

Objective: To describe trends in technology for clean production in the phase of coal mining in Colombia and the department of La Guajira. **Material and Methods:** the research was of type of descriptive and documentary, with sectional design and bibliometric analysis. For data collection analysis matrices were constructed that allowed to record all data of the documentary sources consulted that formed the two populations of this study population (patents) and population B (scientific articles and documents). **Finding:** Among the results were located 424 patent applications on the part of the Superintendency of Industry and Commerce of Colombia, of which we did not find any related to clean production in the exploitation phase of coal. The nine (9) corresponding articles at national level the domain, the maturity and obsolescence found more than technologies environmental management systems prevail a range high. For the case, articles and local technical documents, the domain was the same result than those found at the national level. **Applications:** the company that manages the 100% of the operation in La Guajira department performs in a responsible manner its process, but by following national trends in management, without introducing clean technologies as such, its sustainability is based in environmental management introduced with conventional technologies while generating some positive contribution to the environment could make greater efforts.

Keywords: Clean Production, Coal Exploitation, Domestic Technological Trends, Local Technological Trends, Mining

1. Introduction

Technological trends, show us where the technologies, are generally aimed toward innovative proposals on a specific topic, for this particular case, the technologies that promote clean production, in coal mining in the stage of exploitation. The above gives an idea about the importance of understanding the term and what it entails in each area of development, providing solutions to problems, without falling behind technologically, that may represent economic losses and market share. technological trends as guidelines that handle the companies

to be at the forefront of technology and so inclined to change technologies, in order to improve them constantly through the time; and be used for the benefit of society¹.

Another mud, technological trends are a tool that allows you to identify the status of technology through a study for a period of time, based on an analysis of the captured information through different media, whether written, printed, or through the web, offering to the researcher the possibility of orienting the horizons of their projects, to point toward the feasibility of developing a product, the creation of a good

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or service, technological adaptation and even toward technological innovation, this with the purpose of that investment to take place, is supported as both toward and sustainability².

For its part, technological trends as the states of propensity or inclination likely in the evolution of a technology over time, allowing you to get information about the innovations, the availability of useful technologies and Acquirable for the organization, as well as differentiate behavioural patterns in various sectors³. Also, some authors define such trends as “the evolutionary state of a technology”, and its analysis brings as results detection of gaps and business opportunities¹. At the same time, technological trends are not predictions of the level of utilization of some technology, improving the elements that are involved in the correct operation based on the levels of consumption, avoiding technological obsolescence, thus allowing to position itself as a successful companies at the forefront of industrialized world⁴. The variable technological trends can be defined operationally as all new knowledge in perspective or who are already materialized technologically are given to get to know each other through publications or patents.

On the other hand, the results indicate that a large percentage of investigations in science and technology are discovered by the trends, transmitted through the processes of written communication such as books, magazine articles, proceedings of Congress and patents⁵. In addition, it must be from a variety of sources of information to analyze trends, it also indicates that the most useful sources are the databases, websites and other internet resources, complemented with the necessary use of computer tools and math starting from the search for information, analysis, evaluation of the same until you reach the conclusions⁶. In accordance with the above, below is summarized in a series of steps the analysis of trends⁷: (a) Check that the behaviour of a variable follows a certain form in time, (b) know some of its attributes (variations and dependence), and (c) provide initial data.

2. Materials and Methods

For the purpose of this research that consists of the description of technological trends for clean production in the phase of coal mining in Colombia and the department of La Guajira, is located in an investigation of descriptive and documentary, with a non-experimental design⁸. Trans-sectional and bibliometric analysis^{9,10}. The present investigation, taking into account that responds to a bibliometric work, the population is made up of so-called “people to people” and “Population B”, the first corresponds to the national patents of the Superintendency of Industry and Commerce of Colombia, the second consisted of the documents and scientific articles, national and local in La Guajira department in Colombia⁹.

For the data collection instruments raised the use and construction of arrays of analysis also recognized as work sheets, which allows you to sort and classify data, i.e., record all data that are queried from documentary sources such as books, magazines, newspapers, and other¹¹. It took into account the validity of content that refers to the degree to which an instrument reflects a specific domain of content of what is measured, i.e. you can't exclude those factors that represent your content to the objectives, because it would not authorise the instrument¹². The reliability of agreement with is not in so far as this research is subject to its own criteria for the selection of material, evaluated by experts that determine its reliability at the time of collecting the information of interest². Data analysis is based on the technique of qualitative analysis, a stand-alone, in accordance with the characteristics of the documentary analysis, which allows you to locate the problem within the framework of science, which reflects the methods used, variables and categories, to avoid making a work that has already been carried out¹³.

3. Results and Discussion

To analyze technological trends at the national level (Colombia), we inquired in the Superintendence of

424 Solicitud(es)

Expediente No.	Título	Figura Característica	Fecha de presentación	Estado(s)	Titular
02310474	PROCEDIMIENTO PARA LA PRODUCCIÓN DE LA OXIMA DE LA CICLOHEXANONA		05 dic 2002	Caducado	DSM IP ASSETS B.V.
03002550	MÉTODOS PARA INCREMENTAR LA PRODUCCIÓN DE ETANOL DE UNA FERMENTACIÓN MICROBIANA		16 ene 2003	Caducado	EMMAUS FOUNDATION. ORG
04202782	METODO PARA PRODUCIR ENERGIA LIMPIA A PARTIR DE CARBON		16 ene 2004	Negada	CALDERON SYNGAS COMPANY
04041909	MÓLECULAS DE ANTICUERPO CON ESPECIFICIDAD POR EL KDR PARA PREVENIR LA INTERACCIÓN ENTRE VEGF Y KDR, Y MÉTODO PARA LA PRODUCCIÓN DE LAS MISMAS		06 may 2004	Caducado	CELLTECH RIJSD LIMITED
04055187	PROCEDIMIENTO PARA PRODUCIR FERRONIQUEL Y PRODECIMIENTO PARA PRODUCIR MATERIA PRIMA PARA LA PRODUCCIÓN DE FERRONIQUEL		11 jun 2004	Caducado	KANUSHIKO KAISHA KOBE SEIKO SHO
04055709	ANTICUERPOS ANTI-INTERLEUCINA-6, COMPOSICIONES, Y MÉTODOS PARA SU PRODUCCIÓN		15 jun 2004	Concedido	CENTOCOR ORTHO BIOTECH INC.

Figure 1. Results of patents in Colombia.

Source: Ministry of Industry and Trade (2017)

Industry and Commerce, the agency responsible for granting patents, by means of the web page <http://www.sic.gov.co/patentes>. In the Figure 1 shows the results obtained under the level of search for clean production in coal mining.

According to the previous image, they found 424 requests, among which were the states: expired, denied, was granted, and in the process. We inquired one at a time, but no results were found associated with the variable and context of study. It is presumed that this is due to the fact that the companies that have interference within the country are of foreign character, which is why there is little research and the development of patents within the country in this area. With regard to the documents (journals, books, articles, among others), in the following chart are listed by year the documents found in the

country, that directly relate to the clean production technologies in the coal extraction phase (Figure 2).

In accordance with the chart above, it can be noticed that there were a total of 9 documents related to the variable and context of studies, where there was the greatest number of documents was in the period between 2010 and 2014, is presumed to be due to the strengthening assessment submitted in the applicable legal regulations in Colombia for these periods, however, there was no progress for the years 2015 and 2016. Despite being Colombia a country producer and exporter of coal, there are few researches in the field of clean production, which more than deliver technologies, offer knowledge management with conventional technologies, to cause as little impact as possible. At the local level (department of La Guajira) inquired about technical reports submitted by

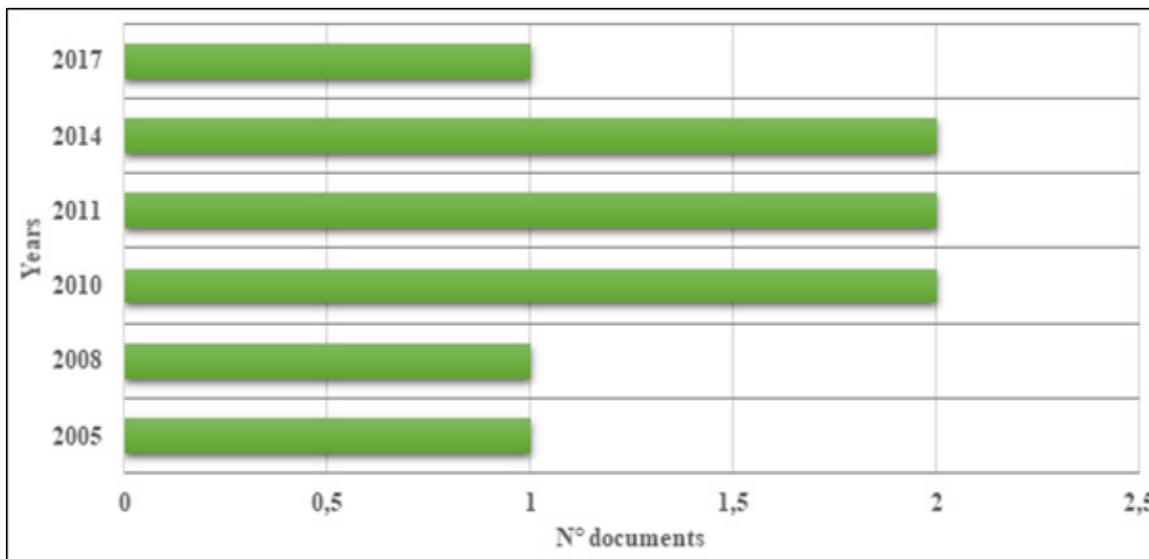


Figure 2. Number of national documents per year.

the company Cerrejon, its institutional page, among other documents are listed below in the following Table 1.

In the table are related documents in quite recent years that speak of clean production in the extraction phase in the department of La Guajira, directly related to the com-

pany Cerrejón, who makes the 100% of the operation in this department, since under resolution 522 of 1997 he ceded the rights of the Cerrejón mine Caypa (south), it should be noted that are not technologies themselves, if not as in previous, knowledge management to implement

Table 1. Local papers - department of La Guajira

Source	Title	Date	Applied Technology
Cerrejón	Sustainable development	2017	Clean mining production technologies
Martinez, H & Velásquez, J	Clean production in the Cerrejon Zona Norte	2010	Machinery and equipment such as environmentally sustainable technologies
Avilés, T & Sanchez, D	Socio-economic and environmental impact of Carbones del Cerrejón: production phase 1986 - 2009	2011	Clean Production
National Environmental Licensing Authority – ANLA	Authorization of environmental management plan	2014	Environmental management

traditional teams with less impact on the environment. In the case of national trends, the assumption is that we did not find any patent for the area and context of study to establish innovative technologies in the area of clean production in coal mining, they found documents which establish management systems for clean production, but with conventional technologies, which if compared with the aspects, life cycle, domain, and positioning, are already mature positions because they come with the common factor of the same characteristics, in various years, which leaves them with a domain and positioning high, because they are the ideas that set the pace in the market for clean production for coal mining.

At the local level (La Guajira), it was found institutional documents and controlling entities, of the organization (cerrejón) that handles 100% of the operation within the department of La Guajira, finding that this performs an operation you are looking for a clean production, but with environmental management programs, which includes clean production with current technologies and conventional, that although contribute to the decline could be greater efforts to generate greater environmental sustainability, information has a positioning, life cycle and high maturity, represented in that this company is a pioneer in sustainably production systems responsible.

4. Conclusions

For trends in technology for clean production in the exploitation phase of coal at the regional level, it was found that the documents as many regional and local point to manage knowledge looking for clean production, introducing processes of environmental sustainability to conventional technologies, although there are no patents at the national level, make great efforts to promote clean production in coal mining, the interior of the country. With regard to local trends with documents of the company that manages the 100% of the operation in La Guajira department, it was found that performs in a responsible manner its process, but by following national trends in management, without introducing clean technologies as such, its sustainability is based in environmental manage-

ment introduced with conventional technologies, while generating some positive contribution to the environment, greater efforts could be made.

Implement in organizations of coal mining in the exploitation phase, greater economic efforts, which enable them to migrate to conventional technologies with environmental management systems, technologies themselves that allow an innovation, improving the mining process, but with environmental sustainability, that is always looking for the balance between production and profits, with the preservation or restoration of the before, during and after the operation. In the same way as organizations seek compliance with environmental policies during the whole process and not when you are already generated the damage under mode with monetary contributions once caused the damage, since these activities and ways of acting, as well generate compensation, many times are not sufficient to compensate for damage caused to the environment. It is also proposed for this purpose, working internally in the organization and in conjunction with research and development to create innovative processes that permit, in accordance with the experience, context and learning generated throughout the activity, new technologies susceptible to being patented in that when you print out an excellent operation with distinctive features of clean production, to serve as an example for other operations and generate added value both for its implementation, such as the negotiations to come out from be patented.

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