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► To cite this version:

Luiz Fernando Martins Gandon, Renato Ribeiro Nogueira Ferraz, Luc Quoniam, David Reymond. Using patent information to identify innovative solutions for respiratory disease prevention in the mining sector. *Revista de Administração da UFSM*, 2020, 13 (3), pp.587-601. 10.5902/1983465928836 . hal-03174764

HAL Id: hal-03174764

<https://hal.science/hal-03174764>

Submitted on 30 Mar 2021

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USING PATENT INFORMATION TO IDENTIFY INNOVATIVE SOLUTIONS FOR RESPIRATORY DISEASE PREVENTION IN THE MINING SECTOR

UTILIZAÇÃO DE INFORMAÇÕES PATENTÁRIAS NA BUSCA DE SOLUÇÕES INOVADORAS PARA PREVENÇÃO DE DOENÇAS RESPIRATÓRIAS NO SETOR DE MINERAÇÃO

Submission: 29/08/2017

Accept: 05/05/2019

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ABSTRACT

Brazil ranks 4th in the world for occupational accidents. There are more than 700 thousand occurrences per year, which cost the country about R\$10 billion. The objective of this study is to identify technologies, related to the prevention of occupational accidents and diseases, that are not protected in Brazil. We used *Patent2net*, a computational data mining tool, to evaluate worldwide patents deposited in the *Espacenet* database. Employing a technometric research approach, a *Patent2net* case study was carried out by analyzing over 1,600 occupational safety and/or occupational disease patents deposited in *Espacenet*. Notably, a Chinese utility model patent describing a helmet with a breathing mask, that provides the worker protection against the inhalation of chemical agents and head overheating. The technology described in the patent could be potentially replicated in Brazil, and utilized in the prevention against respiratory problems commonly diagnosed in miners, such as pneumoconiosis. This disease, in particular, requires compulsory notification and the treatment, under responsibility of the public health system, is costly to the country. Identifying technologies that could potentially reduce the number of work-related incidents and, in turn, lower the associated costs.

Keywords: Patents, *Patent2net*, Pneumoconiosis, Innovation, Data Mining, Big Data.

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RESUMO

O Brasil ocupa a 4ª posição no ranking mundial de acidentes de trabalho, com mais de 700 mil eventos por ano, que custam cerca de R\$ 10 bilhões ao país. Nesse sentido, o objetivo deste estudo é analisar como o Patent2net, uma ferramenta computacional para mineração de dados, pode contribuir para uma avaliação crítica das patentes depositadas em uma base mundial, a Espacenet, buscando identificar documentos cuja proteção não seja estendida ao Brasil e que possam contribuir para a implantação de tecnologias relacionadas à prevenção de acidentes no trabalho e doenças ocupacionais. Realizou-se assim um estudo de caso de aplicação do Patent2net por meio de pesquisa tecnométrica, sendo analisadas mais de 1.600 patentes sobre segurança no trabalho e/ou doenças ocupacionais depositadas na Espacenet. Dentre os resultados da busca, destacou-se uma patente chinesa, sem proteção no Brasil, e com baixo custo de fabricação, que descreve uma máscara de respiração acoplada a um capacete e oferece proteção à inalação de agentes químicos e ao superaquecimento da cabeça. A referida patente pode ser legalmente replicada no Brasil com vistas a prevenir a ocorrência de doenças respiratórias, especialmente a pneumoconiose, classificada como doença de notificação compulsória, e cujo tratamento é encargo do sistema público de saúde, com alto custo para o país.

Palavras-chave: Patentes, Patent2net, Pneumoconiose, Inovação, Mineração de Dados, Big Data.

1 INTRODUCTION

Brazil has been for years among the countries where more workers are killed, mutilated, or injured at work. Among the items of the protocols adopted to address the problem is prevention, which mainly involves using Personal Protective Equipment (PPE), avoiding recklessness, reducing risk exposure, and maintaining a clean and organized work environment. The concern with occupational accidents is guided by a collection of technical norms assembled by the representing sectors of organized civil society: workers, business people and government, and is the basis of Brazilian legislation on occupational safety and medicine (MINISTÉRIO DO TRABALHO, 2011).

The pursuit of best practices for superior performance inevitably passes through the process of innovation, and usually involves the filing of a patent, nationally and/or globally. This can be a long, complex and often expensive process. In Brazil, this registration is made at the National Institute of Industrial Property (INPI), which provides the "(...) temporary title to an invention or utility model granted by the State to inventors or authors or other natural or legal persons, legal rights holders with respect to the creation" (INPI, 2017). While many patents are protected in one or more countries, many are free to use or the protection has expired.

According to the World Competitiveness Center IMD (2016), Brazil does not appear to invest heavily in Research and Development (R&D), ranking 57th out of the 61 economies surveyed, and behind countries like Thailand (28th), Lithuania (30th), Chile (36th), Colombia (51st) South Africa (52nd), Peru (54th), Argentina (55th). Based on this information, an economical path forward, for R&D, is identifying and utilizing these free-use patents (OLIVEIRA, 2003). Barros *et al.* (2015) alerted the importance for Brazil to internalize technologies developed in other countries through the documentary recovery of patent information. The authors went on to demonstrate that the study of patents can assist in monitoring the technological advancement of competing products, geo-identifying company activity, benchmarking for licensing and technology transfer, among others (BARROS *et al.*, 2015).

The *Espacenet* database is a free online patent search service. It was developed and is maintained by the European Patent Office (EPO), offers more than 100 million patent documents, from more than 80 countries, including Brazil, and enables the user to research the text of documents in their entirety (FERRAZ *et al.*, 2016). Using this database, the present study sought to answer the following research questions: Can *Patent2net*, a computational data mining tool used to retrieve information and patent records, identify a free-use technology that minimizes occupational respiratory diseases? If so, could this technology be reproduced in Brazil?

The justification for the investment in this topic is the possibility of offering an explanatory and theoretical study about the proposed search method, and to shed light on the advantages and improvements a tool like *Patent2net* offers. The present study obtained information related to the innovation of a product that can provide workplace protection and reduce the development of respiratory diseases, often diagnosed in miners.

2 OBJECTIVE

The overall objective of this case study is to use *Patent2net* to search for free-use technologies related to the prevention of, pneumoconiosis, an important group of occupational respiratory diseases, and to identify ones that can be freely replicated in Brazil, thereby reducing costs and saving money. Furthermore, after selecting the candidate patents the costs and feasibility of production in Brazil were evaluated.

3 LITERATURE REVIEW

3.1 Innovation

There is a direct correlation between innovation and the development of a country, especially with regards to the creation of strategies for obtaining sustainable advantages and competitive positioning. As proposed by Hamel and Breen (2007) and Davila, Epstein and Shelton (2009), when thinking about strategy innovation must emerge as an indispensable and inherent element of action. Additionally, the Oslo Handbook (1997) refers to the status of innovation as the introduction of a new or somewhat better product or service than a predecessor, in terms of characteristics or predetermined use, with improvements in specific technical specificities, components or materials, in addition to embedded software with the objective of innovating, facilitating the use, among other functional and, above all, operational characteristics.

According to data from the Communications Department of the Ministry of Science, Technology and Innovation, Brazil and the European Union (EU) have been expanding cooperation in research and innovation, since 2015. At the 7th Meeting of the Joint Brazil-European Union meeting, the Ministries of Science, Technology and Innovation and Foreign Affairs met with the objective of planning “[...]new agendas and updating ongoing projects” in areas such as bio-economics, nuclear energy, nanotechnology, marine research and information and communication technologies (PORTAL BRASIL, 2015).

The sixth edition of the Innovation Research - Pintec 2014, which covered 2012 to 2014, pointed to stability in terms of innovation and investment in R&D, by Brazilian companies. From the information collected from 132,529 Brazilian organizations (public and private), it can be observed that R&D investments in the period studied “(...) increased from 0.81% between 2009 and 2011 to 0.84% in 2014. The research also revealed that the volume of investments jumped from R\$17.4 to R\$22.7 billion” (LINHARES, 2016). Among the bottlenecks for innovation in Brazil is the “(...) delay in obtaining patents and low replacement index for obsolete technologies delay innovation in Brazil” (OLIVEIRA, 2016).

A report from 2016 showed that the high costs pose the greatest barrier to innovation in the industrial sector of Brazil (86%), followed by risks (82.1%) and lack of funding (68.8%). In the services sector, high costs (88.5%) were also found to be the biggest obstacle (LINHARES, 2016). In this perspective, innovation emerges through inventions, patents, products, brands, among many others, and one of the factors required for the development of a country. As will be discussed later, society needs to pay attention to the need for investments in innovation and patent rights.

3.2 Patents

According to Di Blasi (2010), a patent can be understood as a property title, presupposed in the so-called Intellectual Property Law - Law No. 9.279 / 1996 (BRASIL, 1996), giving the holder the right to prevent and at the same time to exploit the invention (brand or product, etc.) in the defined territory. Similarly, the National Institute of Industrial Property (INPI, 2017) defines a patent as a property title with a fixed term of an invention, granted by the State of the one who holds the right to the creation. Thus, the owner can control whether he grants or denies third parties the right to manufacture and/or commercialize the invention. On the other hand, the inventor is required to disclose the content and/or process of the invention. Patent filing is a statutory intellectual property lien, which gives the holder of the patent possession of the possibility for exclusive exploitation and unrestricted use and in full compliance with the proprietor's unique conveniences.

Another important aspect concerns international law, which allows a patent protected in a certain country to be freely used in any other territory where it is not protected (JANKE, 2003). This justifies the existence of extensive patent databases that can be consulted, and from which ideas for the development of new technologies or products, based on previously patented innovations, are obtained (BARROS et al., 2015).

Barros *et al.* (2015) showed that "(...) of 1,781,768 patent applications from a search in the Patentscope database (2017), only 2% of the deposits were from Brazil". This low percentage reflects Brazil's need for innovation and patent output, which will almost certainly be beneficial, as seen in many other countries. Mining patent databases, data mining, allows the user to collect information related to patents on a specific subject, using complex statistical and mathematical techniques (LAROSE, 2005).

There are several patent databases available to researchers, private and public (with free access). The current case study used the *Espacenet* patent database, from the EPO, which has more than 100 million patent documents from over 80 countries, including Brazil, making it possible to search for the patented documents in their entirety (FERRAZ *et al.*, 2016).

3.3 Patent2net

Patent2net is a free tool used for data mining in *Espacenet*. It extracts information directly from the *Espacenet* database, assembles graphs and dynamic tables and facilitates the selection of patents of interest (FERRAZ *et al.*, 2016). Additionally, it is an open source patent tracker of the *Espacenet* database, developed and fostered through academic work carried out by an international multidisciplinary team, which groups together about twenty researchers and scholars, teachers and students from nations such as Brazil, Algeria, Senegal, France, Switzerland and Portugal (PATENT2NET, 2016). According to Ferraz et al. (2016), *Patent2net* performs the data mining process efficiently and effectively, taking into account the speed, volume and variety of

the information processed during the research, while at the same time complying with the legal precepts related to the search for information in patented documents.

All of the few free patent web search services have limitations, such as the number of records that can be downloaded. Direct searches of *Google Patent Search* (www.google.com/patents), *Patentscope* (<http://wipo.int/patenscope/en/>) and *Espacenet* (<http://worldwide.Espacenet.com/>) can all be carried out with *Patent2net*.

3.4 Workplace Safety

In 2014, at the 20th World Congress on Safety and Health, in Frankfurt, Germany, it was reported that 2.3 million deaths per year were due to occupational accidents and illnesses, and that 860,000 people suffer from some type of work-related injury every day, worldwide (FUNDACENTRO, 2014). Thus, organizations need to develop effective safety and health management programs in the workplace.

In Brazil, there is a high rate of occupational related accidents and diseases, which have a heavy burden on society. An efficient and inexpensive solution is to search for international patents in the area of work safety especially for the prevention of pneumoconiosis. These patents would not be registered in Brazil, and could be incorporated into the national market, where there is an immense field of research in search of better worker protection and improved working conditions.

According to BMJ Best Practices (2016), pneumoconioses are a group of chronic lung diseases “[...] caused by exposure to mineral dust or metals. The major pneumoconioses include asbestosis, silicosis, pneumoconiosis (Coal workers. Black lung disease) and chronic disease due to exposure to beryllium”. Occupations that expose workers to disease-causing dusts include mining (iron, bauxite, potassium and phosphate rocks, asbestos, clays and other minerals containing free silica etc.); and mineral transformation jobs in general, metallurgy, ceramics, glass, civil construction, agriculture and wood industry (REVISTA PROTEÇÃO, 2009).

According to the Secretariat of Health Care (2004), in 1991 there were about 100,000 registered active miners and 400,000 prospectors. Moreover, according to a study by Lido et al. (2008), the number of pneumoconiosis cases reported from 1978 to 2003 totaled 1,147 people (1,075 men and 72 women).

With regards to the prevention of pneumoconiosis, it is recommended that the environment be humidified, that the floors be constantly washed to prevent the floating of dust, and water be sprinkled around the dust production sites (MINISTÉRIO DA SAÚDE, 2004). However, in the searches carried out on websites and official portals, such as the Health Care Secretariat of the Ministry of Health, and organizations and companies dealing with the subject, there was no mention of PPE being specifically employed in the prevention of pneumoconioses.

4 METHODOLOGY

The present study focused on respiratory protection in the workplace, and analyzed patent registrations using a data mining process. Patent documents constitute important references of the chosen data collection method. In addition, it is important to understand the importance of the technological development, as well as to support the proposal of public policies and/or industrial strategies (SANTOS *et al.*, 2004). Simply put, the patent describes in detail the method for reproducing the invention (ABBAS; ZHANG; KHAN, 2014).

This research is classified as quantitative, descriptive and exploratory, which in this particular case is defined as technometric (CIRIBELLI, 2003). Quantitative data on inventions are presented

and are based on the volume of patents related to the subject of interest deposited on the *Espacenet* database (KÖCHE, 2011). We employed *Patent2net* to sequentially run several specific computational modules, mining the *Espacenet* database for texts and registries on patents related to the “prevention of accidents and occupational diseases”, and then analyzed the selected patents.

For data collection, the following search strategy (string) was provided to the tool: (*ta* = “*job securit**”) OR (*ta* = “*work securit**”) OR (*ta* = “*job safet**”) OR (*ta* = “*work safet**”) OR (*ta* = “*occupat* diseas**”). Briefly, the software searched *Espacenet*, in the title or in the abstract (*ta* =, being “*t*” for title and “*a*” for abstract), the terms presented in the search string, defined by time in consultation with a professional in the safety area at work.

Following collection, data was analyzed and presented in the form of graphs and reports, generated by *Patent2net*. This allowed for the quantitative evaluation of the patented documents on the proposed topic, and made it possible to identify available technologies that can be replicated in countries where the patents do not have extended protection (i.e. Brazil). Part of the results presented can be classified as technometric, since the data obtained can be used to analyze and construct indicators.

The analysis was performed using libraries or open source computing packages, such as *Gephi* (networks), *data table* (displaying or searching), *Iramuteq* (textometry) and *Freeplane* (Mind Maps), which were all coupled to the central software. The data mining described in this research lasted for approximately 24 uninterrupted hours, on a personal computer with 16Gb of RAM, an I7 processor, internet connection, and an approximate download speed of 96GB. Additionally, the system could retrieve illustrative images, references to existing products, citations, among other features not discussed in this study, which may however increase the chances of obtaining relevant documents (BOFF; FORTES; TOCCHETTO, 2018). The obtained results were stored on a personal computer; however, such extractions could be hosted in a surface internet provider, and viewed by any interested party, guaranteeing transparency in the research.

After the data mining process, floating reading was performed as proposed by Bardin (2008), selecting the documents based on content analysis, although not aiming at this moment to categorize the information obtained. Categorization was verified from a “List of coding categories”, initially defined according to the research objectives, considering that more coding categories should appear in proportion to the progress made in the reading and interpretation of the analyzed material (BOGDAN; BIKLEN, 1994). The material was then exploited, which includes encoding the data obtained by means of a consistent criterion, based on categories. Finally, we treated the results, constituting a phase of reflection, with support from empirical materials and confrontation between accumulated and acquired knowledge.

Computational details related to *Patent2net* can be obtained from the seminal work of Reymond & Quoniam (2016), and detailed information for installation and execution of the software is available at <http://patent2netv2.vlab4u.info/dokuwiki/doku.php?id=page>.

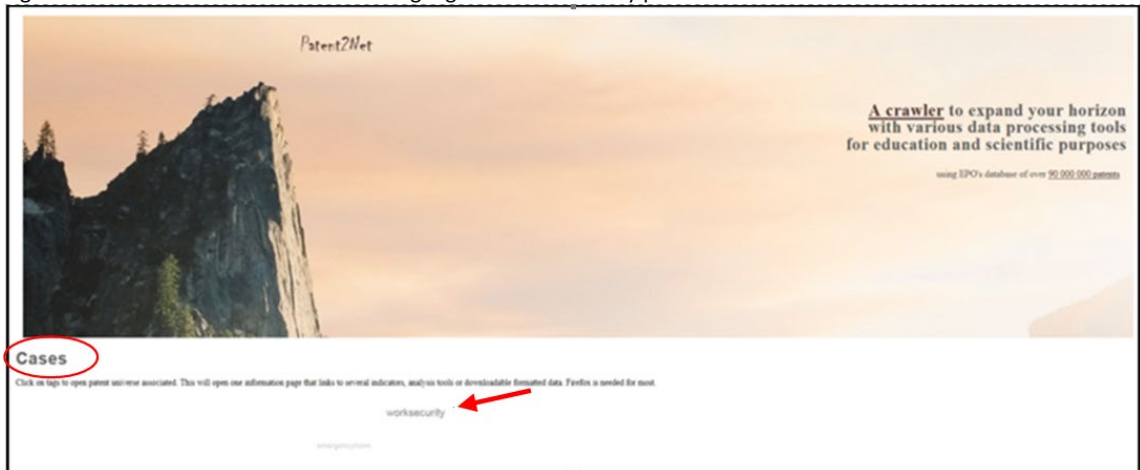
5 RESULTS AND DISCUSSION

The results extracted from *Espacenet* were compiled by *Patent2net* and maintained offline, as web page Hyper Text Markup Language (HTML) files. These results were presented in the form of graphs and dynamic tables, with information regarding the technological production on the topic addressed in this article, presenting a panorama of the productivity of the researched theme.

The *Patent2net* tool provides a wide range of consultation options, including: 1 - geolo-

cation maps of patent protection applications, companies requesting the grant and patent inventors; 2 - networks between inventors, patent depositors and technology companies; 3 - dynamic tables analyzing the legal status of the patents, among other indicators; 4 – patent selection with worldwide protection, and in Brazil; and 5 - identification of patents with the participation of Brazilian inventors and companies, when searching for free-use patents in Brazil. The results from the reported extractions were available at the link shown in Figure 1.

Figure 1 –*Patent2net* home screen with highlights for work safety patents

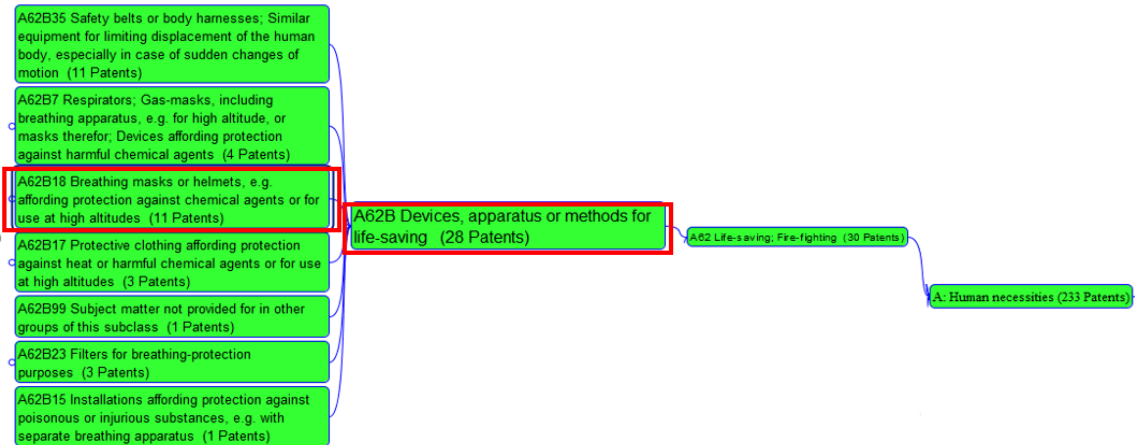


Source: Data obtained by the authors with the *Patent2net* software (2017).

In the lower part of Figure 1, note the word “Cases” (circled in red), as well as the indication of the searched topic, “Work Security” (red arrow). To get to the page, a HTML file provided by the software itself was executed. By accessing the “Work Security” link, a screen with two blocks indicated by the titles “Informations”, which presents various data about the extractions performed, and “On-line analysis tools”, giving the user access to different results.

Com objetivo de aprimorar a busca por patentes com potencial de frugalidade (econômicas no uso dos recursos evitando desperdício) e, especialmente, com viabilidade de replicação a baixo custo no Brasil, utilizaram-se na tela de buscas, no campo denominado “Title”, as palavras-chave “*construction*” (buscando patentes para a construção civil), “*gloves*” (luvas), “*hand protection*” (proteção das mãos), “*seat belt*” (cinto de segurança), e “*helmet*” (capacete) In order to search for patents with potential of frugality (economical in the use of the resources and avoiding waste), and feasibility (replication at low cost in Brazil), the keywords “*construction*” (seeking patents for construction), “*gloves*”, “*hand protection*”, “*seat belt*”, and “*helmet*” were used. For the selection of patents of interest, as indicated by a red rectangle in Figure 2, we searched for an EPI that could be used to minimize the problem of inhaling toxic dust, commonly faced by heavy construction workers and miners, and one of the main causes of pneumoconiosis.

Figure 2 – Mind map of section A (Human needs), showing the subgroup A62B18



Source: Data obtained by the authors with the software *Patent2net* (2017).

Among the 1,631 documents originally extracted, 7 patents with frugality potential (represented by the kind code “U”), protected only in China, and specifically covering technologies used in helmets were identified (Figure 3).

Figure 3 – Patents with frugality potential containing the keyword “helmet”

| Country | Title | Inventor | From | Applicant | From | IPCRI1 | IPC7 | CPC | Prior-Date | Pub year | Label | Kind | Ref |
|---------|---|--|---|-------------------------------|----------------------|------------|------|-------------|------------|----------|-------|------|-----|
| CN | Safety helmet of comfortable practicality among high temperature environment | Song Xiaobo, Li Songyuan, Zhang Liming, He Jie, Yang Lei, Wang Xiaoguang | State Grid Corp China, State Grid Tianjin Electric Power Co Ltd | A42B1/04 | A42B1 | 2015-05-22 | 2015 | CN204742743 | U | 0 | | | |
| CN | Protective helmet for occupational disease prevention of electric operators | Yu Weisong | Yu Weisong | A61F9/06 | A61F9 | 2014-05-20 | 2014 | CN203885711 | U | 0 | | | |
| CN | Multifunctional safety helmet for building operations | Qin Jianzhi, Zhang Qun, Tian Zhen, Wang Min, Wei Dong | Shandong Academy Agricultural Sciences | A42B1/04, A42B1/06 | A42B1, F21V33 | 2012-10-18 | 2013 | CN202819770 | U | 0 | | | |
| CN | Half-length protective clothing with electric welding protective helmet | Tao Tao, Wang Haoran, Li Zhen, Qiao Fei, Ding Zhongyong | Xinjiang Blue Ridge Yuhua Polymer Co Ltd | A41D13/05, A41D13/11 | A41D13 | 2015-12-28 | 2016 | CN20523525 | U | 0 | | | |
| CN | Full-protection helmet shield | Sun Yusho | Sun Yusho | A61F9/06 | A61F9 | 2013-02-06 | 2013 | CN203138832 | U | 0 | | | |
| CN | Breathable geology mining helmet | Tian Jie, Xu Jie, Cui Siyong | Tian Jie | A42B3/28, A42B3/04, A42B3/30 | A42B3 | 2014-04-17 | 2014 | CN203952569 | U | | | | |
| CN | Air supplying and dust filtering type safety helmet for building construction | Hu Wei | Harbin Western Region Dev. Construction Co Ltd | A62B7/10, A42B1/24, A62B13/02 | A62B7, A42B1, A62B13 | 2015-01-12 | 2015 | CN204395257 | U | | | | |

Showing 1 to 7 of 7 entries (filtered from 1,631 total entries)

Source: Data obtained by the authors with the software *Patent2net* (2017).

These 7 patents were evaluated according to their reproducibility potential and production costs. The first example is a helmet for high temperature environments; the second provides protection against electric shocks; the third is a multifunctional helmet for building operations (no protection against the inhalation of particles); the fourth was a type of clothing with a helmet attached, and protects against electric discharges; the fifth and sixth items promised protection and isolation against trauma.

The seventh document, label CN204395257 (Figure 3, red arrow), was found to be the most appropriate, and described a “Construction helmet with air supply and dust filter”. This patent was filed on 06/17/2015 and is classified as a utility model. Based on its label, the full document was identified in the *Espacenet* database (Figure 4). This document contemplates technologies with IPCR7 of the group A62B18, and concerns the capacity of dual utility protection of

both the respiratory tract and the head of the worker, both indispensable especially in the civil construction and mining.

Figure 4–Page with the tag CN204395257 typed in the search field (“smart search”)

The screenshot shows the Espacenet Patent search interface. At the top, there is a navigation bar with the Espacenet logo and language options (Deutsch, English, Français). Below this is a search bar with the text 'Smart search: CN204395257'. The search results section displays 'Espacenet: free access to the database of over 90 million patents' and 'Access to Global Dossier and links to the European Patent Register and national registers'. There are also sections for 'Espacenet outages' and 'News flashes'.

Source: <https://worldwide.espacenet.com/>

As shown in Figure 5, the priority period for this patent expired in October 2016, and is therefore free to consult in full, by simply accessing the link “Original document” (indicated by the red arrow). In the English abstract available at the bottom of the screen (Figure 5), it was possible to identify that the described technology functioned as a shield against head contusions and overheating, as well as respiratory tract protection, since the helmet is coupled to an exhaust system that removes dust and other particles suspended in the air.

Figure 5–Espacenet page with the basic information about the patent CN204395257.

The screenshot shows the Espacenet Patent search interface for the patent CN204395257. The search results section displays 'Bibliographic data: CN204395257 (U) — 2015-06-17'. The title of the patent is 'Air supplying and dust filtering type safety helmet for building construction'. The inventor is listed as 'HU WEI ±' and the applicant as 'HARBIN WESTERN REGION DEV CONSTRUCTION CO LTD ±'. The classification is '- International: A42B1/24; A62B18/02; A62B7/10'. The application number is 'CN2015218175U 20150112' and the priority number is 'CN2015218175U 20150112'. A red arrow points to the 'Original document' link in the left sidebar.

Source: https://worldwide.espacenet.com/publicationDetails/biblio?II=0&ND=3&adjacent=true&locale=en_EP&FT=D&date=20150617&CC=CN&NR=204395257U&KC=U.

By clicking on the link “Original document”, the screen in Figure 6 appears, and describes the technology developed and registered in the document in Chinese.

Figure 6–Screenshot of the Original document for CN204395257

The screenshot shows the Espacenet patent search interface. At the top, there is a header with the Espacenet logo and navigation options in German, English, and French. Below the header is a navigation menu with options like 'About Espacenet', 'Other EPO online services', 'Search', 'Result list', 'My patents list (0)', 'Query history', 'Settings', and 'Help'. The main content area displays the patent information for CN204395257 (U) — 2015-06-17. The document title is 'Air supplying and dust filtering type safety helmet for building construction'. The interface includes a sidebar with 'Original document' selected, and a main content area displaying the patent information in Chinese. The patent information includes the title '(12) 实用新型专利', the applicant '(73) 哈尔滨西部地区开发建设有限责任公司', the inventor '(72) 胡巍', and the patent number '(19) 中华人民共和国国家知识产权局'. The document is available in English and Chinese.

Source: https://worldwide.espacenet.com/publicationDetails/originalDocument?CC=CN&NR=204395257U&KC=U&FT=D&ND=3&date=20150617&DB=&locale=en_EP.

And, searching for the selected patent label in the Google Patent Search, an automatically translated English version was provided by the tool itself (Figure 7).

Figure 7–Portuguese version of the patent description CN204395257

Google

Patentes chinês inglês

Air supplying and dust filtering type safety helmet for building construction

CN 204395257 U

RESUMO

The utility model provides an air supplying ad dust filtering type safety helmet for building construction. The health condition of workers is not optimistic at present, pneumoconiosis is one of the occupational diseases which damage the most the health of the workers, patients with pneumoconiosis increase each year, and no time is to delay to prevent and treat dust occupational diseases, so that the demand on the safety helmets is greatly increased. The air supplying ad dust filtering type safety helmet for building construction comprises a housing (1) which is respectively connected with a transparent panel (4), a permanent panel (5) and a dustproof canvas (7); the transparent panel is connected with the permanent magnet panel, wherein the permanent magnet panel is equipped with filtering cotton. The air supplying ad dust filtering type safety helmet is applied to building construction.

| | |
|----------------------|---|
| Número da publicação | CN204395257 U |
| Tipo de publicação | Concessão |
| Número do pedido | CN 201520018175 |
| Data de publicação | 17 jun. 2015 |
| Data de depósito | 12 jan. 2015 |
| Data da prioridade | 12 jan. 2015 |
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| Exportar citação | BIBTeX, EndNote, RefMan |
| Classificações (3) | |
| Links externos: | SIPO (escritório de patentes da China), Espacenet |

DESCRIÇÃO traduzidas do chinês

Construction Engineering helmet blowing dust

[0001] Technical Field:

[0002] The utility model relates to a construction engineering helmet blowing dust.

[0003] BACKGROUND:

[0004] The current state of health of workers is not optimistic, where one of the workers' pneumoconiosis is harmful to the health of the most serious occupational diseases, face increasing pneumoconiosis patients each year, to strengthen the prevention and treatment of occupational urgent dust, dust helmets Demand has continued to grow. Material existing closed-type dust mask helmet use is mostly plastic with glass, wide range of vision, focusing on anti-dust to keep the front portion, an improvement compared with dust masks can be used in low-dust workplace, but Because of its poor adhesion, the same can not be used in high concentrations of dust in workplaces. Due to the limited space of the mask and the nose and mouth isolated exhaust is not timely, it will make the workers shortness of breath, easy to feel hot, thus affecting workers' jobs. In coal mines, quarries, sand dust weather environments, the flow of dust due to static friction, in the same volume of the same quality, the electrostatic charge generated much fine dust particles; large concentration of dust in the flow friction collision opportunities, too much static charge generated, and some dust will be magnetized.

REIVINDICAÇÕES (4) traduzidas do chinês

A helmet blowing dust building works, which consists of: helmet shell, wherein: said helmet shell are respectively connected with the transparent panel, a permanent magnet panel, dust canvas, said transparent panel and The permanent panel connections, the permanent panel has a cotton filter.

Dust blower according to claim 1, wherein the helmet construction project, which is characterized by: the lining of the helmet shell roof mounted exhaust pipe, the outside of the shell helmet mounted LED lights, exhaust fan, switch, mounted intake fan, a fan and a permanent dust board power connector on the permanent panel.

3. Architectural Engineering blowing dust helmet 1 or 2 of the preceding claims, characterized in that: the intake fan dust fan and a permanent board power connector and the connecting wires through the switch by wire with said LED lights, the exhaust fan connection.

4. The air dust building works helmet 1 or 2 of the preceding claims, characterized in that: the lower end face of the permanent magnet panel using permanent magnets 3 layer vacuum filter plate, filter cloth dust multilayer, each layer permanent magnets arranged filter plate has apertures, holes board layers sequentially shifted, said permanent magnet in the inner panel is also equipped with a multi-layer fabric dust filter.

Source: <https://patents.google.com/patent/CN204395257U/en?q=CN204395257>

The technology presented is a utility model, protecting the worker from heat and particles in the air. As shown in Figure 8, the helmet and mask has a ventilation system (1) attached to an upper jacket (10), with exhaust pipe (11), external housing with LED lamp (3), fan (9), switch (2) mounted on the fan, a small control panel (6) with magnet system, fan and permanent connection board for dust removal (8), visor (4), mouth guard (5), neck protection (7) and a system for opening the mouth guard (8).

With regards to operation, as the worker breathes in, the air passes through a disposable filter system, the LED lamp turns on and the fan initializes a suction system controlled by the electronic panel. Alternatively, when the worker breathes out, the suction system eliminates hot air from the exhaust pipe, thus preventing overheating.

Figure 8 – Sketch of the selected helmet and mask patent.

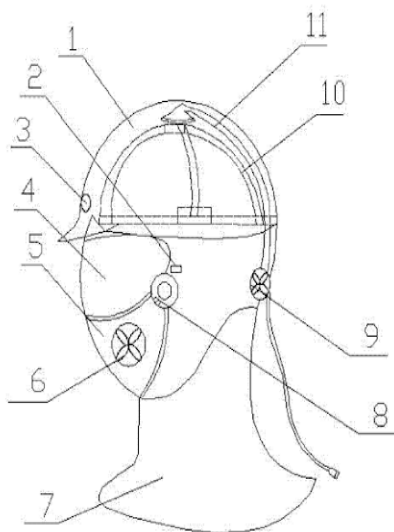


图 1

Source: https://worldwide.espacenet.com/publicationDetails/originalDocument?CC=CN&NR=204395257U&KC=U&FT=D&ND=3&date=20150617&DB=&locale=en_EP.

The characteristics make the equipment efficient and effective at protecting the worker stand out. According to the inventors themselves, the described utility model is quite simple, economical and environmentally safe. It can be cleaned after each use, and has a long life. The proposed exhaust system keeps the internal temperature constant so as to avoid overheating of the head. Furthermore, metallic particles in the inspired air are immediately extracted by the magnetic system coupled to the apparatus, preventing entry into the respiratory system.

Pneumoconioses are a significant cause of death or disability in many Brazilian workers, especially those exposed to chemical products in the form of aerodispersoids (i.e. metallic fumes, dust and silica). Thus, eliminating or even minimizing this exposure will increase the safety of the workers, which is a constant concern of safety and occupational health professionals (DIAS *et al.*, 2009). The best option, of course, would be to execute a collective protection project directed at the source generating the pollutant. However, when this is not possible, the provision of PPE to the worker is adopted, and includes the use of respirators with chemical filters or disposable masks.

It was determined that the selected patent could be replicated in Brazil, especially due to the manufacturing process, which was quite simple in terms of engineering and had relatively low costs. Production costs (approximate values) include: 1 - shell of the helmet and the mask (injectable plastic): R\$50.00; 2 - internal suspension (crown): R\$30.00; 3 - blowing mechanism (fan and hose): R\$150.00; 4 - acrylic visor: R\$100.00; 5 - other minor components: R\$120.00. Thus, the cost to manufacture this helmet is approximately R\$450.00. It should be pointed out that no values for plastic injection machines and/or equipment for component manufacturing were computed, since this process cannot be accurately estimated.

Interestingly, the cost of treating only one patient with pneumoconiosis is about R\$450.00/month, a value only considering medical consultation with a specialist (pulmonologist), and not including radiographic examinations, physiotherapy and corticoid treatment (anti-inflammatory drugs), or the cost of one helmet. It should be noted that the treatment can last from 6 months (simpler cases) to 2 years, generating costs that can reach close to R\$10,000.00 per patient. This is further exacerbated when accounting for expenses related to loss of work,

government expenditures with social security benefits, and the socioeconomic disruption for the life of the patient and their families.

6 FINAL CONSIDERATIONS, LIMITATIONS AND PROPOSALS FOR FUTURE RESEARCH

In Brazil, accidents and occupational diseases are rampant, and can force workers to be removed from their jobs. The present study identified a free-use patent that could be reproduced in Brazil, and, more specifically, a patent that could reduce the inhalation of particles in the air, thereby reducing the risk of developing pneumoconiosis.

In order to answer the proposed research questions proposed, we used the *Patent2net* software to extract, organize and present information related to patents deposited in the *Espacenet* database, on occupational safety and diseases.

From the case study described here, a patent for a helmet and anti-particle mask were identified. It was verified that, in view of the need to stimulate innovation-oriented research, especially with increased investments (not always available to private companies), and with the stimulus to the research by means of the granting of fomentation of the public organs, in times of a claudicating economy, *Patent2net* proved to be an effective tool in the provision of inventions that are free for reproduction in Brazil, and which could be used to protect the worker against pneumoconioses, providing transparency to the information in the patent registers, which until then were only available in a static .pdf format, deposited in the deep web. Despite the fact that only one patent base was found, *Espacenet* contains more than 100 million documents. In summary, we were able to take advantage of the inventions not protected in Brazil. The identified helmet and mask could reduce occupational accidents, especially with regards to pneumoconiosis.

The next steps will involve building the first prototype, which could be included in epidemiological trials evaluating the potential effectiveness of the helmet against the inhalation of foreign substances. *Patent2net* is capable of not only searching for technological solutions related to public health, but could also be employed to search for patents related to any topic of interest.

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|--|------------|------------|------------|------------|
| 1. Definition of research problem | √ | √ | √ | √ |
| 2. Development of hypotheses or research questions (empirical studies) | √ | √ | √ | √ |
| 3. Development of theoretical propositions (theoretical work) | √ | √ | √ | √ |
| 4. Theoretical foundation / Literature review | √ | √ | √ | √ |
| 5. Definition of methodological procedures | √ | √ | √ | √ |
| 6. Data collection | √ | | | |
| 7. Statistical analysis | √ | √ | √ | √ |
| 8. Analysis and interpretation of data | √ | √ | √ | √ |
| 9. Critical revision of the manuscript | | √ | √ | √ |
| 10. Manuscript writing | √ | √ | | |
| 11. Other (please specify) | | | | |