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RESEARCH ARTICLE

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TECHNOLOGICAL PROSPECTION OF SEWAGE TREATMENT DEVICE DIRECTED TO SINGLE-FAMILY USE

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ABSTRACT

The sewage collection and treatment system are one of the biggest problems of contemporary civilization, likewise, Brazil has a deficit in the proportion of production/collection and treatment, moreover, this senile contributes to the pollution of the environment and the proliferation of diseases, since waste is released in nature in the streets and river beds in regions where there is no sewage network. Based on this problem, this work aims to prospectively survey patents related to devices that present sewage treatment technology. For this purpose, the European Patent Office (ESPACENET) database was used. The prospecting was based on keywords and international classification of patents and resulted in 10796 records, of which 75% refer to IPC C02F9, which encompasses technologies covering the multi-stage treatment of water, waste water or sewage.

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INTRODUCTION

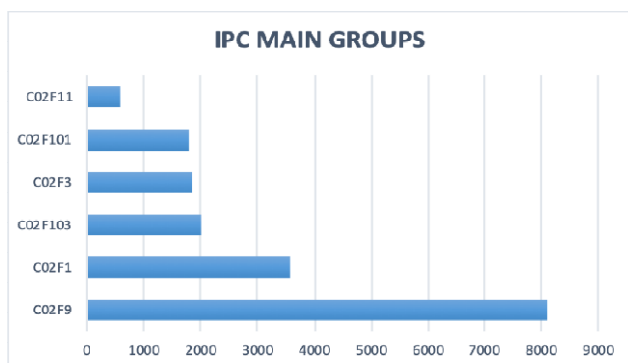
The United Nations (UN) in 2010 recognized basic sanitation as an essential human right and, paramount to the quality of natural resources, especially water resources. This recognition was instituted by virtue of the social mobilizations that took place all over the planet in favor of this purpose. This legitimization symbolizes the first political step towards the universalization of basic sanitation services (LOFRANO, 2010). In Brazil, this right is enshrined in the Federal Constitution of 1988, within the chapter of Social Security, which deals with health in its numerous facets. This being a duty of the State to guarantee society the rights described therein (ALCHIO, 2007). Since the constituent, the State has been trying to meet this right through public, social and economic policies aimed at implementing efficient sewage collection and treatment systems (Saúde e Sociedade, May 2020). As a result of these investments, it is expected that in addition to quality of life, it will also have an impact on the reduction of communicable diseases from this unhealthy environment, and last but not least, it is expected that the actions of improvements of these systems will be implemented in equal ways for the population. Public health aims to prevent diseases, prolong life and promote preventive actions through the organized efforts of society. The link between health and basic sanitation is noticeable, since discarded waste in nature can form a stronghold of proliferation of contagious diseases, as they are released into the environment

without the removal of microorganisms harmful to human health. With this perception, it is clear that an efficient system of basic sanitation contributes significantly to the rise of a quality public health, which consists of a complete state of physical, mental and social well-being (Saúde e Sociedade, May 2020). Inappropriate management of solid waste is closely linked to the incidence of different types of diseases such as dengue, cholera, diarrhea and helminthes, which are called Diseases Related to Inadequate Environmental Sanitation (DRSAI). In addition to contributing to the proliferation of these diseases, sewage discarded in nature in large numbers pollutes rivers, degrades the soil and contributes to climate change, since both soil and rivers can filter waste in a certain proportion, and that, once exceeded, cause pollution, to the detriment of this, decontamination becomes important before disposal, because it helps the environment to filter the water and return it to us drinking. (Health in Debate, January 2020). Currently, Brazil has been facing prominent challenges regarding basic sanitation. Numerous factors help to prevent the solution of this problem, such as the territorial extension of the country, the reliefs present in some regions, the geography of some cities, the lack of investments, among other aggravating factors. According to data from the National Sanitation Information System (SNIS), in 2017, 83.5% of the Brazilian population had access to the treated water supply network, 46.0% were served by sewage collection and treatment and 98.8% enjoyed regular collection of municipal solid waste. Although these figures represent an advance over previous years, there are still more than 30 million Brazilians who do not have a quality water supply and more

than 100 million discard fresh sewage in the environment (Saúde em Debate, January 2020). In 2018, the SNIS pointed to the northern region as the last place in the sanitation ranking, because only 10.5% of the populations were served with sewage treatment network, 57.1% had a drinking water network and 83.6% were regularly served with solid waste collection. Among the capitals of the northern region, Porto Velho, capital of the state of Rondônia, was in the final position, at the time the city collected and treated 3.39% of the sewage and reached 33.5% of the population with drinking water (Instituto Trata Brasil, 2018). As a counterpoint to this conjuncture, there are many residential and commercial units that perform sewage treatment in a decentralized way, this process is usually carried out through a Sewage Treatment Plant – ETE (MASSOUD, 2009). However, the installation and maintenance of an ETE requires considerable investment, making it unattractive to users, an alternative would be the development of affordable devices to enable the individual treatment of their effluents (Built Environment, May 2020). In view of the importance of basic sanitation to promote a quality public health and, considering the current Brazilian conjuncture regarding the collection and treatment of sewage, especially in the urban area, the need for public investments systematized in this sector and the conduct of research to develop solutions pertinent to the problem is latent. In view of the foregoing, the present work aims to collect patents related to residential sewage treatment devices, without the need to connect to a public collection network. It aims to map the current technological panorama of inventions registered in patent banks and provide a north to the progress and development of new patents in this area of studies.

METHODOLOGY

The prospective survey of this research was carried out through the patent search tool of the Platform of the European Patent Office - ESPACENET, which contains patent publications from more than 90 countries. This choice was due to the scope of the platform, was because it is constantly updated, allows free access, provides selection mechanisms and data refinements and because it is easy to access and handle. In addition to this survey, a bibliographic search was carried out in the Prospecting Notebook, focusing on published articles addressing the theme of basic sanitation and sewage treatment, however, the results achieved did not present relevant information for the research proposed here, this fact, points to the existence of a gap in research in this area. In the research of published patents, advanced search resources were applied in order to find the key words in the titles and/or abstracts of the prospected material, thus the following terms were applied: sewage, effluent, waste water, domestic sewage and domestic effluent. For grouping of the terms, the quotation marks and the Boolean connectors "OR" and "AND" were used with the purpose of identifying the patents of greatest relevance for this prospecting. The first step in the systematization of the obtained results was organized. The patent survey on the theme Basic Sanitation, using the above-mentioned keywords resulted in 1,004,672 patents. A posteriori, an advanced research was carried out applying the International Patent Classification (IPC) code with the purpose of refining the result for the purpose of prospecting. Graph 1 shows the relevant classifications for the search performed.



Graph 1. Main International Patent Classification (IPC) codes verified

As can be seen in the graph, the C02F group was the most recurrent result, for this reason, it used the three codes that appeared most frequently (C02F9, C02F1 and C02F103) for better design of prospecting. With this debugging, the research generated 10,796 results, these were manually included in the Excel spreadsheet, for later construction of the graphs and quantitative demonstration of the technological scenario and development of the prospected technology.

RESULTS AND DISCUSSION

The theme of basic sanitation has become increasingly relevant over the last few years, mainly to the detriment of the increase in the world population and consequent advance of the urban environment. This scenery has attracted the attention of the rulers and the scientific community, which has sought to implement public policies and developed technological research to mitigate the environmental impact resulting from this expansion. Among the numerous problems, the collection and treatment of residential sewage has been constantly debated. Because of the tons of waste that are released in nature into the environment have caused polluting and proliferation of contagious diseases. In view of this, this work presents the result of prospecting targeted technologies to solve the problem of sewage collection and treatment of single-family homes without the need to connect to the public sewage network. The first result evaluated was referring to the countries where technology has been attracting the greatest interest. Graph 2 shows the numbers of patent publications by countries for those with significant results. It can be observed that the countries of the Asian continent have the ones with the highest number of technology registrations that encompasses a system or device of domestic sewage treatment, totaling 11797 deposits.

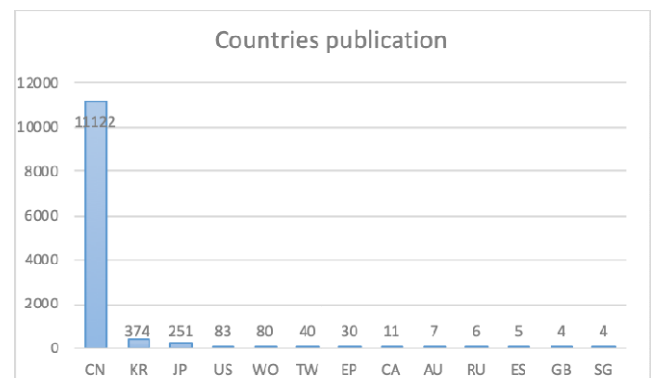
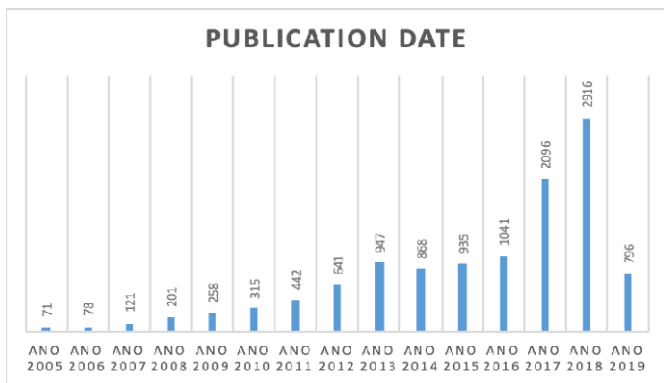


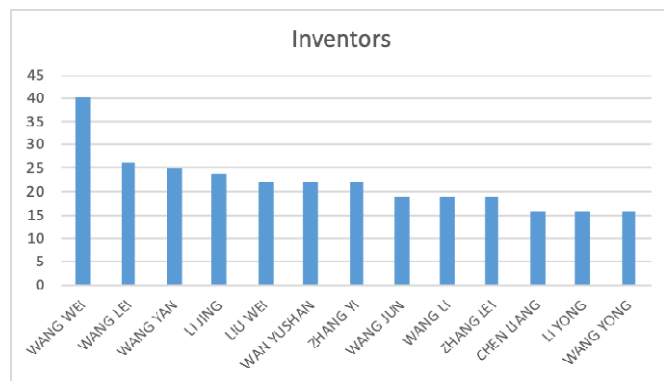
Figure 2. Number of publications by country

China is the country with the highest number of publications with 11,122, South Korea with 374, followed by Japan with 251. This scenario presents a huge disparity between the first place and the others, with a difference ten times greater than the others. Regarding the year of publication of the patents analyzed, a survey was made taking into account the annual number of publications. In Graph 3, it is plausible to identify that the patent publication of this theme began significantly in 2005. From this point on, there is an expressive growth over the subsequent years. It is worth noting that the first patent of this technological niche was registered in 1986 in Great Bethany.

In this analysis of the annual evolution of patent deposits, it is feasible that in 2018 the technology reached its apex in number of records, totaling 2916 applications. Showing the global commitment to seek solutions to the problem of sanitation. Graph 4 features the names of the greatest inventors of domestic sewage treatment systems technology, ordered at the following scale: Wang Wei with 40 deposits, followed by Wang Lei with 26 deposits and in third place Wang Yan with 25 deposits. The first three places were occupied by Chinese, a fact that shows that China is the country that invests the most in this technology.



Graph 3. Annual evolution of patent publications on the proposed theme



Graph 4. Main inventors of this technology

Another important result obtained was the registration of the main applicants for domestic sewage technology. For, it is well known that to be born a patent does necessary an inventor, who develops a new product or process or proposes an improvement to a one existing. However, this technology may be registered by an applicant, who may be an authorized natural or legal person for this purpose, which is called the applicant, and Graph 5 presents the analysis of this search.

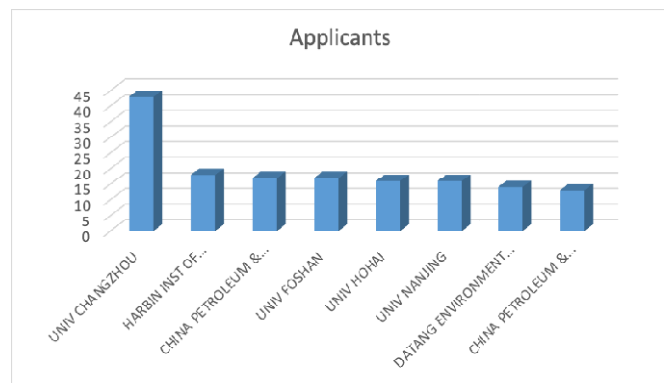


Figure 5. Main patent applicants

In this sense, the largest applicants for domestic sewage treatment system technology are: Changzhou University with 43 applications, Harbin Institute of Technology with 18 applications and China Petroleum & Chemical with 17 applications. This classification visibly points out that the Chinese academy emerges once again as the main developer of technologies in this area. Taking into account the scenario of inventor countries, China with 407 records once again stands out, followed by South Korea with 329 and Japan with 169. Confirming the trend of the previous charts, graph 6 shows that the technology is widely researched and disseminated in these three countries mentioned.

CONCLUSION

Basic sanitation is one of the basic rights of the human being and thermometer to measure the socioeconomic development of a nation. The first aspect guarantees people a free and quality public service, while the second is the showcase that demonstrates how a country is developed and invested in technologies to solve this benefit to the citizen, added to this, an adequate collection of these wastes prevents the contamination and proliferation of numerous diseases linked to lack of basic sanitation. Due to the relevance of the theme, this article presented a prospection on the technologies developed with the purpose of offering technological solutions to solve the problem of sewage treatment produced by a single-family residence that does not have a public network for the collection and management of solid and liquid waste. Globally, this research identified 13,528 patents in the line of technologies aimed at sewage collection and treatment, of which the C02F group stands out, which relates the technologies directed to the production of devices and systems capable of offering solutions to the problem of disposal collection. Despite finding a significant number of patents already published on the subject, the reality of most cities around the planet and especially in Brazil is still alarming and chaotic with regard to the collection and treatment of sewage. Regarding prospected technology, it was observed that China is ahead of other countries in several issues, such as a greater number of inventions and publications, as well as having the inventor with more patent registration. Far from this imposing result, Brazil presents irrelevant numbers, despite having a huge deficit in the supply of this service to the population and needing to invest in technology in this area. Although it is a relatively new technology, which presents records from 2005, the problem analyzed, is present everywhere on the globe where cities and villages are located and, one of the possibilities that can contribute to alleviate this problem, especially in isolated places and difficult to access, is the decentralized treatment for domestic sewage. And in this way cooperate for the maintenance and preservation of the environment.

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