**INFORMATION ON PATENTS IN THE AREA OF INDUSTRIAL RESIDUES RECOVERY: THE CASE OF SLUDGE FROM DOMESTIC WASTEWATER TREATMENT**

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**1. INTRODUCTION**

A technological innovation is defined by the introduction on the market of a product or production process technologically new or substantially improved (PESQUISA DE INOVAÇÃO TECNOLÓGICA - PINTEC, 2005). According Tidd, Bessant and Pavitt (2008), the process of innovation is the key to company business, associated with the renovation and development of business, renewing what the company offers and how it creates and delivers that offer. Innovation, therefore, is an essential activity linked to survival and growth.

To meet the dimensions of sustainability innovations should generate positive economic, social and environmental results, at the same time. It is important to point out the difficulty of concealing these interests without losing competitiveness, considering the uncertainties that innovations bring, essentially when very radical or with a high degree of novelty.

Barbieri, *et al.,* (2010) defines sustainable innovation as the introduction (production, assimilation or exploitation) of products, production processes, or business or management methods that are new or significantly improved for the organization in question, bringing economic, social and environmental benefits, when compared with the relevant alternatives, not just reducing negative impacts, but advancing in net benefits.

To ensure the appropriation of the results obtained from the process of technological innovation of enterprises that have invested in Research and Development, the society grants, through the patent, to these organizations a temporary legal protection method. The patent allows the exploitation of its innovation in return for detailed information about substantial part of technical content contained in that matter protected by law. (GARNICA and TORKOMIAN, 2009).

The patent data can show changes in the structure and development of creative activities of a country, in industry, technologies and in enterprises. Patents can also indicate dependency changes of certain technologies, in addition to its dissemination and scientific penetration, technical and, ultimately, market (ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, 2002).

Puhlmann and Moreira (2004) say that patents can be used as a source of information for a variety of purposes, among which stand out: (a) identification of technological alternatives; (b) identification of technological developments already made; (c) evaluation of future markets, since the patenting usually precede the placing on the market in a few years; (d) evaluation of emerging technologies, in order to characterize the trends of technological development in a particular area of knowledge; (e) evaluation of the activities of Research and Development and the detection of strategic changes of institutions and companies.

According to Barbieri, *et al.,* (2010) the process of knowledge production and its implementation on the part of the organization constitutes the central theme of the literature on the management of technological innovation. However, there are few works dealing with the marketing of such knowledges, subject related to the process of technology transfer between different organizations. There are few studies on patenting and licensing of technologies produced under the administrative optics in the available literature.

As an example of sustainable innovation we can quote the reuse of sludge coming from domestic wastewater treatment (sewage sludge) in the production of new materials. The disposal of sewage sludge is a common problem in many communities in Brazil. The main polluting agents of water resources in urban areas are the sewers, which often are released directly in bodies of water. The lack of adequate sanitation conditions can contribute to the proliferation of many infectious and parasitic diseases, as well as the degradation of water bodies (COSTA and COSTA, 2011).

The final proper disposal of this waste is a difficult step in the operating process of a sewage treatment station (ETE), because your planning has been overlooked and presents a cost that can reach 60% of the operating budget of a treatment system. Waste management can mean a market with good potential prospects in the areas of design, planning and management of services, equipment and supplies (ANDREOLI and PEGORINI, 1998; MIKI, ANDRIGUETI and ALEM SOBRINHO, 2001).

The choice of alternatives for final disposal of sludge is the consequence of the local situation of technology and available resources. Between these alternatives are incineration, use in agriculture, landfill disposal and use as an alternative raw material to industries (PESQUISA NACIONAL DE SANEAMENTO BÁSICO, 2010).

The use of sewage sludge as raw material in the ceramic industry is a practice that has been adopted in several countries (Germany, Spain, Japan and others) and presents a number of advantages over other types of use, because the operations inherent to the ceramic industry (ovens operating at high temperatures) make that health risks are reduced to the maximum (ARAÚJO, LEITE, *et al*., 2008).

Within this context, this paper aims to make a survey of the technologies used for the recycling of sewage sludge in ceramic products by means of information available in international databases of patent.

**2. METHODOLOGY**

Information on the patent applications and results are available in the various databases of competent government agencies, especially the National Institute of Industrial Property (INPI), the European Patent Office (EPO) and the World Intellectual Property Organization (WIPO).

For this study we conducted a survey in the literature of the area on the layout alternatives and recycling wastewater treatment sludge. Following were consulted the information available at the World Intellectual Property Organization (WIPO), specifically the tool Patent Scope: (http://patentscope.wipo.int/search/en/search.jsf). It was used as key words to search the terms "Sewage Sludge", "Sludge and Ceramic", "Process", among others.

From the information obtained it was conducted a survey related to the following parameters:

a) Countries with more patent applications related to the area in question;

b) Prevailing technologies on sewage sludge recycling.

**3. RESULTS AND DISCUSSION**

Table 1 presents the main alternative from disposal and recycling of sewage sludge found in the literature.

Table 1 - Main disposition alternatives and recycling of sewage sludge.

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| --- | --- |
| **Disposition Alternatives** | **Theoretical Reference** |
| Landfill | * (Santos, 2003); * (Andreoli, Sperling, & Fernandes, 2001); * (ZAHA & DUMITRESCU, 2008). |
| Incineration | * (Santos, 2003); * (Andreoli, Sperling, & Fernandes, 2001); * (ZAHA & DUMITRESCU, 2008). |
| Superficial Ground dDsposal (Landfarming) | * (Santos, 2003); * (Andreoli, Sperling, & Fernandes, 2001); * (ZAHA & DUMITRESCU, 2008). |
| Recovery of Degraded Areas | * (Santos, 2003); * (Andreoli, Sperling, & Fernandes, 2001); * (ZAHA & DUMITRESCU, 2008). |
| Agricultural Recycling | * (Santos, 2003); * (Andreoli, Sperling, & Fernandes, 2001) * (Costa & Costa, 2011); * (Cukjati, Zupancic, ROS, & Grilc, 2012); * (Tsutiya, et al., 2001); * (ZAHA & DUMITRESCU, 2008). |
| Industrial Recycling | * (Araújo, Leite, Araújo, & Ingunza, 2008) * (ZAHA & DUMITRESCU, 2008); * (Barcellos, Gonçalves, Tessaro, & Bergmann, 2012); * (Casagrande, Sartor, Gomes, Della, Hotza, & Oliveira, 2008); * (Garcia, Aly, Fadaly, Hafez, Nogués, & Martinez, 2011); * (Cusidó & Cremades, 2012); * (Liew, Idris, Samad, Wong, Jaafar, & Baki, 2004); * (Lopes, Messias, Santos, Lima, & Menezes, 2009); * (Tiana, Zuo, & Chena, 2011); * (García, Quesada, Villarejo, Godino, & Iglesias, 2012). |

Through the use of the Patent Scope tool available on the site of the World Intellectual Property Organization (WIPO) was possible to perform the research that focused on get technological information on three main points: a) the sewage treatment process); b) reuse (recycling) of waste in ceramic materials; and (c) reuse (recycling) of sewage sludge. Here are the results obtained in each one of the points:

1) Sewage treatment Process: 856 patent applications were found containing the words "Process", "Treatment" and "Sewage Sludge". The countries with the largest number of patent applications related to the result of the survey were Japan (260), Republic of Korea (194) and United States (169). The main patent classification (IPC-International Patent Classification) find from the research was the CF02 (treatment of water, waste water, sewage, or sludge). Most of the publications date of 2005 (62). In the year 2013 has so far 05 publications. The patent applications deal mostly with technologies for sewage sludge treatment with the use of biotechnology.

2) Reuse (recycling) of waste in ceramic materials: 7 patent applications were found containing the words "Residues" and "Ceramic Materials". The country with the largest number of patent applications related to the result of the research conducted was The United States (05). The main patent classification obtained from the research was the C04B (lime; magnesia; slag; cements; compositions thereof, e.g. mortars, concrete or like building materials; artificial stone; ceramics; refractory; treatment of natural stone) e B01D (separation). Most of the publications date from 2005 (02). In the year 2013 has no date records. The patent applications deal mostly with technologies for the ceramic processing steps such as: drying, grinding and sintering.

3) Reuse (recycling) of sewage sludge: 122 patent applications were found containing the words "Recycle" and "Sewage Sludge". The countries with the largest number of patent applications related to search result were the Republic of Korea (68), Japan (28) and The United States (18). The main patent classification obtained from the research was the CF02 (treatment of water, waste water, sewage, or sludge). Most of publications date from 2007 (10). In the year of 2013 has no date records. The patent applications deal mostly with technologies for recycling alternatives of sewage of treatment sludge in new materials, as for example, in the construction sector.

According to the results obtained, one can see that there is a concentration of patent applications in the United States, the Republic of Korea and Japan, in relation to sewage sludge recycling in ceramic materials.

**4. CONCLUSIONS**

Technological innovation is an important condition for the success of the process related to the productive systems. In the case of sustainable innovation, this should suit the dimensions of sustainability and thus generate economic, social and environmental results. To guide the research and development activities in the creation of new technologies focused on innovation, the pursuit of information in patent documents is essential. Studies show that 70% of the technological information contained in these documents are not available in any other type of information source (INPI, 2013). It was observed that in the case of recovery of wastewater treatment sludge in production of new materials, the use of the information contained in the patent database is configured as a competitive instrument and as a strategic variable presented in the plans of the companies concerned.

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