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A bibliometric analysis of possible alternatives to achieve the replacement of cellulose acetate in cigarette filters from agricultural residues

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Abstract. Polymers have become one of the most recognized materials in the industry, due to their good physical properties and the efficiency of their production process, in addition to the versatility and breadth of their fields of application in the aerospace, automotive, construction, textile and adhesive industries. In the case of cellulose acetate, it is used in a wide variety of everyday products such as photographic films, varnishes and cigarette filters, which makes it a factor that negatively affects the environment, since this material takes a long time to decompose and in the process contaminates the place where it is located with particles, on the other side are the agricultural residues that are manipulated in an inappropriate way, generating contamination in landfills and water sources, the following bibliometric analysis was carried out in order to provide a solution to the worrisome situation of this polymer contamination and the agricultural residues contamination , in order to encourage the development of studies focused on producing degradable materials. Therefore, this article presents a bibliometric analysis on the various alternatives to replace cellulose acetate, focusing on the collection methodology and comparison of studies with a tool known as HitsCite. The articles have been investigated by bibliometric, trend and cluster analysis in a sample of 361 articles. The research has been carried out in one of the most recognized databases such as web of science and has allowed to identify the main trends and dynamics of the scientific literature. This in order to mitigate the environmental problems that are present in our environment and being a starting point to support monetary studies that implement environmentally friendly materials, being a topic that can create a positive and innovating impact in the industries commercial sectors.

1. Introduction

Since 1950, petroleum-based polymeric products are substances composed of long chain macromolecules made up of many repeated subunits, in other words, molecules formed by a large number of small molecules linked together by covalent bonds, have been implemented in a wide range of everyday applications, ranging from electronics to water supply pipelines. It is estimated that 150 million tons of plastics have been accumulated in the world's oceans and the problem has been aggravated by the overloading of waste management and recycling systems, which cannot cope with the increased production of plastics. Polymers are extremely versatile ingredients in semi-solid formulations, which are used to create a range of different effects, from thickening to conservation and conditioning [1-5], however in recent decades, growing environmental awareness has stimulated the development of biodegradable materials from renewable resources as a substitute for conventional non-biodegradable materials in many applications. Polysaccharides are polymers of hexose or pentose sugar residues, joined together they constitute the most abundant and important group of compounds in the biosphere, such as cellulose and starch in plants and glycogen in animals are a very important class of biological polymers in living organisms, which function as a structural component such as cellulose and chitin in plant cell walls, are attracting much attention due to their potential for applications as new functional materials in many fields of research such as pharmaceuticals, food, drugs, tissue engineering and cosmetics offer several advantages for the substitution of synthetic polymers in the plastics industries due to their low cost, non-toxicity, biodegradability and availability [6-10]. Biodegradable polymers offer a possible solution to the waste disposal problems associated with traditional petroleum-derived plastics and have a great advantage over non-biodegradable polymers in terms of degradation. This is because biodegradable polymers can be returned to the soil and enriched through microorganism composting allows for a wider range of waste treatment possibilities compared to traditional plastics, and this is supported by life cycle analysis in this way, biodegradable polymers are able to contribute significantly to the recovery of materials, the reduction of landfills and the use of renewable resources, and their degradation of the polymer results in the formation of natural by-products such as oxygen, nitrogen, carbon dioxide, water, biomass and inorganic salts [11-14]. Cellulose is one of the most abundant polymers on earth, with plants producing about 180 tons per year worldwide and is a renewable biopolymer resource, widely available in various forms of biomass, such as trees, tunicates and bacteria. They are solid, non-toxic homobiopolymers, extremely abundant, easily renewable and biodegradable, pure white in color, a natural linear polymer of anhydroglucose units united in one and four carbon atoms by b-glycosidic bonds [15-18]. On the other hand, cellulose acetate (CA) are important esters of insoluble cellulose considered as a non-toxic, non-initiating and biodegradable material It is heat resistant and less hygroscopic, which are produced by the reaction of cellulose with acetic anhydride and acetic acid in the presence of sulfuric acid, contains a controlled percentage of acetyl content often used together with other pH-dependent or independent polymers to form variable water flow and permeability films [19-21]. CA, unanimously considered to be one of the most important with its vast industrial applications, is produced in large quantities all over the world: textile products CA has been used in textile manufacturing due to its low cost, folding quality, softness, comfort and natural feel, film bases in photography cigarette filters and plastic packaging films, protective film polarizer in crystalline screens, air filter and noise, It is also used in different applications such as surface coatings, controlled release of active substances, compounds, tests, membranes for separation processes and optical films [22-24]. There are 5.6 billion cigarette filters that have been produced by the tobacco industries around the world, and now it is the biggest problem for the protection of the global environment each year, cigarettes and other materials related to smoking (filters and plastics) are the most common garbage items found in beach cleanups [25]. The cigarette butts of cigarette filters are composed of almost 95% synthetic CA which resembles cotton [26]. Cigarette smoking, in addition to being an environmental problem, leads to deterioration in health because cigarettes increase the risk of duodenal and gastric ulcers, delay the rate of ulcer healing, and increase the risk of relapse after ulcer treatment [27]. Cigarette filters are one of the most common types of waste worldwide. Euromonitor international estimates that, by 2013 approximately 5.7 billion cigarettes were produced worldwide. This represents an increase of 1.2 million tons of cigarette waste per year. These amounts are projected to increase to more than 50% by 2025, mainly due to an increase in world demand and population [28]. The study of these problems has led the general population, governments and the scientific community to look for options that reduce in a low proportion the difficulties that this represents for ecosystems and at the same time, maintain a high level of quality of life. The important measures to achieve this objective are numerous, but above all the emergence of green chemistry and the exploration of new and innovative energy sources [29]. The traditional polymer industry has grown steadily since 1950, with the development of petrochemistry. In 2014, world production of conventional polymers was 300 million tons. The extent of polymer activity has generated a number of pollutants on land and sea surfaces, which is attributed to growing concern in the world of science and industry. For this reason, the development of biodegradable polymers is one of the appropriate alternatives [30], as are natural sources of CA such as agricultural residues from corn husks [31]. sugar cane [32,33], rice straw id green landscaping [34] In the last century, the phenomenon of global climate change has alerted the scientific community to the increase in atmospheric agglutination. Several groups of researchers have succeeded in anything at the result that the concentration of CO_2 in the environment must be reduced from 385 ppm to 350 ppm to preserve the planet [35].

Several studies have been carried out to find an alternative to CA. One of them demonstrated the feasibility of producing CA from the chemical recycling of the newspaper. When acetylation is performed with the material received the reaction time was 48 hours and the material produced was a cellulose diacetate. For the lignified newspaper, the reaction time was 24 hours, Resulting in cellulose triacetate [36]. The results showed that, with the compositions used CA dichloromethane water and CA dichloromethane / water magnesium perchlorate, it was possible to produce asymmetric membranes from CA produced from mango seeds and newspapers [37]. On the other hand, it was found that it is possible to synthesize CA from agricultural residues such as sugarcane under various circumstances in estigated from the synthesis. Lignin and hemicellulose were not completely eliminated, but this did not negatively influence the properties of CA, which presented a percentage of acetyl groups of 43.50% and a degree of substitution of 2.52, resulting in the synthesis of cellulose triacetate [38]. Another project analyzed the synthesis and identification of cellulose nanofibers from banana husks und bracts to alter the nanocellulose fibers by acetylation and esterification, for the production of acetyl cellulose and nanocellulose, respectively [39]. Another resource containing cellulose is coffee and rice husks in the 34%-35% range, making them a good source of cellulosic material for different industrial [40].

The aim of this study is to present an overview of the research into alternatives for substituting CA from agricultural residues using bibliometric techniques The overview of the most influential and productive research will be presented based on the data collected from the web of Science (WoS). The data collected have been organized by research articles authors journals, institutions, countries and languages The data show that Wu 3 is the most influential author in the research.

2. Methodology

Data were analyzed between 2002 and 2018, web of science was extracted, where the filter by title was used for the CA substitution search keywords. The software used to process the archives was HistCite, which generates historical maps of bibliographic collections resulting from searches of subjects, authors, institutional journals or sources on the other hand also generates chronological historiographies that highlight the most cited works in the recovered collection other listings include classifications by authors, journals, institutions, countries, cited documents and keywords The analysis and classification of scientific results, subject categories, journals, authors, countries and institutes were elaborated manually and processed in Microsoft Excel 2017 and Tableau which is a tool that helps the researcher to visualize and understand data [41]. The current search contains research studies presented from 2002 to 2018. We specifically found 361 publications using the keywords selected in the web of science search tab.

3. Results

The articles published in the research on the substitution of CA during the years 2002 to 2018 were analyzed. The parameters analyzed included: type of document; language of publication, annual production publications by journals, publications by country and articles of greater impact and their most cited authors.

3.1. Types of documents and language.
A total of 361 documents were found. The type of document that stands out most is the research article (9335% of the 361 documents), followed by procedural documents (3.05%), procedural article (2.49%). editorial material (0.55%), summaries (0.28%) and book and chapter reviews (0.289%). Citation data were analyzed for different types of documents. A greater number of publications in a given type of document gives a greater probability of being cited. The texts were written in 6 different languages, of which English was predominant, with 96.40% of the total data, this fact is due to the fact that English is the language that is used internationally and that in some journals it is a requirement for researchers that the article be in that particular language.

3.2. Annual research production.
The first set of results refers to the historical series These analyses are useful for the description and representation of the main tendencies of literary productions. Figure 1 shows all the scientific data produced from 2003 to the end of 2018 The percentage growth rate is equal to 14.75 although it is clear that literature production increased markedly after 2012. This could be due to the exploration of new issues that help mitigate environmental pollution.

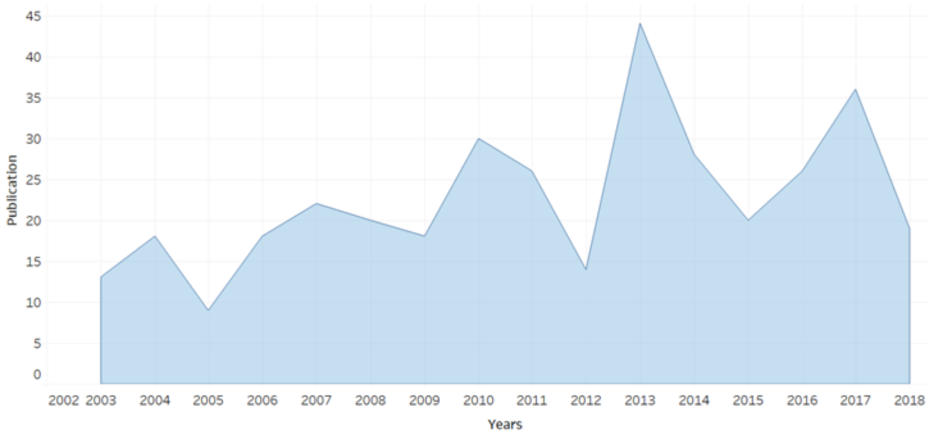

Figure 1. Annual production of CA replacement items from 2002 to 2018.

3.3. Distribution by country.
The Figure 2 shows that the largest literature production on cellulose substitution is scattered all over the world however the data from China are (more than 82 articles), contributing more than 18% to the total literature production in 16 years, after China, Germany, Japan and USA also show a literary production of more than 48 articles. In addition to this, Germany ranks first in total citations (1688), followed by China (1570) and Japan (1068). This trend is not confirmed if average article citations are taken into account, probably due to the fact that the strong literature production of most productive countries leads to fewer average article citations over the years.

3.4. Distribution of journals and research papers.
The Figure 3 reflects the top 5 journals with the largest number of publications related to the subject, it can be observed that the journal with an extensive development in this type of literature is carbohydrate polymers, with 13.3% of total publications, is a leading journal in the field of glycosocience, which follows the study and exploitation of polysaccharides that have a current applicability and great potential in areas such as bioenergy, bioplastics, bio-materials, however not having more copies published means

that it is the absolute generator of citations, given that biomacromolecular publishes fewer articles but have a greater impact on the global citation record (1097).

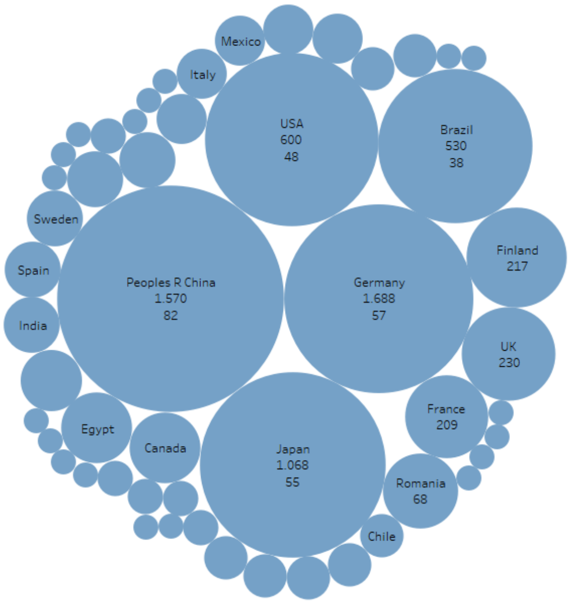

Figure 2. Countries with the largest number of publications.

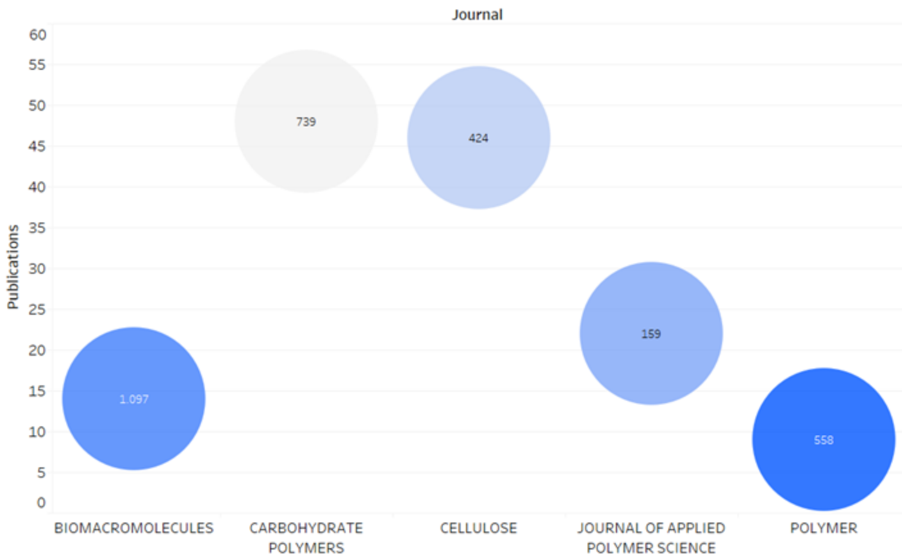

Figure 3. Top 5 of the journals with the largest amount of publication.

4. Conclusions

In general terms, the line of research on alternatives for the substitution of cellulose acetate has experienced a constant growth between 2007 and 2018, which has reflected a greater attention on the part of researchers on the subject during the period between 2012 and 2014. Thus, it is evident that it is necessary to identify solutions to the environmental problem caused by the use of cellulose acetate and residues from agricultural processes associated with pollution by toxic degradation that influences the environment, especially water sources.

It was pointed out that the typology of documents of greatest interest and impact for researchers are the research works that generated a figure of 361 documents and the researches on the use of agricultural residues. The analysis of the types of documents reveals that the nationality of the authors does not always have an impact on the language used in the writings because six of the languages used were found, but at a lower rate, nevertheless, English was a very important factor in the drafting of the different works and researches that were carried out. This is attributed to the fact that some research journals require the implementation of this language for the respective publication since being a universal and known language, the information can be offered even more to the public.

In view of the current high pollution rates and the commitments of the vast majority of countries to reduce the use of petroleum products such as plastics, it is expected that the use and search for new solutions to replace cellulose acetate will continue to increase Today, more than 50 countries contribute significantly to research into the substitution of cellulose acetate, focusing their production on China Germany, Japan and Brazil.

China is the leading country in research into the substitution of cellulose acetate, as it has the largest number of published articles (82) as well as being the second country with the largest number of citations generated (1570), which demonstrates the interest generated within the country for environmental protection.

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