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Waste Water Treatment: A Bibliometric Study of Scopus and Web of Science publications

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Waste Water Treatment: A Bibliometric Study of Scopus and Web of Science publications

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Abstract: A bibliographic study of the different publication trends in waste water treatment have been carried out from 2000-2019, and presented in the manuscript. The study revolves around publications considering waste water treatment of insecticide, pesticide, dyes, heavy metals, containing waste water. The growth of research in waste water treatment in the past decade, as evident from the publication databases, has led to the development of interest and curiosity in the growing area of water treatment. The reference points for the analysis in the present study have been Scopus and Web of Science databases, which have been considered and referred to as renowned sources in the research community. Several parameters such as year of publication, citations, country of publication, funding agencies, etc. have been discussed in detail. The manuscripts in the domain of waste water have shown a percentage distribution of 56.25 %, 39.58 % and 4.17 % for research articles, review papers and conference publications in Scopus database, whereas 73.53 %, 25.00 % and 1.47 %, in Web of Science database, in the period ranging from 2000 to 2019. India shows almost 35.29 % of these publications whereas China 22.06 %, out of all the publications in the mentioned period. The authors have analysed the publication pattern till date thereby determining the coverage and impact, highlighting the importance of the domain chosen.

Keywords: Wastewater treatment, dyes, heavy metals, insecticides, pesticides, bibliometric.

1. Introduction

There has been an increase in the number of textile industries in the past decade (India Brand Equity Foundation, 2020). These textile industries majorly use dyes as essential constituents for different processes. Dyes are very toxic in natures (Weisburger, 2002), which are let into the water bodies from the textile industries in the form of effluent. In addition to dyes, there has been a substantial increase in the use of insecticides and pesticides, which further are toxic to the aquatic fauna and flora, which, when pass into the water streams (Robinson et al., 2001 and Rafatullah et al., 2010). Owing to the toxicity of these substances, there have been researches carried out for the removal and treatment of these contaminants. Some bibliometric analyses studies have already been carried out in the field of wastewater treatment (Zheng et al., 2015, Jiang et al. 2018, Qi et al., 2019, Zhao, 2019 and Zyoud et al., 2016).

Predicting trends in wastewater treatment researches, depending upon the rapid rise in the usage of these chemicals (Mesnage & Antoniou, 2018, Mahmood et al., 2016 and Benbrook, 2012), was the primary motivation to write this research paper. The prime objective of the research was to analyze the trends in the study in the mentioned area, considering several parameters to establish possible patterns in a related study, leading to an estimation of the potential future directions.

2. Data source and methodology

The data was extracted using Scopus and Web of Science databases.

For peer-reviewed literature, Scopus is one of the largest databases consisting of 69 million records covering all the significant areas of science, in addition to other top-level fields of research, with almost 11,678 publishers, of which 34,346 are peer-reviewed journals (ELSEVIER Scopus, 2020). Web of Science, on the other hand, provides access to multiple databases of varied academic disciplines (Clarivate Analytics, Web of science, 2020). The

primary keyword for the search was “Wastewater treatment," and the secondary keywords were "Textile dye removal," "Heavy metal removal," and “Insecticide pesticide removal." The search with the primary keyword gave 19476 documents from the year 1959 to 2020 for Scopus and 19898 papers from the year 1980 to 2020 for Web of Science. For precision, secondary keywords are given fetched 48 documents from the year 2002 to 2019 for Scopus and 68 papers from the year 2000 to 2019 for Web of Science as on 19.11.19. An analysis of the data after the input of secondary keywords was carried out, which has been presented and discussed.

3. Results and discussions

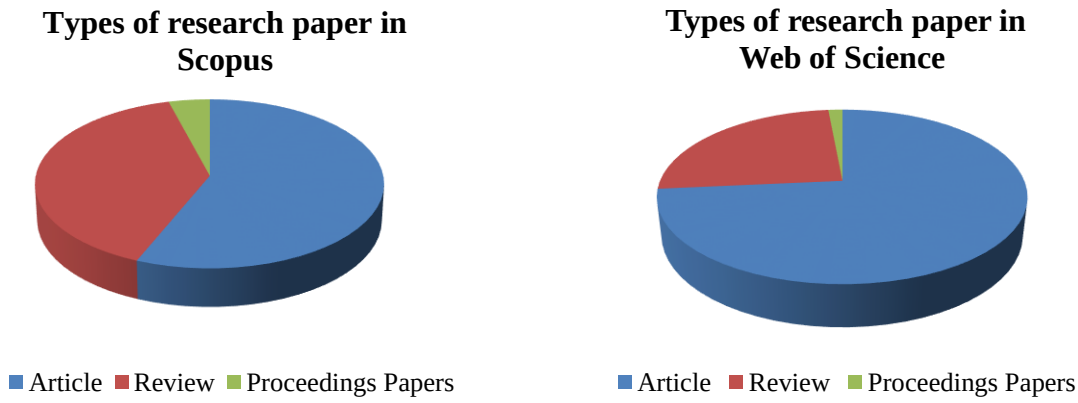
3.1 ***Papers year wise***

The data obtained after applying the primary and secondary keywords revealed that maximum work in the related area was done in 2019 and 2017. A study of the numbers portrays that there has been a significant leap in relevant researches after 2014 (Table 1).

Year	No. of Papers in Scopus	No. of Papers in Web of Science
2019	8	7
2018	5	6
2017	8	8
2016	4	5
2015	7	5
2014	2	7
2013	2	2
2012	5	3
2010	4	2
2009	1	7
2005	1	5
2002	1	3
2001	-	1
2000	-	1

Table 1: Year-wise data obtained for the number of research publications

The research papers published were a combination of research articles, review, and conference papers (Figure 1a and 1b), encompassing varied research areas in the field of wastewater treatment. A comprehensive list of the critical research domains in principle domain has been graphically shown in Figures 2a and 2b. Out of the total papers available from 2000 to 2019, almost 56.3% of documents were research articles, 39.6% were review papers, and 4.17% were conference publications in Scopus (Figure 1a). These were 73.9% research articles, 26.75 % review papers, and 1.44 % conference proceedings for Web of Science database (Figure 1b). The maximum number of publications, almost 16.6%, was in the year 2019 for Scopus and 10.3% in Web of science, clearly indicating that there has been a growing awareness and need for wastewater treatment and remediation, leading to an increase in research in this field.



(a) (b)

Figure 1: Types of research papers in the domain (a) Scopus (b) Web of Science

Almost 39.7% and 29.7% of documents were in the domain of environmental science, and indicative of this being a significant field addressed (Figure 2a). Web of science depicted a collection (Figure 2b) of some papers in the additional areas, important ones being the area of artificial intelligence in wastewater treatment, instrumentation, statistics, probability, nanoscience, and technology, etc.

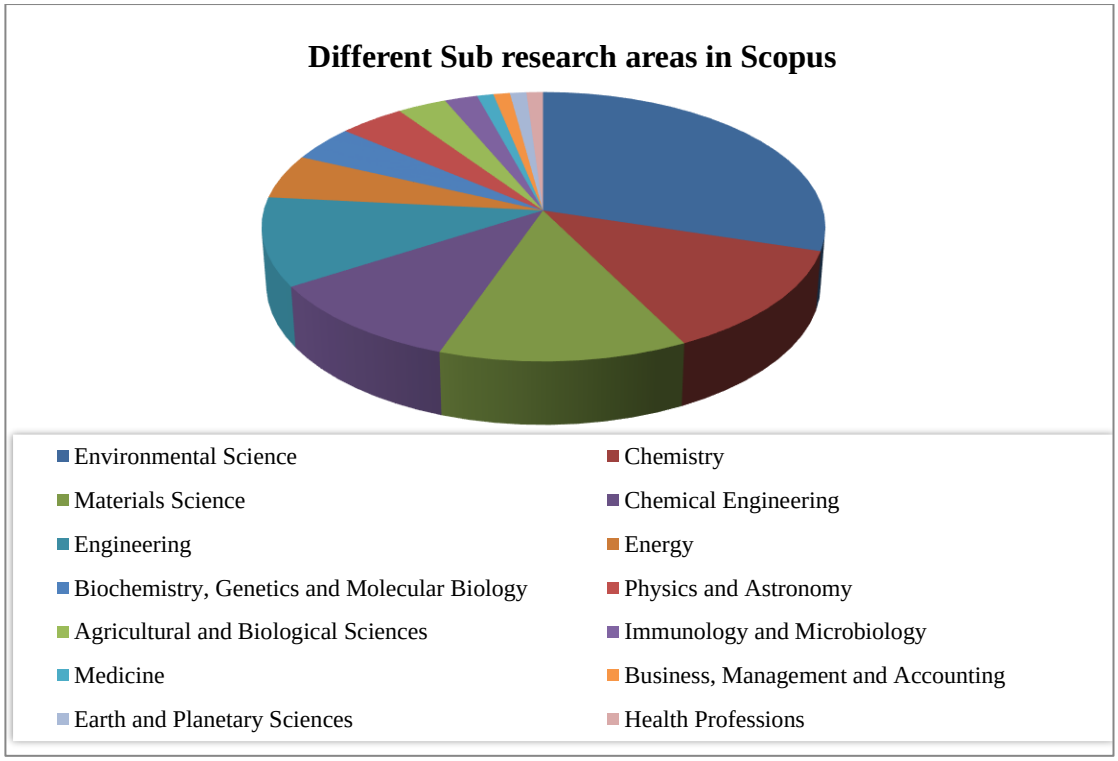


Figure 2(a): Diagrammatic representation of sub research areas Scopus

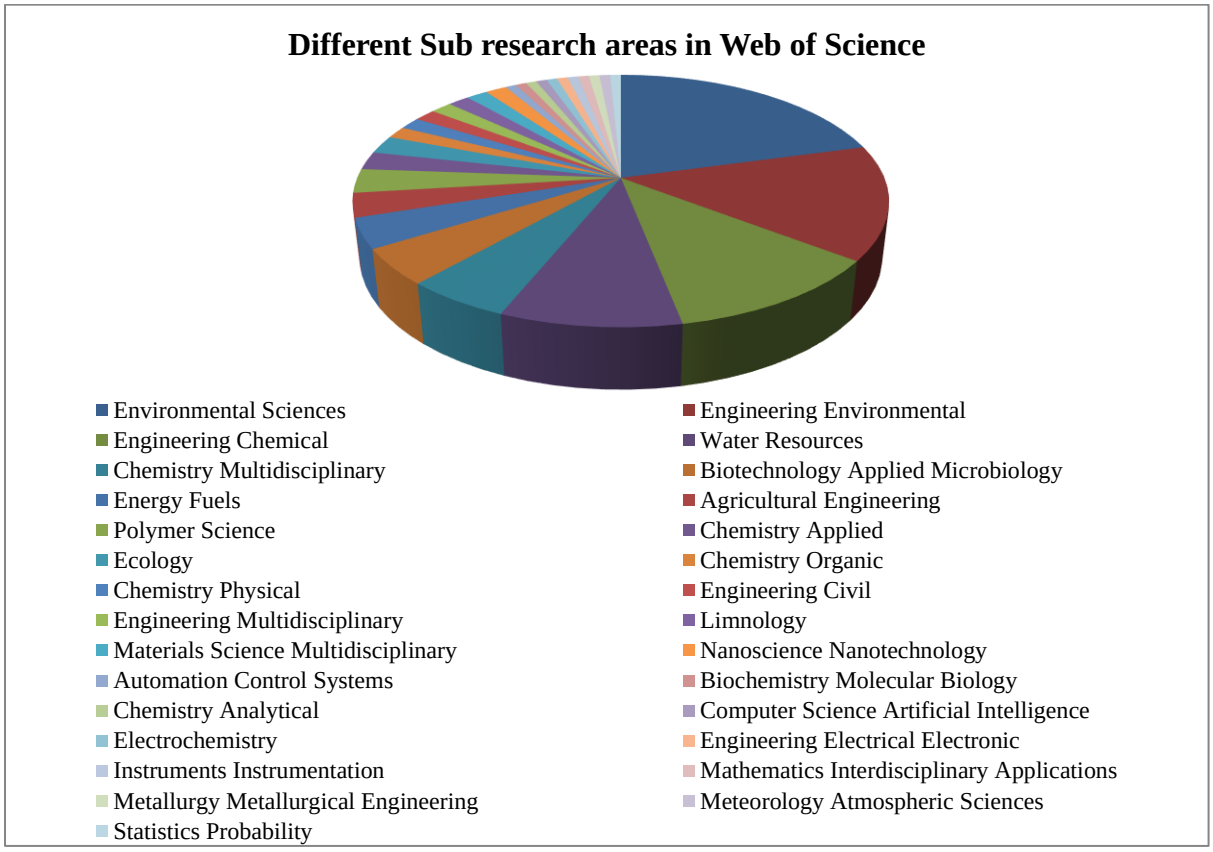


Figure 2(b): Diagrammatic representation of sub research areas in Web of Science

3.2 Country-wise search

Figures 3a and 3b represent a country wise data search of papers where it is seen that India has been the contributor to the highest number of publications. India showed 37.50% contribution, which was the highest for the Scopus database (Figure 3a), and China with 22.06% contribution was the highest in the Web of Science database (Figures 3b). The USA, Turkey, Spain, England, and Taiwan, etc. were also significant in contributing to this field.

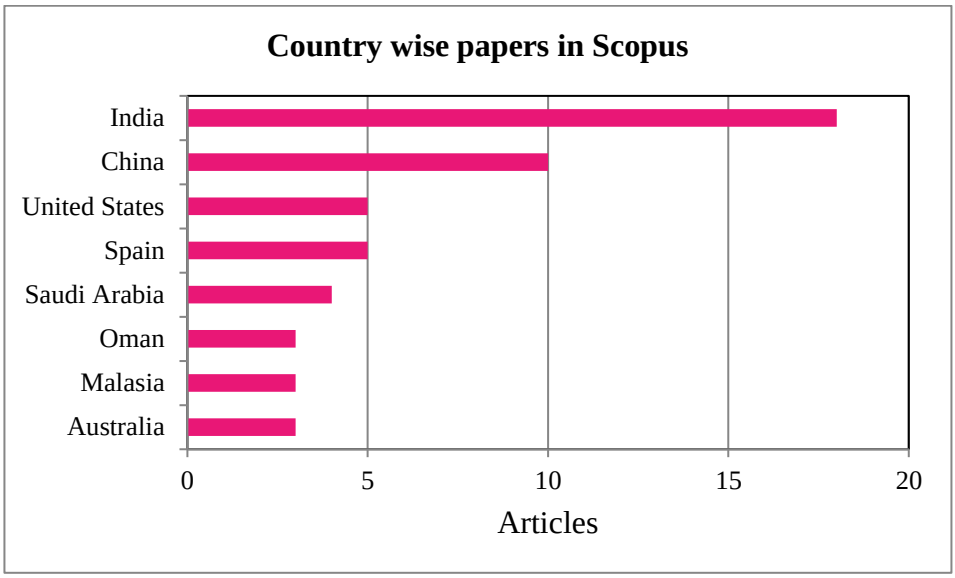


Figure 3(a): Country-wise papers in wastewater treatment in Scopus

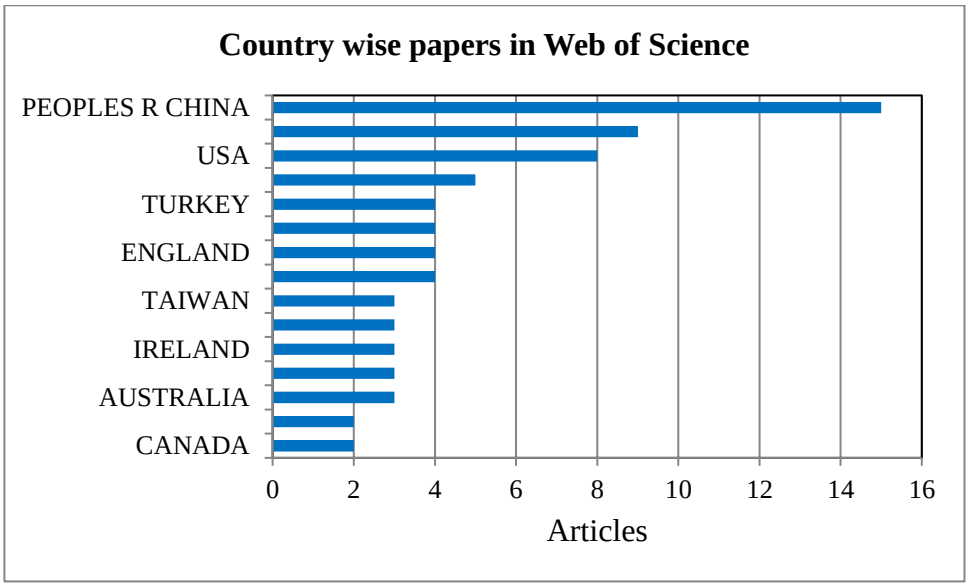


Figure 3(b): Country-wise papers in wastewater treatment in Web of Science

3.3 Funding agency

As portrayed from Figures 4a and 4b, National Natural Science Foundation of China has been dramatically contributing in terms of funds in the area of wastewater treatment as evident from both the databases with 16.28% funding in Scopus (Figure 4a) and 8.82 % funding in Web of Science database (Figure 4b). Fundamental Research Funds for the Central Universities were the second largest contributor in Scopus and Consejo Nacional De Ciencia Y Tecnologia (Conacyt) in Web of science.

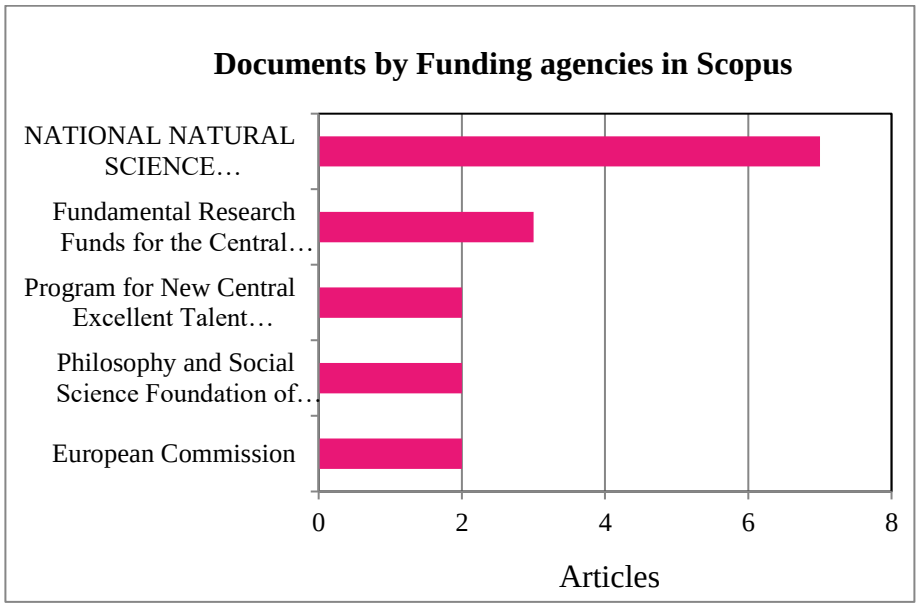


Figure 4(a): Funding agencies: Scopus

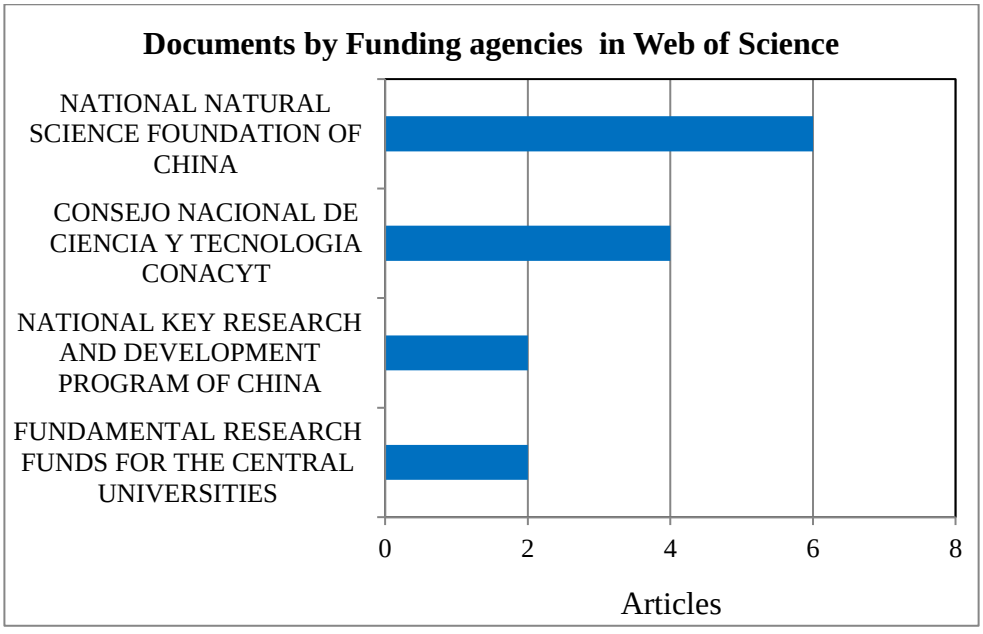


Figure 4(b): Funding agencies: Web of Science

3.4 Citations

Tables 2a and 2b portray the citation index of the different journals in this domain.

As portrayed in Table 2a, research publications in Progress in Polymer Science (Oxford) gained, impact factor 24.505, acquired 52.13% citations. Other major citation counts following the mentioned were in Water Research (146) > Science of the Total Environment (130).

Source title	Year	Cited by
Progress in Polymer Science (Oxford)	2005	1298
Water Research	2016	146
Science of the Total Environment	2017	130
Water Research	2015	122
Journal of Environmental Chemical Engineering	2018	87
Renewable and Sustainable Energy Reviews	2015	71
Nanoscience and Nanotechnology - Asia	2012	67
Journal of Environmental Management	2017	57
Renewable and Sustainable Energy Reviews	2017	39
Journal of Renewable and Sustainable Energy	2010	37
Environmental Monitoring and Assessment	2002	37
Journal of Hazardous Materials	2009	36
Chemosphere	2018	35
Journal of Cleaner Production	2017	35
Journal of Photochemistry and Photobiology B: Biology	2015	34
Journal of Hazardous Materials	2015	32
International Biodeterioration and Biodegradation	2013	31
Environmental Monitoring and Assessment	2017	24
Journal of Membrane Science	2018	23
Chemical Engineering Journal	2012	20
Marine Pollution Bulletin	2018	16
Current Organic Synthesis	2017	14
Chemical Engineering Journal	2012	14
Environmental Sciences: Processes and Impacts	2015	13
Environment International	2018	10
Indian Journal of Biotechnology	2012	10
Materials Science Forum	2016	7
Journal of Environmental Management	2019	6
Journal of Environmental Management	2016	6
Water Environment Research	2013	6
Separation and Purification Technology	2017	5
Water Environment Research	2010	5

International Journal of Environmental Science and Technology	2017	4
Journal of Environmental Science and Health - Part A Toxic/Hazardous Substances and Environmental Engineering	2012	3
WIT Transactions on Ecology and the Environment	2010	3
Journal of Nanotechnology	2019	2
Carbon - Science and Technology	2014	2
Micro and Nano Letters	2019	1
Chemical Engineering Journal	2019	1
Journal of Donghua University (English Edition)	2015	1
Asian Journal of Chemistry	2015	1
Water Environment Research	2014	1
Current Analytical Chemistry	2010	1
Science of the Total Environment	2019	0
Sustainable Materials and Technologies	2019	0
RSC Advances	2019	0
Journal of Membrane Science and Research	2019	0
MATEC Web of Conferences	2016	0

Table 2a: Citation Index of Journal publications in Scopus

The data presented help in understanding the impact of the journal in the relevant field. As per Scopus (Table 2b), the journal Bioresource Technology, a journal with impact factor 6.669 of Elsevier publications, showed 683 citations (18.91%) of different books in the field of wastewater. The other two impactful journals with highest citations, publishing in the area were Journal of Hazardous Materials (321) >Bioresource Technology (321), indicating that Elsevier was the most impactful publisher in the field.

Source Title	**Year**	**Total Citations**
Bioresource Technology	2008	683
Journal of Hazardous Materials	2006	321
Bioresource Technology	2010	320
Critical Reviews in Environmental Science and Technology	2010	210
Chemical Engineering Journal	2006	175
International Journal of Phytoremediation	2008	168
Ecological Engineering	2016	163
Biotechnology Advances	2014	151
Journal of Environmental Chemical Engineering	2014	132
Journal of Hazardous Materials	2017	90

Journal of Applied Polymer Science	2006	89
Bioresource Technology	2006	80
Journal of Hazardous Materials	2009	65
Carbohydrate Polymers	2010	61
Science of the Total Environment	2010	59
Rsc Advances	2015	55
Chemical Engineering Journal	2010	54
Chemosphere	2009	54
Journal of Chemical Technology And Biotechnology	2006	54
Chemical Engineering Journal	2018	47
Nanoimpact	2016	46
Carbohydrate Polymers	2017	45
Ecological Engineering	2014	44
Chemical Engineering Journal	2012	41
Journal of Environmental Engineering-Asce	2001	36
Journal of Materials Chemistry A	2017	33
Frontiers in Chemistry	2014	32
Journal Of Water Process Engineering	2015	28
Colloids and Surfaces A-Physicochemical And Engineering Aspects	2013	28
Desalination	2010	28
Water Science and Technology	2009	26
Bioresource Technology	2008	23
Desalination	2019	18
Water Research	2018	17
Science of The Total Environment	2017	15
Environmental Pollution	2017	12
Journal of Environmental Engineering And Landscape Management	2013	10
Environmental Engineering and Management Journal	2012	10
Science of The Total Environment	2009	10
Journal of Industrial and Engineering Chemistry	2015	9
Desalination and Water Treatment	2012	9
International Journal of Environmental Science And Technology	2017	8
Rsc Advances	2015	8
Chemistry and Ecology	2011	7
Separation and Purification Technology	2019	5
Chemical Engineering Journal	2015	5
Chemometrics and Intelligent Laboratory Systems	2018	4
Journal of Materials Science	2014	4
Water Air and Soil Pollution	2011	4
Water Environment Research	2002	4
Critical Reviews in Environmental Science and Technology	2019	2
Water	2018	2
Environmental Engineering and Management Journal	2014	2

Environmental Science and Pollution Research	2019	1
Korean Journal of Chemical Engineering	2018	1
Applied Nanoscience	2017	1
Electrochimica Acta	2017	1
Desalination and Water Treatment	2016	1
Journal of Engineering	2016	1
Water Research	2019	0
Biointerface Research in Applied Chemistry	2019	0
Water Environment Research	2019	0
Journal of Macromolecular Science Part A-Pure And Applied Chemistry	2018	0
International Journal of Geomate	2016	0
Journal Of Central South University	2014	0
Journal of Applied Research And Technology	2010	0
Chemistry Journal of Moldova	2009	0
Chemical Engineering Communications	2000	0

Table 2b: Citation Index of Journal publications in Web of Science

3.5 Affiliation

An analysis of the associations of research papers showed the highest number of research papers in the field of wastewater treatment, as per Scopus were from Vellore Institute of Technology, Vellore. Web of Science showed the University of Limerick as the lead. Ministry of Education China, Chinese Academy of Sciences, Chinese Academy of Sciences, Indian Institute of Technology, Delhi Technological University, etc. were among the significant contributors.

4. Conclusion

Studies showed Scopus showing maximum publications in the year 2019, with 10 citations for the publications in this area in this year, whereas Web of Science showed maximum papers in the year 2017 with 205 citations. The major sub domains in the field of wastewater treatment as per the study were engineering, environmental chemistry, and environmental science. Many areas such as artificial intelligence, statistics, and probability, metrology and automation are still progressing to create an impact in the domain.

As evident from the results that there has been a significant rise in the number of research publications, articles, review papers, and conference proceedings with each passing year. This could be attributed to the increase in pollution levels of water bodies leading to a need for wastewater remediation, awareness regarding wastewater treatment, and the advent of new and useful technologies. Considering the given scenario, a further rise in research being carried out is expected to come up with possible solutions and technologies for wastewater treatment.

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