



## BIBLIOMETRIC STUDY ON METALURGI: MAJALAH ILMU DAN TEKNOLOGI PUBLISHED DURING 2016-2020

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**ABSTRAK:** Analisis bibliometrik dilakukan terhadap Metalurgi: Majalah Ilmu dan Teknologi periode 2016-2020. Sumber data diakses dari situs <http://ejournalmaterialmetalurgi.com/>. Fokus kajian ialah total artikel tiap tahun, pengarang, institusi, kota asal, penulis produktif dan kata kunci. Data diolah menggunakan Ms. Excel. Hasil penelitian menunjukkan bahwa jurnal ini telah menerbitkan sebanyak 78 artikel. Total artikel terbanyak ditulis secara berkolaborasi 4 orang (17 judul; 21,79%) dan paling sedikit ditulis secara berkolaborasi 7 orang (8 judul; 10,25%). Adapun artikel yang ditulis secara individu sebanyak 10 judul (12,82%). Nilai derajat kolaborasi rata-rata adalah  $C=0,87$ . Efendi Mabruri merupakan penulis paling produktif. Institusi penelitian berkontribusi di jurnal ini adalah LIPI dan Sultan Ageng Tirtayasa. Kota tempat penulis bekerja terbanyak ada di Tangerang. Kata kunci terbanyak adalah Microstructure 15 kali (3,51%) dan kata kunci yang mengandung kata Nickel berturut-turut adalah Nickel alloys sebanyak 4 (0,95%), Nickel ores sebanyak 2 (0,47%), Nickel plating sebanyak 2 (0,47%), dan Nickel Hidroxyde 1 (0,23%). Kesimpulan penelitian yaitu jurnal Metalurgi menerbitkan artikel terbanyak dari LIPI, demikian pula dengan peneliti yang paling produktif juga berasal dari LIPI, dengan artikel sebagian besar ditulis secara berkolaborasi.

**Kata kunci:** Bibliometrika; metalurgi; nikel

**ABSTRACT:** This bibliometric studied Metalurgi : Majalah Ilmu dan Teknologi, a serial publication managed by Metallurgical and Materials Research Center LIPI. The data were observed through <https://ejournalmaterialmetalurgi.lipi.go.id/>, taking a period from 2016-2020 publications. The data collected and recorded were the number of articles each year, the number of authors, the authors' affiliations, the city where the author works, the most productive authors, and keywords. The data was processed using Ms. Excel and the results of data processing were displayed in table form with the percentage of each variable studied. The study showed that during 2016 - 2020 the Metallurgical Journal published 78 articles, with the highest number of articles written in collaboration with 4 people (17 titles; 21.79%) and at least written collaboratively by 7 people (8 titles; 10.25%). There were 10 articles written individually (12.82%). The mean value of the degree of collaboration is  $C = 0.87$ . Efendi Mabruri is the most productive writer with producing 10 titles, the most research institution contributing was LIPI with a frequency of 58 (84.06%), while the most productive college is Sultan Ageng Tirtayasa, 24 (30.76%), and other institutions that contributed to the writing were the Ministry of Industry and PT Petrokimia Gresik. Most authors were living in Tangerang, which is 62 (37.57%). Most keywords are microstructure 15 times (3.51%) and keywords containing Nickel words are 4 (0.95%) Nickel Alloys, Nickel Ores 2 (0.47%), Nickel Plating 2 (0.47%), and Nickel Hydroxide 1 (0.23%).

**Keywords:** Bibliometrics; metallurgy; nickel

## 1. INTRODUCTION

The term bibliometrics was the first time defined by Alan Pritchard (1969) as the application of mathematics and statistical methods to books and other media. It involves analysing a series of publications characterized by the presence of bibliographic variables such as author, place of publication, subject keywords, and citations. According to Hood & Wilson (2001), bibliometric methods and their specialization are related to informetrics, scientometrics, and webometrics. It can be used for research on various topics, such as the distribution of the frequency of use of words, phrases, in-text databases, development studies of academic disciplines, and research institutions, and citations as well. A very basic bibliometric attribute that governs the relationship between information items and activities that librarians and statisticians create to conduct bibliometric studies (Mahendra Kumar, 2014). Furthermore, according to Sulisty-Basuki (2002) through the bibliometric method, it can be explained about the written communication process and its development in a scientific discipline.

Currently, Indonesia occupies the number one position in global nickel reserves, approximately 21 million tons. The availability of limonite nickel or low-grade nickel and saprolite nickel as high-grade nickel is quite high so that it can be used as raw material for batteries for electric vehicles (WE, 2020). Therefore, according to CNN Indonesia, the President of Republic Indonesia wanted Indonesia to be able to play in the electric car and mobile phone market. Nowadays, Indonesia is already running the nickel industry, by processing nickel or into nickel pig iron, ferronickel, and stainless steel. All this time, Indonesia has been exporting more nickel rather than processing it. In 2019, based on the records from the Ministry of Energy and Mineral Resources, nickel ore exports reached 30 million tons more than in 2018 which amounted to around 22 million tons. Nickel downstream has been started by stopping the export of nickel ore. The government banned the official export of nickel ore on January 1, 2020 (CNN Indonesia, 2021).

In supporting the government for nickel processing innovation, information about nickel research in Indonesia need to be studied and conveyed to policymakers, particularly to the Ministry of Research and Technology. This study measured the *Metalurgi: Majalah Ilmu dan Teknologi* (Metallurgy: Science and Technology Magazine), academic publishing covering metallurgy by using bibliometric analysis. This research continues of the research conducted by Rahayu and Nurhayati in 2017. Based on their research, it was found that (1) the distribution of metallurgical journals from 2016-2020, (2) the distribution based on the number of metallurgical journal publications in the 2016-2020 period, (3) the pattern the authorship of metallurgical journals in the 2016-2020 period, (4) the degree of collaboration of metallurgical journal authors in the 2016-2020 period, (5) the productivity of writers in metallurgical journals in the 2016-2020 period, (6) the universities that publish articles in the journal metallurgy for the period 2016-2020, (7) the research institutions that published articles in metallurgical journals in 2016-2020, (8) the cities where the researchers are, (9) the keywords that appear in metallurgical journals 2016-2020.

This research is focused on *Metalurgi: Majalah Ilmu dan Teknologi* (Metallurgy: Science and Technology Magazine) published by the Indonesian Institute of Sciences Research Center for Metallurgy and Materials that can be visited at the <http://ejournalmaterialmetallurgi.com/>. The scope of this journal includes advanced materials and nanotechnology, characterization and analysis of minerals and materials, extraction metallurgy, ceramics and composites, corrosion and its prevention, mineral resource processing, metallurgical and materials modelling and simulation, and metallurgical instrumentation. The Metallurgical Journal is published three times a year, namely every April, August, and December.

## 2. PREVIOUS FINDINGS

Several studies on bibliometric analysis include the following. Modern hydrometallurgy has been developing for more than 100 years and many articles have been produced. Based on research by

Jia, LP., et al. (2020) regarding research trends and global perspectives conducted bibliometrically, it is known that based on keyword analysis, first of all, it was found that most of the research conducted was related to rare earth, recycling, lithium, ionic liquid, and thorium. Furthermore, it is also known that the proportion of bio hydrometallurgy is growing from 5% to 15%, and there is a lot to say about bioleaching.

Another study was conducted by Gaurav et al., (2020). His bibliometric study has looked at research trends related to titanium metal alloys. The data were obtained from the Web of Science (WoS). A total of 1,291 articles were analyzed based on research subjects, language, total author publications, and the number of author citations. The results of his research showed that the fields of engineering and materials science were in the top place where China was the country that does a lot of research in these fields, represented by Nanjing University of Aeronautics and Astronautics having the highest number of publications. The keywords that often appear were minimum quantity lubrication (MQL), nanofluid, cryogenic machining, cutting temperature, CFD, microstructure, sustainable machining, green machining, tool wear, micromachining, optimization parameters, tool life. The most frequently used new keywords were turning, mining, grinding, EDM and WEDM. This study also showed that titanium alloys were 16.94%. The titanium alloy machining research received attention since 2016 and evolved gradually from year to year.

Jose Ignacio Rojas-Sola & Angel Inocencio Aguilera Garcia in 2015 conducted a bibliometric analysis to analyze the evolution of research for the Mining & Mineral Processing category using data from the Web of Science (WoS) from the period 1997-2012. The analysis carried out includes the number of documents, authors, average citations, research centers where the author works, country of origin, and the language of the article. The results of the analysis show that English is the most common publication language, and the United States is the most productive country although it has a relatively low impact factor. The University of Science and Technology of Beijing and the Russian Academy of Sciences are the most productive institutions in the study of this field.

Furthermore, Yang L, Wang Q, Bai X & Deng J (2018) also researched coal in China. They used software called CiteSpace, and social network analysis for the publication period from 1971-2017. The information studied is in the form of information on authors, countries, institutions, journals, hot issues, and research trends in these objects. The results of their study show that: (1) Shifeng Dai, Robert B Finkelman, Guijian Liu, and James C Hower have many publications with great influence. (2) China (29.8%) and the United States (22.2%) have high productivity in total publications. China and the US are closely correlated in the network system of cooperation. (3) China University of Mining and Technology and Chinese Academy of Sciences are in the leading position in the number of publications among all research institutes (4) Energy and fuels, Engineering, and Environmental Sciences are the three disciplines with the most studies in this field. The International Journal of Coal Geology, Fuel, Energy and Fuels, and Fuel Processing Technology are the top four journals with the most publications in this field. (5) Origin of enrichment and mode of occurrence of trace elements is the main research related to trace elements in coal and ash. The environmental problems caused by burning coal have driven the development of trace elements in coal research, and human health has become increasingly popular in recent years. The study findings provide a better understanding of the trace element features in coal and ash research, which can be used as a reference for further studies in this field.

Other similar bibliometric studies have also been carried out by Das (2015), Garg & Sharma (2017), Edewor (2013), Kumar (2014), Royani & Idhani (2018), and Rahayu & Tupan (2018). From all this, it can be seen how bibliometric studies are studies that are increasingly being carried out by academics and researchers.

### 3. RESEARCH METHODOLOGY

The data for this bibliometric study was obtained from the Metallurgical: Science and Technology Magazine published by LIPI from the 2016-2020 period which was downloaded from the website <http://ejournalmaterialmetalurgi.com/>. The focus of the study to be investigated is the frequency of the number of articles each year, the frequency of the number of articles per number, the number of authors, the collaboration of authors, the most productive authors, the institution where the author works, the city where the author works, and the research topic keywords. The data that has been obtained, then the data is processed using Ms. Excel Spread Sheet and calculate the percentage for each recorded variable. After that, the data will be interpreted, described, discussed, and finally given a conclusion.

The degree of collaboration is calculated using the formula (Subramanyam. K., 1983), which is:

$$C = Nm / (Nm + Nn)$$

Note:

*C = degree of collaboration*

*Nm = Total research results from researchers of a certain discipline in a certain year which are carried out in collaboration.*

*Nn = Total research results from researchers of a scientific discipline in a certain year Degree of collaboration C = Level of collaboration of researchers of a discipline, with values ranging from 0 to 1.*

### 4. RESULTS AND FINDINGS

*Distribution of Articles by Year*

Table 1. Distribution of articles by year

Year	Volume	Number of issues	Number of articles	(%)
2016	31	3	17	21,79
2017	32	3	16	20,52
2018	33	3	15	19,23
2019	34	3	15	19,23
2020	35	3	15	19,23
<b>Total</b>	<b>165</b>	<b>15</b>	<b>78</b>	<b>100</b>
Average articles per year			15,60	

Table 2. Articles based on the issue number

Issues	Volume					Total	(%)
	31	32	33	34	35		
1	7	5	5	5	5	27	34,61
2	5	6	5	5	5	26	33,33
3	5	5	5	5	5	25	32,06
<b>Total</b>	<b>17</b>	<b>16</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>78</b>	<b>100</b>

*Authors' Collaboration*

Table 3. Authors' collaboration pattern

Year	Number of authors							Total
	One author	Two authors	Three authors	Four authors	Five authors	Six authors	Seven authors	
2016	2 Titles	4 Titles	8 Titles	1 Title	1 Title	1 Title	0 Title	17 Titles
2017	2 Titles	2 Titles	3 Titles	5 Titles	2 Titles	1 Title	1 Title	16 Titles
2018	2 Titles	1 Title	3 Titles	4 Titles	3 Titles	1 Title	1 Title	15 Titles
2019	2 Titles	1 Title	2 Titles	4 Titles	3 Titles	2 Titles	1 Title	15 Titles
2020	2 Titles	1 Title	0 Title	1 Title	0 Titles	4 Titles	5 Titles	15 Titles
<b>Total</b>	<b>10</b>	<b>9</b>	<b>16</b>	<b>17</b>	<b>9</b>	<b>9</b>	<b>8</b>	<b>78</b>

*Degree of Authors Collaboration*

If the value of C = 0, then it means that the article is written by a single author. If the value of C = 1, it means the article is written in collaboration or with more than one author (Sormin, 2009).

Table 4. Degree of author collaboration distribution

Pattern	Year					Total	(%)
	2016	2017	2018	2019	2020		
Single	2	2	2	2	2	10	12,82
Collaboration	15	14	13	13	13	68	86,30
Total	17	16	15	15	15	78	100
Degree of Collaboration	0,88	0,87	0,86	0,86	0,86	0,87	

It seems that the degree of collaboration among all publications is in the range of values 0.86 – 0.88. It indicates that most of the articles are written collaboratively.

*Prolific Authors*

Table 5 below shows the 10 names of the most productive authors. The first is Efendi Mabruhi with a total of 10 articles. He is a Research Professor at the Metallurgical Research Center of the Indonesian Institute of Sciences. He is followed by Dewa Nyoman Adnyana, a professor and lecturer from the National Institute of Science and Technology with a total of 9 papers. Then, Mochammad Syaiful Anwar and Toto Sudiro, both of them are researchers from the Metallurgical Research Center LIPI, wrote 6 articles. The other authors are shown in the following table accordingly.

Table 5. Prolific authors

No.	Authors' Names	Numbers of publication
1	Efendi Mabruri	10
2	Dewa Nyoman Adnyana	9
3	Mochammad Syaiful Anwar	6
4	Toto Sudiro	6
5	Ika Kartika	5
6	Agus Budi Prasetyo	4
7	Latifa Hanum Lallasari	4
8	Soesaptri Oediyani	4
9	Aprilia Erryani	3
10	Bambang Hermanto	3

*Higher education institutions*

Table 6 below shows that 13 higher education institutions have contributed to *Metalurgi: Majalah Ilmu dan Teknologi* for the 2006-2020 period.

Table 6. Higher education institutions

No	Institutions	Numbers of publication	(%)
1	Universitas Sultan Ageng Tirtayasa	24	30,76
2	Universitas Indonesia	11	14,10
3	Institut Sains dan Teknologi Nasional	9	11,53
4	Universitas Gadjah Mada	8	10,25
5	Institut Teknologi Bandung	6	7,69
6	Universitas Parahiyangan	4	5,12
7	Universitas Islam Negeri Syarif Hidayatullah Jakarta	4	5,12
8	Universitas Jenderal Achmad Yani	3	3,84
9	Universitas Diponegoro	2	2,56
10	Universitas Lampung	2	2,56
11	Politeknik Manufaktur Negeri Bandung	2	2,56
12	Universitas Teknologi Sumbawa, Batu Alang NTB	2	2,56
13	Institut Teknologi PLN	1	1,28
	<b>Total</b>	<b>78</b>	<b>100</b>

*Research institutions*

Table 7 shows that 3 research institutions have contributed to *Metalurgi: Majalah Ilmu dan Teknologi* in the period 2006-2020 as follows.

Table 7. Research institutions

No.	Institutions	Numbers of publication	(%)
1	Lembaga Ilmu Pengetahuan Indonesia	58	84,06

2	Badan Tenaga Nuklir Nasional	7	10,15
3	Badan Pengkajian dan Penerapan Teknologi	4	5,79
	Total	69	100

*Other institutions*

Besides higher education and research institutions, Table 8 shows that 2 others institutions have contributed to the journal they are The Ministry of Industry of the Republic of Indonesia as many as 7 articles, and PT Petrokimia Gresik gave 1 article.

Table 8. Other institutions

No	Institutions	Numbers of publication	(%)
1	Kementerian Perindustrian RI	7	87,50
2	PT Petrokimia Gresik	1	12,50
	Total	8	100

*Authors' Residences*

Table 9. Authors' Residences

No	Authors residence	Frekuensi (kali)	(%)
1	Tangerang	62	37,57
2	Bandung	26	15,75
3	Cilegon	24	14,54
4	Depok	12	7,27
5	Jakarta	11	6,66
6	Yogyakarta	9	5,45
7	Lampung	7	5,09
8	Semarang	3	1,81
9	Sumbawa	2	1,21
10	Bekasi	1	0,60
11	Cimahi	1	0,60
12	Gresik	1	0,60
13	Indramayu	1	0,60
14	Makassar	1	0,60
15	Malang	1	0,60
16	Medan	1	0,60
17	Sleman	1	0,60
18	Surakarta	1	0,60
	<b>Total</b>	<b>165</b>	<b>100</b>

*Keywords*

From the data obtained, there are 108 keywords used by all articles published in this journal, here are the results.

Table 10. Keywords

No	Keywords	Total	(%)
1	Microstructure	15	3,51
2	Nickel	13	3,09
3	Aluminum	12	2,85
4	Corrosion resistance	11	2,61
5	Chromium	9	2,14
6	Mechanical properties	9	2,14
7	Scanning electron microscopy	9	2,14
8	Lithium	8	1,90
9	Stainless steel	8	1,90
10	Carbon steel	7	1,66
11	Martensite	7	1,66
12	Coal	6	1,42
13	Corrosion rate	6	1,42
14	Magnesium	6	1,42
15	Copper alloys	5	1,19
16	Hardness testing	5	1,19
17	Steel	5	1,19
18	Composite materials	4	0,95
19	Heat treatment	4	0,95
20	Leaching	4	0,95
21	Limonite	4	0,95
22	Metallurgical research	4	0,95
23	Milling (machining)	4	0,95
24	Nickel alloys	4	0,95
25	Tempering	4	0,95
26	Zinc alloys	4	0,95
27	Carbon monoxide	3	0,71
28	Corrosion inhibitors	3	0,71
29	Lithium batteries	3	0,71
30	Magnesium alloys	3	0,71
31	Petroleum pipelines	3	0,71
32	Thermal effects	3	0,71
33	X-ray diffractometer	3	0,71
34	Yttrium	3	0,71
35	Abrasion resistance	2	0,47
36	Adsorption	2	0,47
37	Alloy steels	2	0,47
38	Aluminum alloys	2	0,47



39	Boiler tube	2	0,47
40	Brain water	2	0,47
41	Calcium	2	0,47
42	Carbon	2	0,47
43	Chromium alloys	2	0,47
44	Citric acid	2	0,47
45	Deposition	2	0,47
46	Electromagnetics	2	0,47
47	Fatigue (materials)	2	0,47
48	Leak detection	2	0,47
49	Microwaves	2	0,47
50	Molybdenum	2	0,47
51	Nickel ores	2	0,47
52	Nickel plating	2	0,47
53	Porous materials	2	0,47
54	Roasting (metallurgy)	2	0,47
55	Silicon	2	0,47
56	Steam turbines	2	0,47
57	Substrates	2	0,47
58	Surface roughness	2	0,47
59	Turbine blades	2	0,47
60	X-ray diffraction	2	0,47
61	Activated carbon	1	0,23
62	Additives	1	0,23
63	Adsorbents	1	0,23
64	Aileron block	1	0,23
65	Aluminizing	1	0,23
66	Aluminum oxide	1	0,23
67	Anneal hardening	1	0,23
68	Annealing	1	0,23
69	Austenite	1	0,23
70	Biodegradable plastics	1	0,23
71	Biomass	1	0,23
72	Bismuth	1	0,23
73	Boric acid	1	0,23
74	Calcium sulfates	1	0,23
75	Carbon dioxide	1	0,23
76	Carbon nanotubes	1	0,23
77	Carbonates	1	0,23
78	Catalyst degradation	1	0,23
79	Cavitation	1	0,23
80	Cerium	1	0,23

81	Chemical vapor deposition	1	0,23
82	Chromium plating	1	0,23
83	Coal mining	1	0,23
84	Coating techniques	1	0,23
85	Coatings	1	0,23
86	Cobalt alloys	1	0,23
87	Compressors	1	0,23
88	Corrosion	1	0,23
89	Corrosion protection	1	0,23
90	Corrosion resistant alloys	1	0,23
91	Crystal structure	1	0,23
92	Crystallinity	1	0,23
93	Degradation	1	0,23
94	Density	1	0,23
95	Diffusers	1	0,23
96	Diffusion process	1	0,23
97	Dryers	1	0,23
98	Dye-sensitized solar cell	1	0,23
99	Elbow tubes	1	0,23
100	Electrodeposition coating	1	0,23
101	Zirconium	1	0,23
102	Polymer PLA/ABS	1	0,23
103	Nanorods zink oxida,	1	0,23
104	Al-Si-Cu-Fe Alloy	1	0,23
105	Nickel hydroxide	1	0,23
106	Magnesium	1	0,23
107	Biocomposite	1	0,23
108	Al-Si-Cu-Fe alloy	1	0,23
<b>Total</b>		<b>420</b>	

## 5. DISCUSSION

Based on the results and discussion, it can be concluded that in the period 2016-2020 Metallurgy: Science and Technology Magazine has published 78 articles where the most articles were written in collaboration with 4 people in 17 titles (21.79%), and the least was written in collaboration with 7 people in 8 titles (10.25%). There are 10 articles written individually (12.82%). The value of the average degree of collaboration is  $C=0.87$ . Efendi Mabururi is the most prolific author with 10 papers. The research institution that contributed the most was LIPI with a frequency of 58 titles (84.06%), meanwhile, the most productive university was Sultan Ageng Tirtayasa with their 24 papers (30.76%). As for the city where the author lives, Tangerang shows the most, which is 62 authors (37.57%). Most keywords are Microstructure (3.51%) and keywords containing the phrase "Nickel" are Nickel alloys with 4 keywords (0.95%), Nickel ores with 2 keywords (0.47%), Nickel plating with 2 keywords (0.47%), and Nickel Hydroxide with 1 keyword (0.23%).

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