



SCIENTOMETRIC ANALYSIS OF THERMODYNAMICS RESEARCH PUBLICATIONS IN EUROPEAN COUNTRIES

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ABSTRACT

This paper discusses or analyses trends in Thermodynamics research during from 2012-2017, the data have been collected from web of science database. Aim of the study to analyze source wise research output, year wise publications, authorship pattern, and country wise research. The study finds that articles occupies first place among various forms of sources, during the study period in the year 2017 published highest research output, Germany have published highest publication among the Thermodynamics, majority research papers published themes of Thermodynamics in chemistry field.

KEYWORDS: Thermodynamics, Free Energy, Enthalpy and Entropy .

INTRODUCTION

Thermodynamics is the study of the energy, principally heat energy that accompanies chemical or physical changes. Some chemical reactions release heat energy; they are called exothermic reactions, and they have a negative enthalpy change. Others absorb heat energy and are called endothermic reactions, and they have a positive enthalpy change. But thermodynamics is concerned with more than just heat energy. The change in level of organization or disorganization of reactants and products as changes take place is described by the entropy change of the process. For example, the conversion of one gram of liquid water to gaseous water is in the direction of increasing disorder, the molecules being much more disorganized as a gas than as a liquid. The increase in disorder is described as an increase in entropy, and the change in entropy is positive.

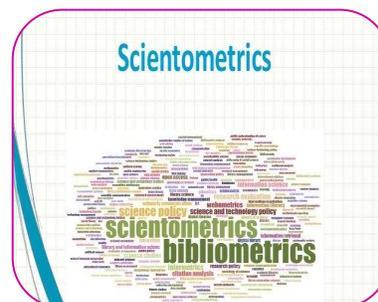
Whether a chemical reaction or physical change will occur depends on both the **enthalpy** and **entropy** of the process, which are quantities that can be calculated from tabulated data. Both terms are combined in the **free energy**-the third and most important thermodynamic term. If the change in free energy is negative, the reaction will proceed to the right; this reaction is called a spontaneous reaction. If the sign is positive, the reaction will not proceed as written; this reaction is no spontaneous. A powerful prediction as to whether a reaction will or will not take place can be made using tabulated data to calculate the change in free energy.

Thermodynamics is a powerful tool for chemists. After all, nature left to its own devices is always moving toward a minimum of potential energy. Thermodynamics tells the chemist in which direction this minimum lies.

OBJECTIVES

To major objectives are formulated the present study as mentioned below:

1. To examine the Thermodynamics output during the study period.
2. To study the country wise research output of Thermodynamics research.



3. To identify the authorship pattern.
4. To study the language wise and institution wise Thermodynamics research publications studies.
5. To identify the source wise Thermodynamics research publications studies.

METHODOLOGY

This study aims to analyze the trend in the development of Thermodynamics research in Scientometrics. It is also focused to trace the past trends in the area of Thermodynamics research publications in Scientometrics based on the sample data. The study evaluates the contribute on countries to the growth pattern and development of research productivity in this discipline during the last few decades.

DATA COLLECTION

The publication of research output on Thermodynamics research in scientometrics is obtained from various sources, such as Journals articles, Conference papers. Review, short survey, note, editorial press release, and letter. The research data required for the present study are downloaded from the web of science database. All the publications retrieved from the web of science database on Thermodynamics and scientometric cover the period from 2012-2017. Further, the researcher has downloaded the data in the form of notepad files; then the bibliographical details are converted to the form of MS-EXCEL format using the PHP (Hypertext Preprocessor) scripting language text unique data are rearranged in MS-EXCEL format to eliminate duplication from the download data. Overall data retrieved by the researcher are 8516 records for analyzing the present study.

LIMITATIONS

The findings of this study apply only to Thermodynamics studies in to the fields related to the heat and temperature and their relation to energy and work. This study covers Thermodynamics with respect to the chemistry field, brought under the purview of the study and no other themes. This study makes a special attention only on the performance of research output in Thermodynamics research. This study covers the years from 2012 to 2017 only.

Analysis and Interpretation

Table-1 Year wise publication Thermo dynamic research

S.NO	Publication Year	Recs	Percent
1	2012	1248	14.7
2	2013	1267	14.9
3	2014	1357	15.9
4	2015	1504	17.7
5	2016	1550	18.2
6	2017	1590	18.7
	Total	8516	100.00

The year wise productivity of publications in Thermodynamics research during from year 2012 to 2017 is presented in table-1. It shows that the publication of output is gradually increased and decreased trend. In the 2017 occupied first position that the output is increased (14.7%) compared to 2012 and 2017. It is clearly stated that in future the research productivity in Thermodynamics research is increasing trend.

Table-2 Sources wise output in Thermo dynamic research

S.NO	Document Type	Recs.	Percent	TLCS	TGCS
1	Article	7785	91.42	4150	81881
2	Review	323	3.79	332	9361
3	Article; Proceedings Paper	227	2.67	74	1133

4	Editorial Material	67	0.79	21	241
5	Meeting Abstract	46	0.54	0	0
6	Review; Book Chapter	24	0.28	30	1163
7	Correction	16	0.19	1	7
8	Letter	16	0.19	7	31
9	Article; Book Chapter	8	0.09	0	75
10	News Item	4	0.05	7	22
	Total	8516	100.0	-	-

Note: TLCS: Total Local Citation Score, TGLS: Total Global Citation Score

The source wise output incontinent level of Thermodynamics research is given in table-2. It shows that the Article is occupies first position (91.4%), second is Review (3.8%); Article; Proceedings Paper (2.7%) followed by Editorial Material; Meeting Abstract; Review; Book Chapter; Correction; Letter and etc.

Table-3 Authorship pattern in Thermo dynamic research output

S.NO	YEAR	SINGLE	DOUBLE	THREE	FOUR	FIVE	ABOVE FIVE	TOTAL
1	2012	178	240	293	211	126	200	1248
2	2013	163	256	280	195	142	231	1267
3	2014	180	262	307	241	146	221	1351
4	2015	174	282	339	245	165	299	1504
5	2016	193	270	363	253	178	293	1550
6	2017	183	300	325	282	171	329	1590
	TOTAL	1071	1610	1907	1427	928	263	8516

The author productivity of research output is given in table-3. The authorship pattern is classified as single, double, three, four, five and above authors. It could be noted that single author contribution is dominated (1071articles) followed by double, triple authors.

Table-4 Top 10 authors in Thermo dynamic research (total 32901)

#	Author	Recs	Percent	tlcs	TLCS/t	TLCSx	TGCS	TGCS/t	TLCR
1	Maslov VP	58	0.7	186	56.05	2	268	91.40	183
2	Lucia U	44	0.5	331	76.87	28	758	199.37	309
3	Perlovich GL	35	0.4	45	13.43	6	243	91.22	46
4	Ruggeri T	32	0.4	246	59.68	43	440	111.78	198
5	Sharnin VA	32	0.4	39	9.88	0	98	25.02	43
6	Fabrizio M	30	0.4	35	8.92	12	131	42.13	22
7	Seifert U	28	0.3	8	2.67	7	1527	358.08	30
8	Gonzalez JA	27	0.3	58	14.28	2	178	50.60	57
9	De la Fuente IG	26	0.3	56	13.78	2	171	48.85	56
10	Domanska U	26	0.3	86	31.75	4	471	157.82	79

Table 4 shows that top 10 authors of continent level of Thermodynamics research. It could be noted that the Maslov VP occupied in first position (0.7%) compared to Lucia U second position (0.5%) followed by Perlovich GL and others. Domanska U occupied in last position with (0.3%).

Table-5 Top 10 Journals in Thermo dynamic research

S.NO	JOURNAL	RECS	PERCENT	TLCS	TLCS/T	TGCS	TGCS/T	TLCR
1	Physical Review E	229	2.7	0	0.00	2364	701.15	116
2	Journal of Chemical Physics	176	2.1	0	0.00	1566	465.72	55
3	Physical Review D	161	1.9	0	0.00	3116	837.47	59
4	Physical Review B	141	1.7	0	0.00	1917	614.52	16
5	Russian Journal of Physical Chemistry A	132	1.6	80	21.83	259	78.63	67
6	Entropy	113	1.3	98	24.27	543	190.85	149
7	Journal Of Chemical Thermodynamics	106	1.2	142	41.83	914	257.33	109
8	Physical Chemistry Chemical Physics	103	1.2	51	15.53	796	290.67	83
9	Physical Review Letters	102	1.2	0	0.00	4341	1297.37	43
10	Journal of Physical Chemistry b	97	1.1	62	13.92	1197	291.67	45

The Journal wise output in continent level of Thermodynamics research is given in table-5. It could be noted that the Physical Review E Occupies in first position (2.7%) compared to Journal of Chemical Physics(2.1%); third is Physical Review D (1.9%) followed by Physical Review B, Russian Journal of Physical Chemistry A, Entropy, Journal Of Chemical Thermodynamics and followed by others.

Table-6 Top ten Country wise of Thermo dynamic research

S.NO	COUNTRY	RECS	PERCENT	TLCS	TGCS
1	Germany	2505	29.4	1283	39010
2	France	1581	18.6	716	19922
3	Italy	1498	17.6	1258	15926
4	Russia	1357	15.9	724	7062
5	Spain	981	11.5	519	13027
6	USA	840	9.9	407	17815
7	Poland	601	7.1	319	6416
8	Turkey	508	6.0	210	4461
9	UK	456	5.4	176	9415
10	Peoples R China	254	3.0	134	3709

The country wise output in continent level of Thermodynamics research is given in table-6. It could be noted that the Germany is occupies in first position (29.4%) compared to France(18.6%); Italy (17.6%) followed by Russia and etc.

Table-7 Top ten Institutions wise of Thermo dynamic research

S.NO	INSTITUTION	RECS	PERCENT	TLCS	TGCS
1	Russian Acad Sci	583	6.8	352	2976
2	CNRS	226	2.7	70	2939
3	Ist Nazl Fis Nucl	151	1.8	45	1884
4	CNR	135	1.6	39	1408
5	Univ Bologna	128	1.5	351	1240
6	Polish Acad Sci	113	1.3	51	1294
7	Univ Roma La Sapienza	111	1.3	32	1113
8	Natl Acad Sci Ukraine	104	1.2	24	363
9	Univ Stuttgart	104	1.2	62	2645
10	Univ Paris 06	101	1.2	44	1171

The Institution wise output in continent level of Thermodynamics research is given in table-7. It could be noted that the is Russian Acad Sci. occupying in first position (6.8%); second CNRS (2.7%) followed by Ist Nazl Fis Nucl. etc.

Table-8 Word wise of Thermo dynamic research

S.NO	WORD	RECS	PERCENT	TLCS	TGCS
1	Thermodynamics	1777	20.9	1617	18529
2	Thermodynamic	575	6.8	308	4672
3	Model	466	5.5	230	4136
4	Phase	463	5.4	206	3920
5	Systems	361	4.2	314	3575
6	Quantum	360	4.2	96	5517
7	Water	349	4.1	262	3986
8	Based	348	4.1	221	3747
9	Properties	338	4.0	120	2811

The word wise output in continent level of Thermodynamics research is given in table-8. It could be noted that the is occupies in first position Thermodynamics (20.9%) compared to Thermodynamic (6.8%), Model (5.5%) followed by Properties and etc.

Table-9 Languages wise of Thermo dynamic research output.

S.NO	Language	Recs	Percent	TLCS	TGCS
1	English	8430	99.0	4610	93850
2	Russian	38	0.4	5	32
3	German	10	0.1	0	4
4	Polish	8	0.1	1	4
5	Turkish	8	0.1	0	6
6	French	7	0.1	6	29
7	Ukrainian	6	0.1	0	3
8	Spanish	5	0.1	0	0
9	Italian	3	0.0	0	1
10	Japanese	1	0.0	0	2

The language wise output in continent level of Thermodynamics research is given in table-9. It could be noted that the English is occupies in first position (99.0%) compared to Russian (0.4%); German (0.1%) followed by Polish, Turkish and etc.

CONCLUSION

It is due to the pivotal place of journal as a medium of scientific communication than any other form of publication; majority of the research output published in article in general. It could be deduced from the discussion that, during the study period the research paper publication trend is increasing and degreasing. Highest percent of publication published in 2017. Very lowest percent of research paper published in the year 2012. Conclude from the study, multi authored contributions is high compare to single authorship pattern. More papers published theme of Phase, System, Water, Quantum and Properties evident of continent level developed chemistry field.

REFERENCE

Cf., e.g., Moravcsik 1973, Gilbert 1978, Rescher 1978 (Sect. VI and quoted literature), Tagnte et al. 1981.

So did already the young Price (1951, p. 91): "We may therefore interpret the rate of growth as being an index of the scientific man-power mobilized around the field studied."

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