

GROWTH AND SCATTER OF ALCOHOL FUEL LITERATURE

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Investigates alcohol fuel literature (1901-1980) in terms of forms of publications, countries contributing to the field, the type of publications in which the literature is scattered and correlation between research productivity of an author and breadth of the research interest, using Alcohol Fuels Bibliography brought out by the U.S. Department of Energy. The study reveals that there was a slow growth in the alcohol fuel literature during 1901-1970; but there was a rapid rise in literature especially in the use of alcohol as a vehicle fuel presumably due to oil price hike. It is further noted that this area has not been an area where publications relate to high scientific activity as most of the articles are reported in popular journals. The study also shows that in this area there is a positive and strong relationship between research productivity and breadth of research interest of the authors.

INTRODUCTION

Since the escalation in oil prices in the year 1973 by the OPEC countries, sustained efforts are being made by almost all countries of the world for the development of new and renewable sources of energy. The significance of alcohol fuel as a source of energy in the spectrum of alternative energy sources is proved by the literature originating from conferences, books and articles appearing in journals. Valachy [1], Sengupta[2], Arunachalam[3] have carried out studies in disciplines and subdisciplines of science like physics, biophysics and superconductivity respectively. But studies related to fields of economic importance are not many. However, a study by Anenaike[4] on plants of economic importance can be cited in this context. These studies point out that

journals are the primary media for the communication of research results.

The present study is an attempt to investigate whether a similar pattern is followed in an area of economic importance like alcohol fuel. It also tries to study the countries contributing to this field, distribution of subject area according to various subdisciplines, publications where the literature is scattered and to understand the relationship between research productivity and breadth of research interest.

METHODOLOGY

To carry out the investigation we made use of the *Alcohol Fuels Bibliography* compiled by the National Alcohol Fuels Information Centre, Solar Energy Research Institute, U.S. Department of Energy, U.S.A.[5]. The period covered in the bibliography is from 1901-March 1980. The abstracts in the bibliography have been divided into various subfields like General, Feedstocks of various types, Production, Coproducts, Economics, Use as Vehicle fuel, Government policies, Environment effect, and Safety.

The bibliography also provides the author index along with their area of specialisation and covers approximately 1500 technical and non-technical English language citations. A wide range of documents including journal articles, reports, books, dissertations and conference papers have been included in the bibliography.

DISCUSSION OF RESULTS

Growth of Alcohol Fuel Literature

The graph (Appendix I) showing the growth of alcohol fuel literature, indicates different growth rates during different time periods. During the period 1901-20 the growth of

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alcohol fuel literature is very little (0.60%), while during 1920-40 the growth rate is 4.47% and almost constant. The period 1940-50 shows a slight rise in the literature growth where it is 5.98%. After 1950 there is a decline in the growth of literature till 1960, however, during the period 1960-70 the growth is very small and almost similar to that of the period 1901-20. During the last ten years (1970-80) there is exponential growth of literature (89%). It is a clear indicator of the importance given to the subject after the *Oil Crisis* in 1973. The growth of literature till the period 1970 is not significant but after 1973 it is highly significant.

Countries contributing to the Literature

U.S.A. is the major contributor in the field of alcohol fuels with 37% documents of the total publications followed by Canada 2.26%, West Germany 1.85% and India 1.64%. Rest of the publications are distributed among U.K., Japan, Brazil, New Zealand, Australia, Sweden and others. This is the picture based on the English language publications. West Germany ranks third but presumably this country should be having much high contribution in German language. The low contribution from Brazil (15 documents) inspite of its National Alcohol Program to supply anhydrous ethanol for mixing with gasoline, is understandable as English is not their official language. United Kingdom which has reported only 17 documents may be due to the non-availability of raw materials for the production of alcohol as United Kingdom depends on third world countries for sugar and other cellulose products which are the main sources for alcohol production.

The maximum output of literature i.e. 417 papers (28%), is in the area of Use of Alcohol as Vehicle Fuel indicating that the major R&D effort thrust was directed towards using alcohol as a vehicle fuel. 267 (18%) documents relating to alcohol production and 179 (12%) documents relating to economics are significant as they clearly indicate focus on techno-economic studies and economic methods of production. Rest of the publications are scattered in various

subdisciplines like general (225), feedstocks various types (230), government policies (79), and environmental effect (34).

Type of Literature

As is usual with any R&D subject, most of the work is being published in journal articles. A major portion (50%) of the work has been reported in journal articles followed by reports (25%), and books (20%). Out of 342 reports published, 96 are on the use of alcohol as vehicle fuel while 43 are on production, and 21 on government policies. It again shows the importance of alcohol as fuel for transportation and as an alternative source of energy for the present as well as for the future.

Most of the literature in the field of alcohol fuel are reported in *SAE Preprints*, *New York Times*, and *Wall Street Journal* which contribute 47% of the literature. These journals, except *SAE Preprints*, are not primary research journals but are popular type magazines, which highlight the importance of the subject. The primary journals of scientific & technical nature, publishing on alcohol fuels, are *Science*, *Industrial and Engineering Chemistry* and *Gasohol*. The field being multidisciplinary in nature does not seem to have core journals. A most interesting finding from the analysis of the bibliography is that literature on alcohol fuel is scattered among the disciplines of chemistry, biology, physics, engineering, agriculture, energy, environment, economics, and business. Because of the diversity in subject scope and type of documents, there is currently no single source which provides comprehensive literature coverage on alcohol fuels.

The absence of core journals is further established by the fact that 185 journals published 1 to 5 articles while 18 journals have carried 6 to 10 articles over a period of 80 years. Only 13 journals out of 216 (6% of the total journals) reported 11 articles and more.

Research Productivity and Breadth of Interest

One point of theoretical interest which can be investigated from the bibliography is to test the hypothesis that more productive alcohol fuel scientists tend to work & publish in several

subfields and do not limit their research publication to one subfield. Similar studies have been carried out by C.D. Hurt[6] and K. Subramanyam[7] for environmental scientists and computer scientists. To test this hypothesis, use of author index, reflecting the area of specialization of each author was made. This has facilitated in finding out the breadth of interest of an author. Productivity of each author has been found by counting each article mentioned against the name of author and making a total of it. Of the 1469 authors in the sample, 1147 authors contributed one paper each during the period 1901-1980 and the remaining 322 authors published more than one paper.

Table 1 shows the distribution of authors and papers by the number of subfields in alcohol fuel. It is interesting to note that 1362 authors (92.72%) in the sample contributed only in one of the 11 subfields. To have a more meaningful idea of author's breadth of subject interests in alcohol fuel, it is necessary to analyse those authors who contributed more than one paper and thus had a chance to contribute in more than one subfield. The distribution of authors contributing more than one paper is shown in Table 2.

Table 2 shows that only one third of the authors (33.23%) who have more than one paper to their credit, contributed papers in more than one subfield. Only 1.24% of the authors contributed in four subfields while only one author contributed in five subfields.

To test the hypothesis that research productivity in a field like alcohol fuel is directly related to breadth of research interest, correlation coefficient between the variables viz. number of papers published by an individual and the number of subfields in which he has contributed was carried out for 322 multiple paper authors. The correlation coefficient (r) between these two variables for 322 authors comes out to be 0.46 which is highly significant at .01 level of significance ($t_{320} = 165.78$). This suggests a positive relationship between research productivity and breadth of research interest. As the two variables under consideration are correlated, we evaluate regression ($t_{320} = 9.658$) which further proves the hypothesis.

Table 1
*Distribution of Papers and Authors by
Number of Subfield*

Number of Subfields	Number of Authors	Percentage of Authors
1.	1362	92.72
2.	81	5.51
3.	21	1.43
4.	5	0.24
Total	1469	100.00

Table 2
*Distribution of Multiple-paper Author
across Subfield*

Number of Subfields	Number of Authors	Percentage of Authors
1.	215	66.77
2.	81	25.16
3.	21	6.52
4.	4	1.24
5.	1	.31
Total	322	100.00

CONCLUSION

From the analysis of results it can be concluded that during the period 1910 to 1970, there was a slow growth in alcohol fuel literature, however, after the rise of oil prices in the year 1973 by OPEC countries, there has been a rapid rise of literature on the subject. USA tops the list followed by Canada & West Germany in respect of contribution. Since the oil crisis, 80% of the literature reported has been on the use of alcohol as a vehicle fuel. Journals appear to be the main source for reporting results during 1901-1970 but during 1971-80 there has been an upsurge in reports and a decline in journal articles. This contradicts the findings of the studies carried out in basic and applied sciences. The upsurge of report literature in fields like alcohol fuels may be probably due to its

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economic and commercial importance. As most of the journals reporting research results are popular journals and this field has yet to become an area of high scientific activity, inspite of few publications appearing in science journals. The study also shows a positive and highly strong relationship between research productivity and breadth of research interest in the field of alcohol fuel literature. It supports the hypothesis that research productivity of scientists working in the field of alcohol fuels (as measured by the number of papers published) is directly related to the subfields of alcohol fuel in which the papers are published.

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APPENDIX - I

