

A Concise History of Drying Technology-An International Journal

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Drying is the oldest unit operation which is found in most industrial sectors. As an energy-intensive operation the continuous rise in interest in drying R&D on the global scale is evident from the numerous international conferences devoted to drying. However, the history of drying R&D as a viable multi-disciplinary field that couples transport phenomena with material science is just about four decades old. Much of the technical literature prior to 1980 appeared in other than English, notably in Russian, German, French, Polish etc. R&D literature in the English language started to appear only since the 80's mainly as a result of the single-handed efforts of the senior author (ASM) at McGill University, Canada. This article attempts to provide a brief historical perspective of the history of the journal Drying Technology since its establishment in 1982. In particular, it is noteworthy that contributions to drying R&D in general and this journal in particular from India have been extremely low but it is time for this to change with the emergence of India as an economic powerhouse in the coming decades. We hope this article will stimulate interest of academics and industry R&D in this fascinating area.

Dr. Carl W. Hall, who was then Director of Engineering at the National Science Foundation in Washington DC, is the Founding Editor and Marcel Dekker the original publisher of the journal. Dr. Hall has made numerous seminal contributions to drying of agricultural products. Dr. Maurits Dekker -then Chairman of Marcel Dekker Inc. NY, USA- was the originator of the idea following up on the success of the first two IDS conferences we held in Montreal in 1978 and 1980. Prof. Mujumdar was involved with the journal from Day 1 as Dr. Hall drafted him to assist him. They sought papers through the global network generated by the IDS conferences. As there was little R&D activity in North America in drying, they had to seek contributions from Western Europe, then USSR, Soviet bloc countries in east Europe, Japan etc. Indeed, this was a very major effort as the papers from non-English speaking countries had to be edited profusely and revised to meet the publisher's requirements for camera-ready manuscripts following peer review using snail mail. This was a massive task that readers not familiar with mechanical typewriters and air mail for sending out manually corrected and marked manuscripts to and from authors, referees and eventually publisher, cannot appreciate. With the internet, word processing and low cost instant communication the process today is at least an order-of-

magnitude, if not even more- faster and simpler. This is true of management of journals, organizing conferences as well as publishing edited and/or authored books. In some cases, they even translated original papers from some European languages to have reasonable technical content in the journal. Even to publish two journal issues in the first two years was a major challenge. Concurrently, Dr Dekker convinced Prof. Mujumdar, against his initial hesitation- to edit a Handbook of Industrial Drying. This book appeared in 1987 after a marathon five year single-handed effort. Indeed, second and third editions of this Handbook appeared in 1995 and 2007. The publisher CRC Press plans 4th edition of this Handbook- often called "Bible of Drying" or "Drying Consultant of Desk"- for publication in early 2014 with some 60 chapters.

Drying Technology Journal went through at least three distinct phases each lasting about a decade. In the first decade of establishment between 1982-1990, Dr. Hall and Prof. Mujumdar had to struggle to obtain adequate supply of manuscripts even for just 2-4 smaller issues per annum. At the same time the IDS series had very good response and flow of papers from 40-50 countries. Authors preferred to publish in the book series that Prof. Mujumdar edited under the titles Drying'N, Drying of Solids, Advances in Drying etc. In the absence of impact factors and citations, authors preferred books to publish their work in. Editors had to use their professional influence to convince some senior researchers to submit their papers to the journal. They even managed to get many papers translated and Prof. Mujumdar corrected the texts word-by-word and they had them retyped after review according to the journal format requirements- a costly and labor-intensive process in the period of mechanical and electronic typewriters and snail mail. In hindsight it is obvious the journal could simply not have survived without this extraordinary effort. Unlike many other fields, technical literature in drying science, engineering and technology was disseminated primarily through books rather than journals for at least two decades. This was necessary due to the fact that R&D in drying indeed followed the initiation of the IDS series rather than preceding it as often happens in most new fields. In fact, IDS and the journal helped established the field of Drying R&D itself! Many entered this multi-disciplinary field as a result of the success of the IDS series which publicized the need for and challenges in drying R&D.

From just small two issues in the first two years, reviewing and getting the papers in camera-ready format remained a huge task for both editor and authors. Since there was no assistance from the publisher in copy-editing the revised papers, as editors we also did the final proof-reading and copy-editing as needed just to have enough papers to publish in given time period, especially with the slow mail service and need to handle paper manually and using Xerox machines. Our university had no funds to support such an activity despite the massive publicity and visibility received through such acts of "dedicated service". Parenthetically, it is interesting to note that we even reprinted (with permission of course) some of the classical papers on diffusion modeling that were published in the 1930's. The journal also published Book Reviews

(often of books published in Russian, German, Polish, Hungarian etc) as well as PhD theses summaries and conference reports. This of course filled some pages of the journal in a useful manner since in the absence of the internet it was not easy to access such information.

In 1988, Prof. Mujumdar took over as Editor-in-Chief. The number of issues increased slowly from four to five to seven to ten and eventually twelve some ten years ago. In 2011 the number of issues rose to 16 per year and still could not cope with the growing manuscript flow. For continual renewal we have had an editorial boards with limited tenure. Eventually, as activity in drying R&D in the globe rose, we needed more Associate editors and Assistant Editors. I recruited younger faculty members from around the world to assist and also to mentor. The future of the journal as well as the future of IDS and drying R&D rests with the younger generation of researchers. Hence this was done as a deliberate move, which has shown success.

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So far Drying Technology has published over 2400 refereed papers. With rejection rate approaching 70 per cent and the manuscript flow rising continuously, it is hard to imagine the hard start-up period of the journal. Even to maintain a very modest publication rate of just four or five issues of the journal we had to be innovative. I initiated the idea of theme issues with expert Guest Editors who were interested in specific areas of drying and had the necessary network limited to those areas. Indeed, I guest-edited the first two such issues dealing with drying of pulp and paper and enlisted co-editors from the relevant industry. This concept was later expanded to many other areas and over the past decade this has been our normal mode of operation. Drying Technology may well have been the first journal to issue theme issues over two decades ago. Another innovation was to publish a book on a specific topic of drying as a theme issue. Professor R. Toei's book was translated from Japanese to English by Prof. Wiwut of Thailand, and published as a full issue. Another idea originated by Dr. Hall was to reprint a couple of classical papers from 1940's that were not read by most drying researchers of 70's and 80's.

The role of referees to maintain high quality of any journal cannot be overstressed. Because of the limited number of drying experts in the west, this was a massive challenge, especially since most of our authors came from non-English speaking countries. Referees had the dual role of examining the technical quality and also make the necessary revision to the English text since the papers after acceptance were simply reprinted from camera-ready manuscripts. It was not unusual for Prof. Mujumdar to rewrite full papers and Mrs. Purnima Mujumdar to retype

manually full papers- all totally volunteer effort in the name of service to the professional society. Those with extensive mathematical expressions were truly massive effort that today's authors cannot even imagine.

The second phase of the journal during 1990-2000 saw an appreciable rise in manuscript flow from English-speaking nations unlike the first phase. A number of international drying conference series emerged around the world which gave impetus to the journal. The peer review process was broadened and tightened. Authors began to look at impact factors and citations. As a technology journal in an area where academic research activity in English-speaking countries was still sporadic it was hard to raise the impact factor significantly as the funding agencies also neglected the area despite its obvious significance to industrial energy conservation and emissions control. Prof. Mujumdar became aware of the fact that most faculty members were simply unaware of the real problems in industrial drying technologies. He wrote a number of articles outlining the need for innovation and suggested where gaps existed in knowledge of drying. He invited experts in various drying fields to write articles reviewing the state-of-the-art in their area so young faculty may find ready access to research problems worthy of challenging research. He also promoted international networking and academia-industry interaction. This clearly worked as the current third phase shows a near-explosive growth in manuscript flow which resulted in raising the number of issues to 16 per annum- over an order-of-magnitude growth relative to its initial state- along with exceptional selectivity and high quality R&D results. Indeed, we are pleasantly surprised at the rise in interest in drying R&D on a globally-averaged scale. It is clear that the need to save energy and reduce the carbon footprint without compromising on product quality and safety of operation will drive this effort for at least a decade longer. There will be new major areas that will emerge as a result of the major issues related to the nexus of food, energy and water- all areas somehow connected to drying technologies in obvious and not-so-obvious ways. For example, drying of wet low rank coal as a way to upgrade it is a new R&D problem although both LRC and drying technologies for such materials have been around for a very long time. Drying of nanotechnology products, new biotech products etc also pose new R&D challenges.

To encourage research in drying, Drying Technology journal published a theme issue just on R&D Needs and Opportunities in Drying in 1996. Prof. Mujumdar has given on a regular basis a number of keynote lectures identifying research areas in drying that are worthy of serious R&D. These efforts have shown positive results with many readers picking up on ideas and suggestions in these papers. In fact several Drying R&D Centers evolved at several universities once they were convinced of the long term viability of drying research. General lack of access to relevant literature has been a deterrent in the past. With easy access through the internet the situation has improved considerably. However, competition from other fields and reduced R&D resources will continue to make it difficult to attract new researchers to the field. Senior

researchers in drying need to make special effort to encourage and guide younger researchers to the field. Industry needs to provide tangible support which will eventually benefit their own bottom line with improved efficiency, safety and reduced environmental impact via innovative drying technologies found in almost all industrial sectors.

Another avenue that Prof. Mujumdar followed to raise the journal profile is that he himself published many of his high quality papers in the journal after peer review to convince others to do the same. He used the familiar line: “Ask what you can do for the journal rather than what the journal can do for you”. It worked to some extent. The following table clearly shows the outcome. As the readers will see, the Pereto Principle applies in this case as well with a smaller number of dedicated authors contributed lion’s share to the emergence of the journal as one of the top journals with high impact. Following the well known Mathew Principle, as recognized researchers contributed to the journal with increasing frequency, a large number of other authors followed suit. The resulting selectivity and rise in publication threshold contributed to the current happy state of this journal.

Table 1 lists the top 10 contributors of Drying Technology Journal. It is interesting to note that Canada has been a huge contributor to the effort followed by Greece and Australia. China and Thailand have also made major contribution and the Asian share of the contribution is expected to rise in the coming decade. Cumulatively, Europe has been a solid contributor during the second phase and the effort came from several countries notably Germany, France, Poland, Sweden etc. In recent decade the contributions from USA and Japan has declined precipitously while those from Brazil and Iran show dramatic rise. This is not reflected in the following table for obvious reasons.

Table 1. Top 10 contributors to Drying Technology Journal (source – ISI web of science; last accessed on March 11, 2012).

Name of the author	No of papers published in LDRT
Mujumdar A.S., Canada/Singapore	198
Langrish T., Australia	52
Soponronnarit S. Thailand	44
MAROULIS Z. , Greece	42
Raghavan G.S.V., Canada	42
Zhang Min ,China	40
Kudra T.,Canada	38
FREIRE J. T., Brazil	34
Chen X. D.,China/Australia	33
KIRANOUDIS , Greece	29

Much tangible support from the Editor-in-Chief was necessary for the journal to flourish. In fact, this journal has been the only archival outlet for engineering papers focusing on drying. This philosophy that showed our personal confidence of the long term viability of the journal in fact has proven effective. The two year impact factor of the journal has been rising continuously as seen from Figure 1. Not shown here is the half-life of the journal papers; it is rather high as our papers continue to attract attention for a very long time after they appear. In 2011 it crossed 2.0 which is a remarkable feat for a technology journal. It now ranks amongst top 15 in the mechanical engineering category. In our opinion this is not truly reflection of our real impact for it underestimates the true impact or value of this publication. As a technology journal we meet the needs of academia as well as industry. The latter do not publish papers; they benefit from results we publish, however. Unfortunately, we have no known measure of this impact but there are many anecdotal examples showing the industrial value of our journal. Lack of major funding for drying R&D also limits the number of publications in this area, Hence, a high impact factor comparable to medical or science journals will never be possible for technology journals despite their high industrial impact.

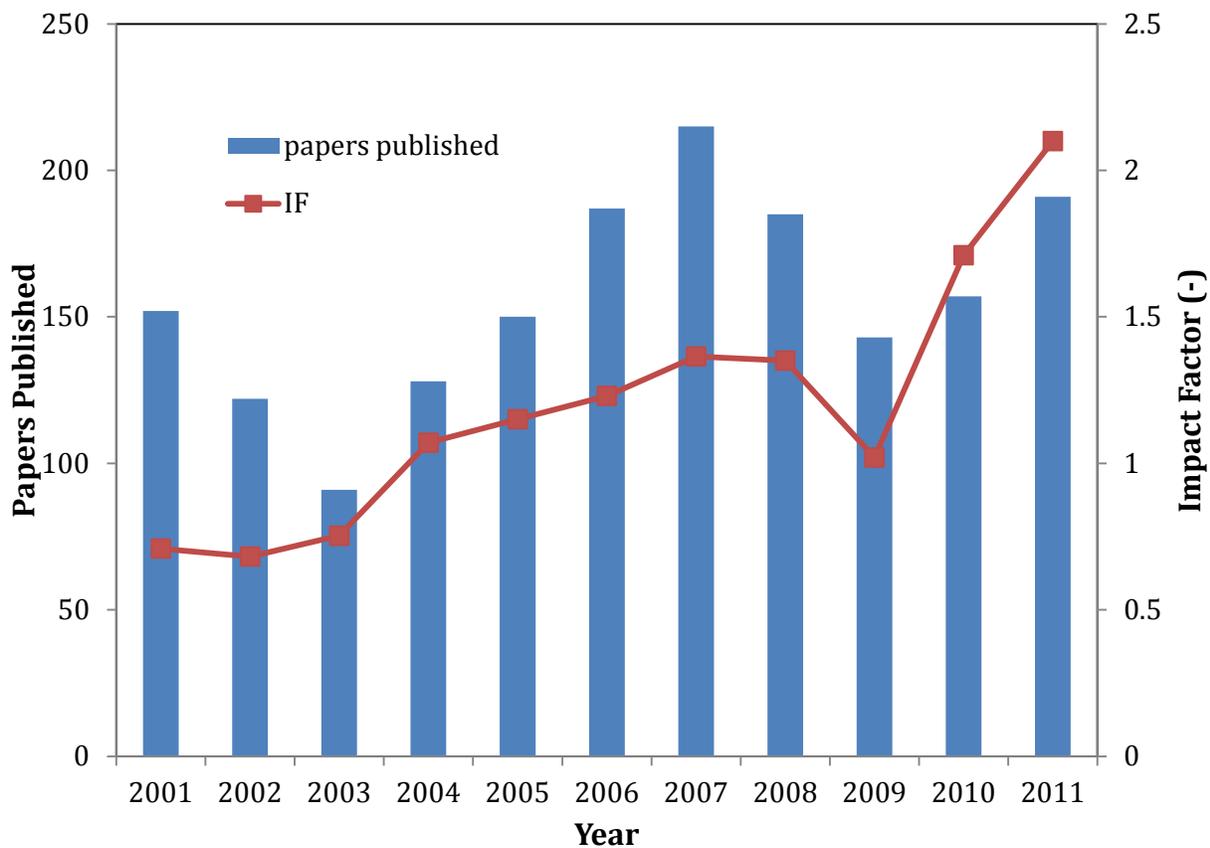


Figure 1. Total no of articles published and Impact factor for Drying Technology Journal (source – ISI web of science; last accessed on March 11, 2012.)

For 2011 the impact factor is estimated to be around 2.1

With increase in global interest in drying R&D with authors originating from about 90 countries over the years, we feel that the journal is serving a valuable purpose. Table 2 shows the top 10 contributing countries to drying technology journal. So far the journal has published over 4500 refereed papers and continues to draw a strong manuscript flow. We think that the impact of the journal goes beyond impact factors and citations. It has contributed to innovation in drying technologies and increased awareness of the significance of drying R&D in industrial operations. Users of drying equipment now quiz vendors of dryers and enforce some degree of innovation and improved performance.

Table 2. Top contributing countries to Drying Technology Journal (source – ISI web of science; last accessed on March 11, 2012).

Country	Overall contribution	Contribution from 2006-2011
Canada	346	90
China	230	115
France	223	49
Brazil	184	82
Poland	180	47
Australia	161	65
Singapore	152	91
Thailand	113	51
India	111	58
Spain	77	30

Finally, the role of China in the development of Drying R&D is worth chronicling. As early as 1984 –when the 4th IDS viz. IDS84 was held in Kyoto- Prof. Mujumdar was invited by the Ministry of Light Industry of China to deliver in Tianjin a 7-day not-so-short course to faculty members and industry personnel from all over China. This was organized at the Tianjin Institute of Light Industry- now expended enormously and renamed Tianjin University of Science & Technology. The title of the workshop was Drying Technologies- Principles & Practice. This perhaps gave a stimulus to drying R&D in many Chinese universities who collaborated with industry to develop their own drying technologies. Now there are many drying equipment manufacturers in China that make world-class drying equipment to meet the massive demand within China and also for export. They also hold regular biennial conferences devoted to drying technology. A journal on drying also publishes regularly which has focus on applications. Interestingly, Prof. Mujumdar presented the first ever published hard copy of his Handbook of Industrial Drying published by Marcel Dekker in 1984 to Professor Long who was President of Tianjin Institute of Light Industries. In later visits he recommended that Chinese experts in

drying produce their own Handbook of Drying-which they did very effectively and in fact this book has also gone into second edition. China and authors of Chinese origin have made very extensive contributions to Drying Technology journal (as can be seen from Table 2) as well as IDS. Many were mentored by Prof. Mujumdar at McGill University and the National University of Singapore. He also co-advises- and continues to do so- a large number of doctoral students at Jiangnan University in Wuxi as well. Overall China has made a major recognizable contribution to drying technology R&D consistent with its growing stature as an industrial and economic powerhouse.