@ Changzhou, China

Plenary Talk

Five Decades of Drying R&D - Personal Perspective on Chinese Contribution to Global Knowledge Generation and Dissemination

- **Prof. Arun S. Mujumdar**

  McGill University, Montreal, Canada

  www.arunmujumdar.com

- **Dr. Shivanand S. Shirkole**

  D. Y. Patil Agriculture and Technical University,

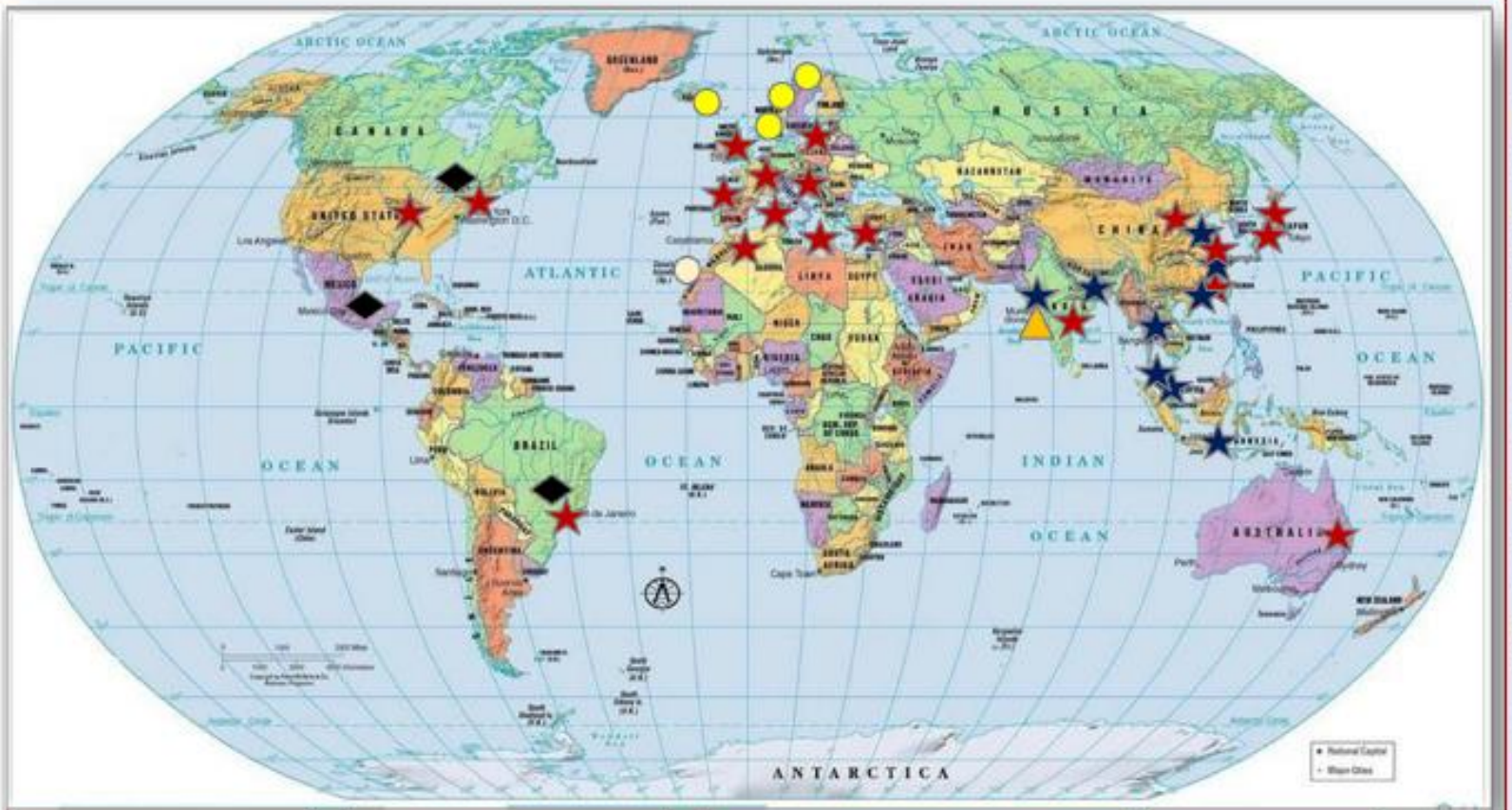
  Talsande, Kolhapur, India.

ADC-CDC2025 Plenary Talk: Outline

- Establishment of ADC: Journey of Global Drying R&D
- Summary of Publications in Drying Technology – An International Journal
- Some Key Observations About Drying Conferences
- China's Global Impact: Key Facts (Short)
- ASM's Efforts in Drying Science & Technology
- A Success Story of International Cooperation in Research
- Future Challenges
- Closing Remarks: Future of Drying R&D on a Global Scale

Journey of Global Drying R&D

Journey of Global Drying R & D



NDC

Iceland
Trondheim
Karlstad
Copenhagen

IADC

Montreal
Veracruz
Sao Paolo

IWSID/WFCFD

Mumbai (11)

IC-DSD

Morocco

IDS

Boston
Montreal (3)
Birmingham
Noordwijkerhout
Versailles
Prague
Krakow
Thessaloniki
Budapest
Magdeburg
Sao Paulo
Lyon
Beijing
Kyoto
Gifu
Gold coast
Xiamen
Hyderabad
Wuxi, China
Illinois, USA
Wuxi, China

ADC

1st 1999, Bali, Indonesia

2nd 2001, Penang, Malaysia

3rd 2003, Bangkok, Thailand

4th 2005, Kolkata, India

5th 2007, Hong Kong, China

6th 2009, Bangkok, Thailand

7th 2011, Tianjin, China

8th 2015, Kuala Lumpur, Malaysia

9th 2017, Wuxi, China

10th 2019, Vadodara, India

11th 2023, Kolkata, India

12th 2025, Changzhou, China ✓

Summary of Publications in Drying Technology –

An International Journal

Drying Technology – An International Journal

Journal metrics

Source: Scopus, Oct 2025

Usage

- **257K** annual downloads/views

Citation metrics

- **2.7 (2024)** Impact Factor
- **Q2** Impact Factor Best Quartile
- **3.4 (2024)** 5 year IF
- **7.1 (2024)** CiteScore (Scopus)
- **Q1** CiteScore Best Quartile
- **1.086 (2024)** SNIP
- **0.668 (2024)** SJR

Speed/acceptance

- **0** days avg. from submission to first decision
- **50** days avg. from submission to first post-review decision
- **11** days avg. from acceptance to online publication
- **32%** acceptance rate

Summary of Publications in Drying Technology – An International Journal

Scopus: Publications Stat

Source: Scopus, Oct 2025

Drying Technology

Years currently covered by Scopus: 1983, from 1985 to 2025

Publisher: Taylor & Francis

ISSN: 0737-3937 E-ISSN: 1532-2300

Subject area: Chemical Engineering: General Chemical Engineering | Chemistry: Physical and Theoretical Chemistry

Source type: Journal

CiteScore 2024

$$7.1 = \frac{5{,}246 \text{ Citations } 2021 - 2024}{738 \text{ Documents } 2021 - 2024}$$

Calculated on 05 May, 2025

CiteScoreTracker 2025

$$6.2 = \frac{4{,}303 \text{ Citations to date}}{689 \text{ Documents to date}}$$

Last updated on 05 August, 2025 • Updated monthly

Summary of Publications in Drying Technology – An International Journal

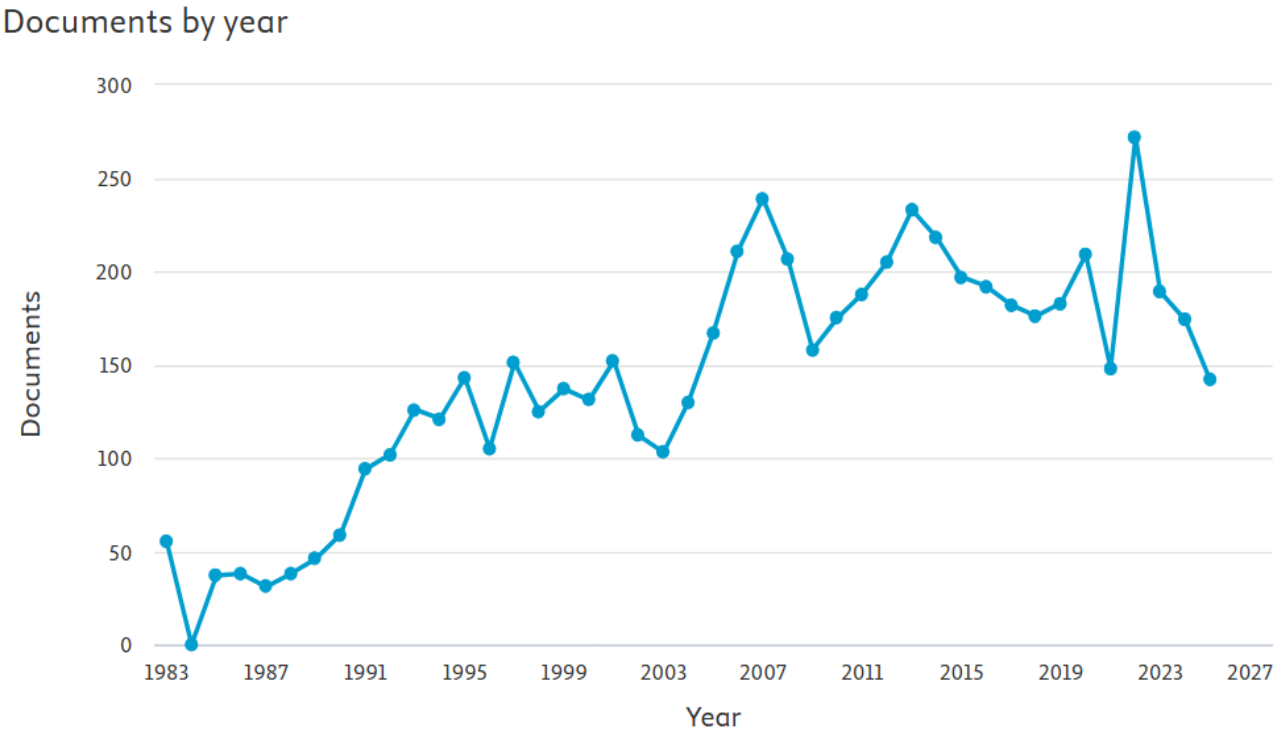
Documents by Year

Source: Scopus, Oct 2025

6,101 document results

Select year range to analyze: 1983 to 2025 Analyze

Year	Documents
2025	142
2024	174
2023	189
2022	272
2021	148
2020	209
2019	183
2018	176
2017	182

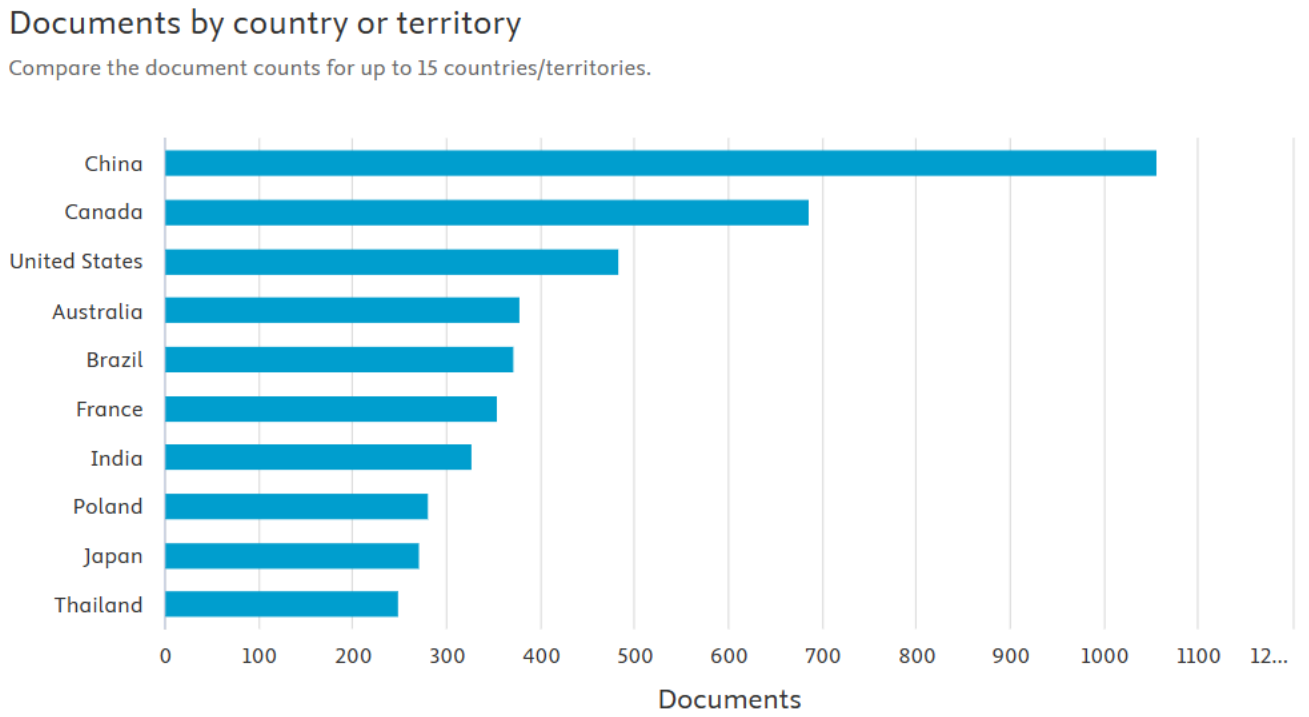


Summary of Publications in Drying Technology – An International Journal

6,101 document results

Select year range to analyze: 1983 to 2025 Analyze

Country/Territory	Documents
China	1054
Canada	684
United States	482
Australia	377
Brazil	371
France	352
India	325
Poland	279
Japan	269



Documents by Country

Source: Scopus, Oct 2025

Summary of Publications in Drying Technology – An International Journal

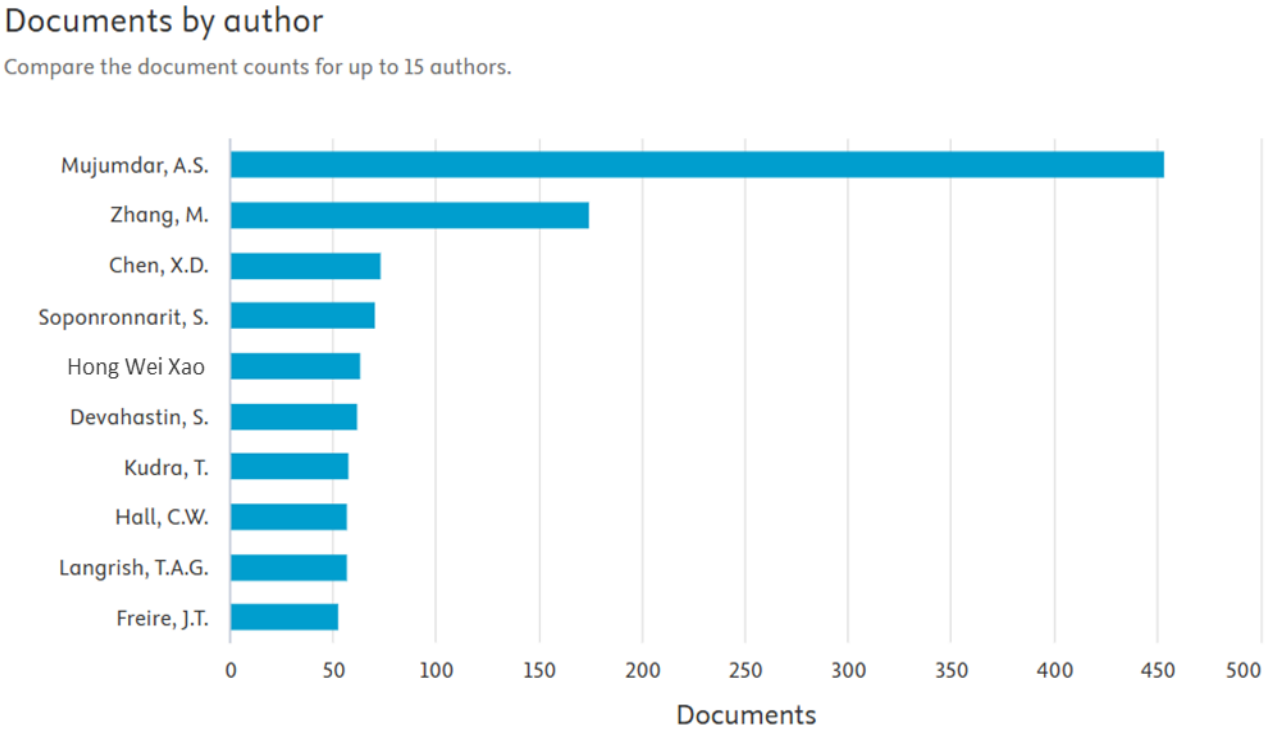
Documents by Authors

Source: Scopus, Oct 2025

6,101 document results

Select year range to analyze: 1983 to 2025 Analyze

Author	Documents
Mujumdar, A.S.	453
Zhang, M.	174
Chen, X.D.	73
Soponronnarit, S.	70
Hong Wei Xao	63
Devahastin, S.	61
Kudra, T.	57
Hall, C.W.	56
Langrish, T.A.G.	56



Summary of Publications in Drying Technology – An International Journal

Top 3 Cited Articles that are Published in 2015-2025

Source: Scopus, Oct 2025

Sort by Cited by (highest)

	Documents	Year	<2000	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
	Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**85**	**444**	**1,065**	**36,640**
1	Encapsulation and delivery of bioactive co...	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	287
2	Red pepper (Capsicum annuum L.) drying: ...	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	252
3	Technical and economic analysis of solvent...	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	239

Article DOI	Publication Year	Total Citation	Corresponding Author
https://doi.org/10.1080/07373937.2019.1653906	2020	287	Emam-Djomeh, Zahra
https://doi.org/10.1080/07373937.2017.1361439	**2018**	**252**	**Hong Wei Xiao**
https://doi.org/10.1080/07373937.2017.1319855	2018	239	David L. Wood

Contribution by China to Drying Technology – An International Journal

Contribution by China to Drying Technology – An International Journal

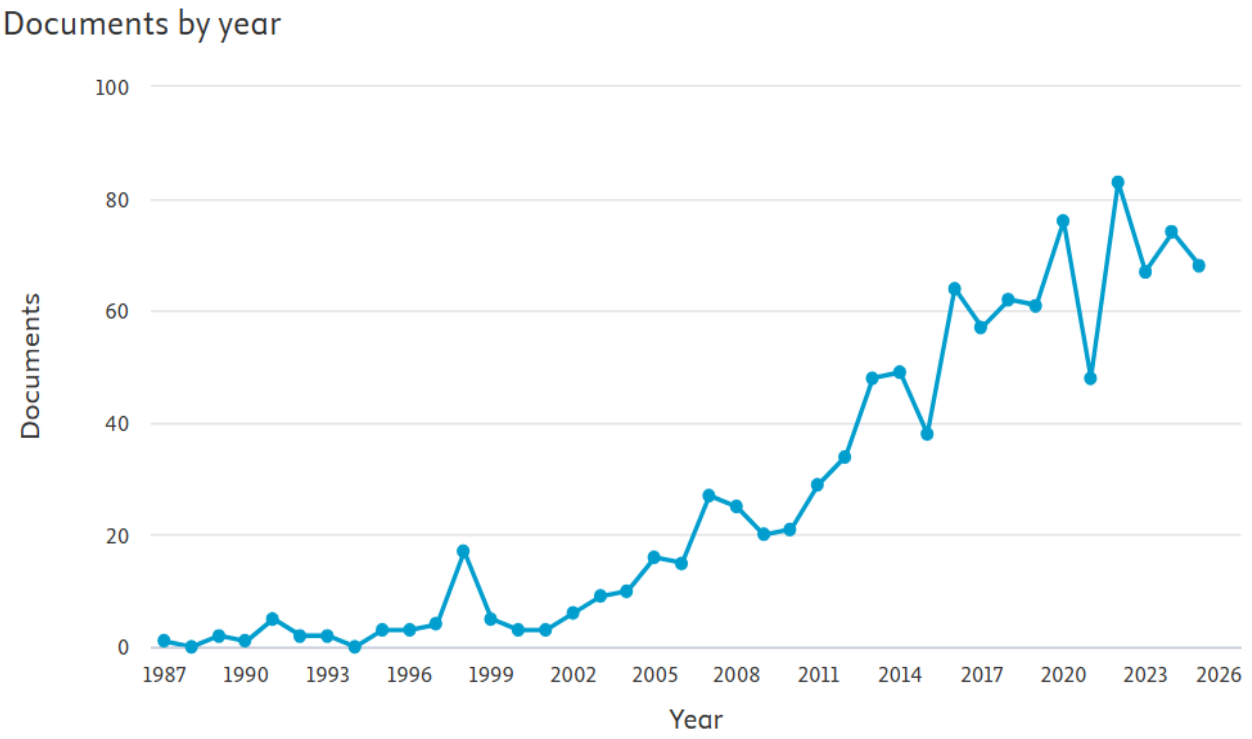
Documents by Years

Source: Scopus, Oct 2025

1,058 document results

Select year range to analyze: 1987 to 2025 Analyze

Year	Documents
2025	68
2024	74
2023	67
2022	83
2021	48
2020	76
2019	61
2018	62
2017	57



Contribution by China to Drying Technology – An International Journal

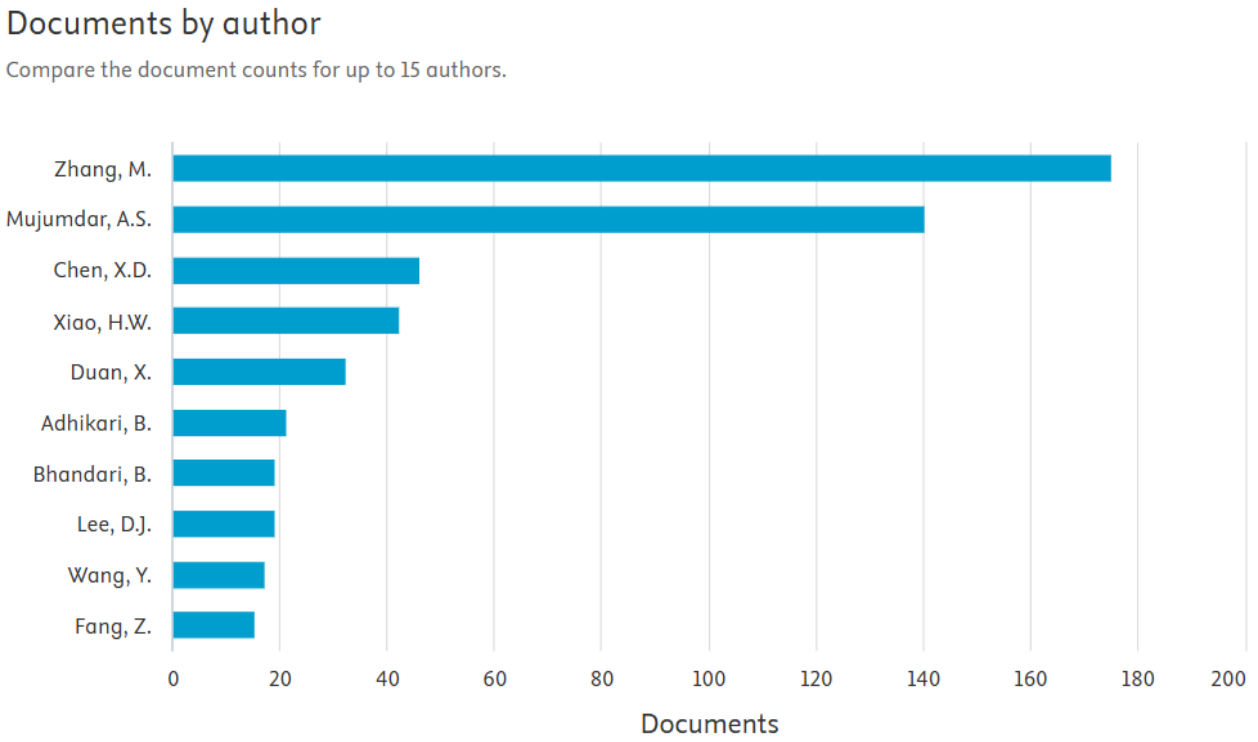
Documents by Authors

Source: Scopus, Oct 2025

1,058 document results

Select year range to analyze: 1987 to 2025 Analyze

Author	Documents
Zhang, M.	175
Mujumdar, A.S.	140
Chen, X.D.	46
Xiao, H.W.	42
Duan, X.	32
Adhikari, B.	21
Bhandari, B.	19
Lee, D.J.	19
Wang, Y.	17



Contribution by China to Drying Technology – An International Journal

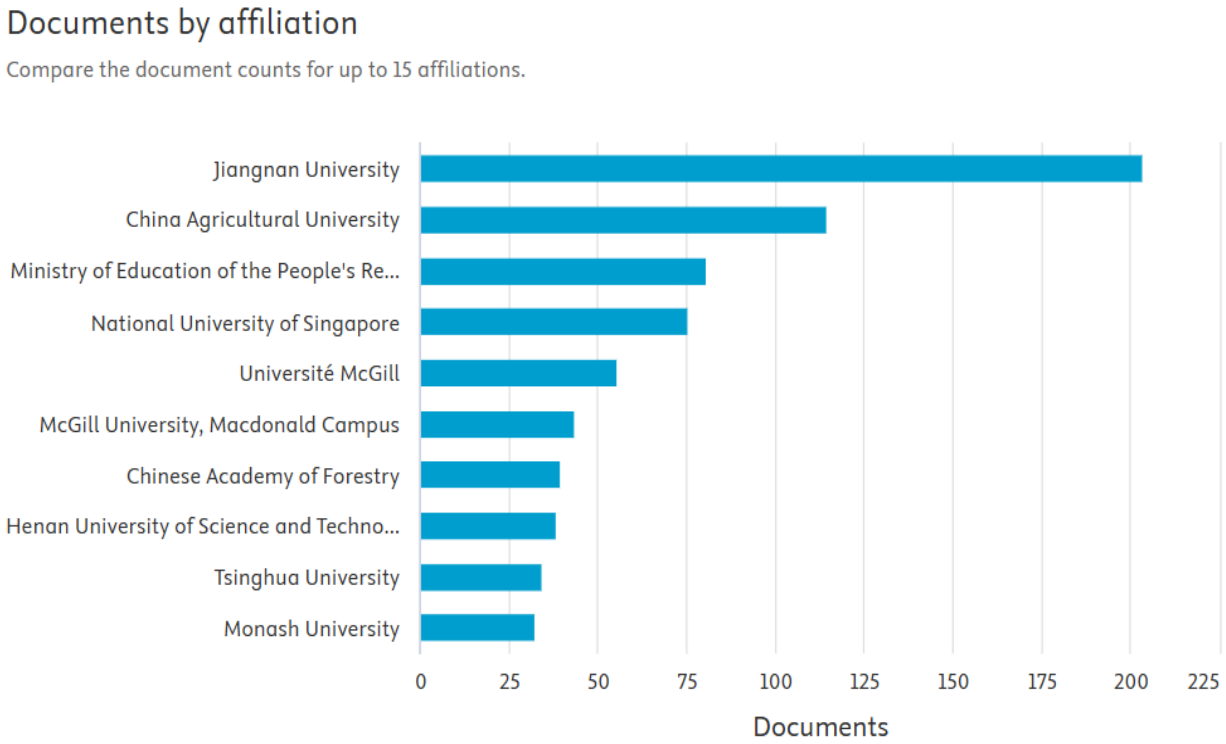
Documents by Affiliation

Source: Scopus, Oct 2025

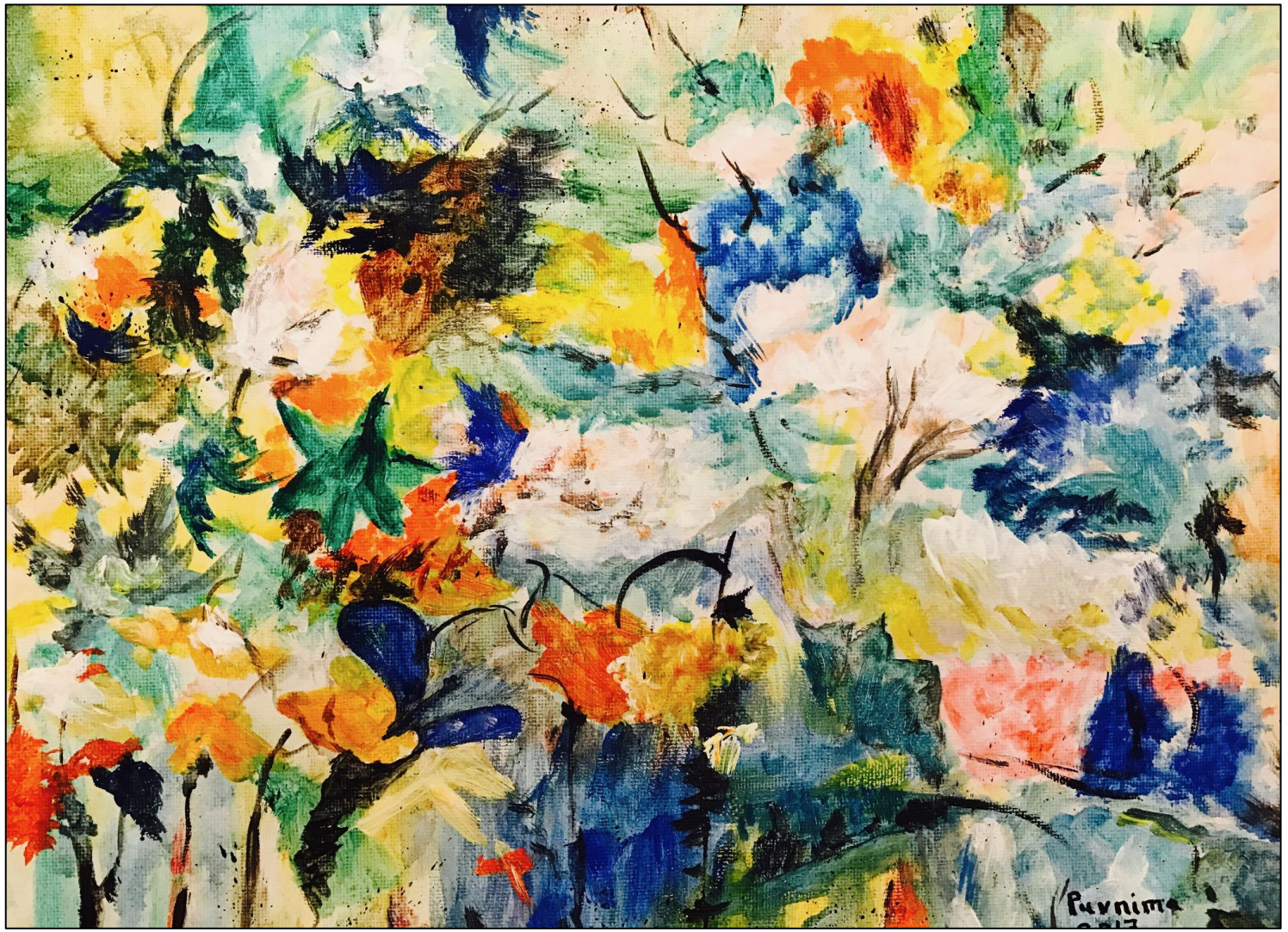
1,058 document results

Select year range to analyze: 1987 to 2025 Analyze

Affiliation	Documents
Jiangnan University	203
China Agricultural University	114
Ministry of Education of the People's Republic of China	80
National University of Singapore	75
Université McGill	55
McGill University, Macdonald Campus	43
Chinese Academy of Forestry	39
Henan University of Science and Technology	38



Articles Published on MW Drying/ Heating in LDRT



Articles Published on MW Drying/Heating in LDRT

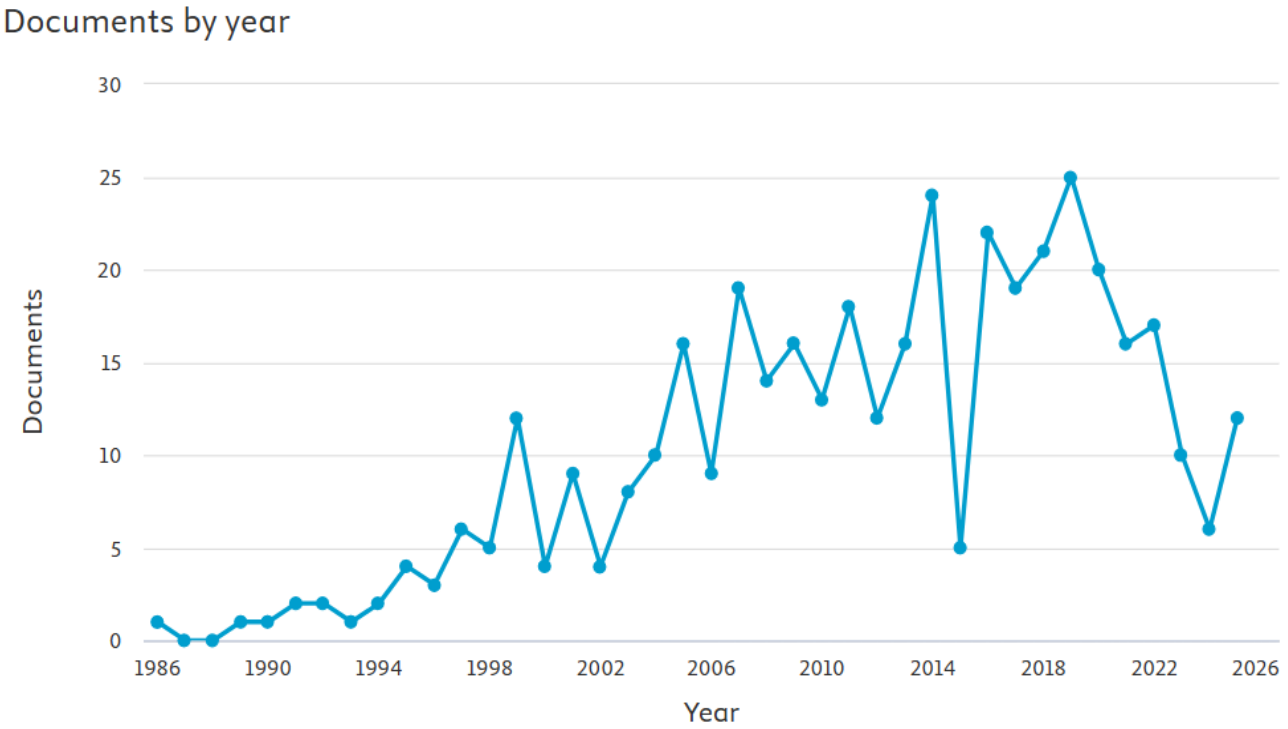
Documents by Year

Source: Scopus, Oct 2025

405 document results

Select year range to analyze: 1986 to 2025 Analyze

Year	Documents
2025	12
2024	6
2023	10
2022	17
2021	16
2020	20
2019	25
2018	21
2017	19



Articles Published on MW Drying/Heating in LDRT

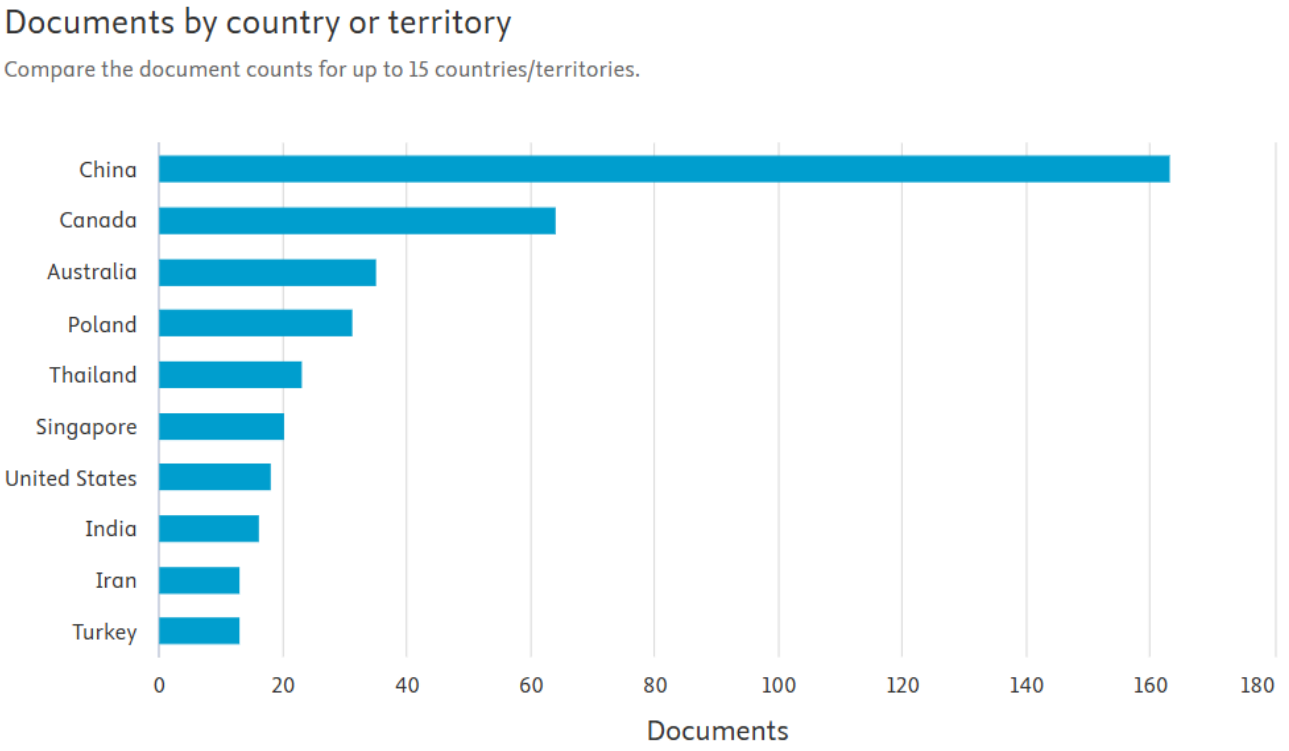
Documents by Country

Source: Scopus, Oct 2025

405 document results

Select year range to analyze: 1986 to 2025 Analyze

Country/Territory	Documents
China	163
Canada	64
Australia	35
Poland	31
Thailand	23
Singapore	20
United States	18
India	16
Iran	13



Articles Published on MW Drying/Heating in LDRT

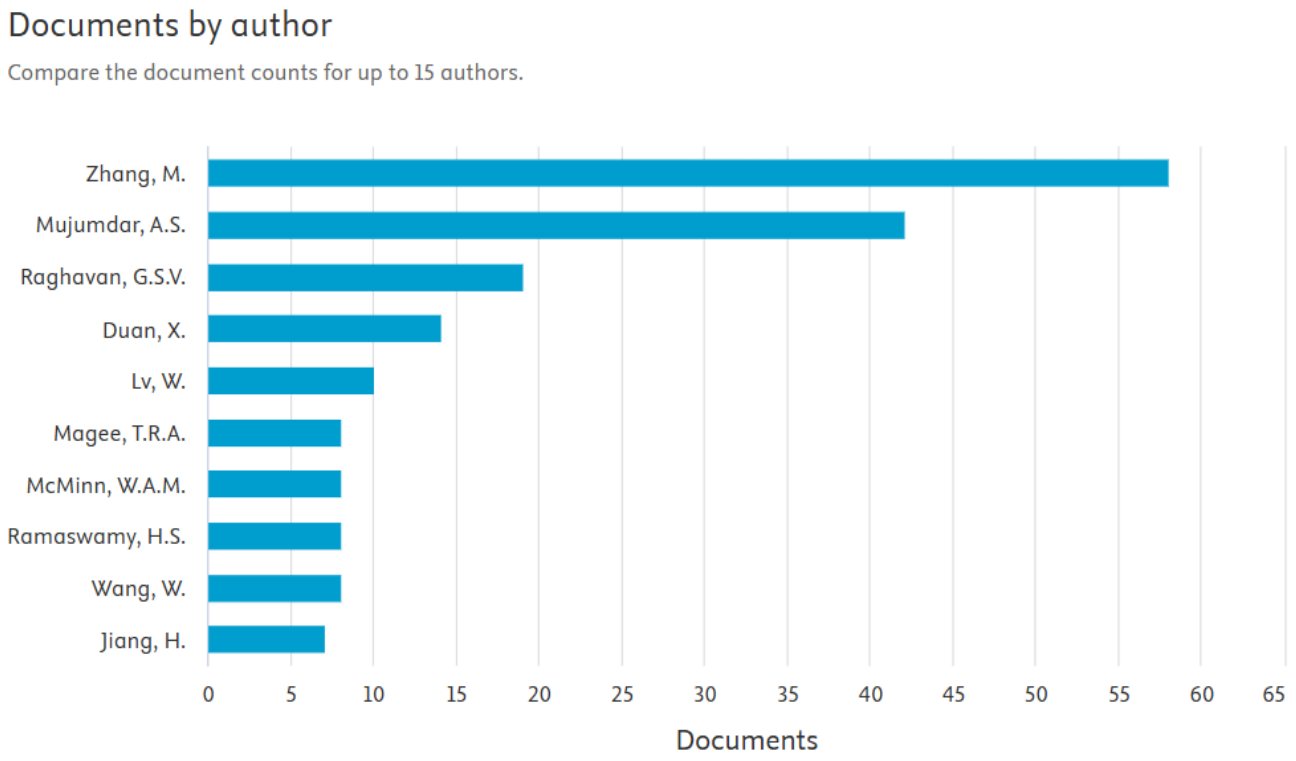
Documents by Author

Source: Scopus, Oct 2025

405 document results

Select year range to analyze: 1986 to 2025 Analyze

Author	Documents
Zhang, M.	58
Mujumdar, A.S.	42
Raghavan, G.S.V.	19
Duan, X.	14
Lv, W.	10
Magee, T.R.A.	8
McMinn, W.A.M.	8
Ramaswamy, H.S.	8
Wang, W.	8



Some Key Observations

About Drying Conferences

Some Key Observations About Drying Conferences

- Only IDS, ADC have had a long life as international drying conferences. CDC is the only National series still going strong.
- Numerous other series have had shorter runs, but they, too, have contributed to the promotion of drying R&D in local regions
- Proceedings of IDS have been a major source for the dissemination of drying literature during 1980-1990.
- Global cooperation and networking increased as a direct result of the biennial meetings in different parts of the world

China's Global Impact: Key Facts (Short)

China's Global Impact: Key Facts (Short)

- Major growth in drying R&D, equipment manufacture, patents, etc., since 2000; now the highest contributor to Drying Technology journal, IDS, CDC, etc.
- **Prof. Min Zhang** of Jiangnan University is the highest contributor to the archival literature on drying science and technology.
- **55 per cent of the global market** of drying equipment is currently around **8 Billion USD** and **growing at 6 per cent.**
- Highest number of PhDs in drying, one third of dryers now incorporate AI, smart technology.
- Enhanced efficiency, reduced emissions, more renewable energy use, and better control are features of new innovative equipment.

China's Global Impact: Key Facts (Short)

- **China's total R&D expenditure exceeded 3.613 trillion yuan in 2024** (R&D intensity ~2.68% of GDP).
- China remains the world's single largest source of patent applications/grants — Chinese-origin innovators filed ~1.64 million patent applications worldwide in 2023, and **China's patent office issued 920,797 patents in 2023**. China also had ~5 million patents in force by 2023.
- **Public spending on education in 2023 reached 6.46 trillion yuan** (education spending + higher-education component ~1.76 trillion).
- **China's economy grew by ~5.0% in 2024 (official),** providing a macroeconomic backdrop for increased investment.

Short History of Research with Research Students/ Scholars from China

Short History of Research with Research Students/Scholars from China

- Over **20 postgraduate students (MEng/PhD), 15+ Research Scholars/ Postdoctoral Fellows** from China - at **McGill (1981-2000), NUS (2000-2024).** Research areas: Math Modeling, Drying, Transport Phenomena, Renewable Energy, etc.
- **Jiangnan University collaboration since 2001 with Prof Min Zhang** - highly productive outcomes in drying and food processing
- China Agricultural University **(Prof. Hong Wei Xiao);** Tianjin University of Science & Technology **(Prof. Z. Y. Li, Prof. Wu Zhonghua).** Also, **several universities in China since 1984.**
- Outcome in the form of several hundred research publications, books, PhD theses, etc. **High level of industry interaction as well.**

ASM's Efforts in Drying Science & Technology

- Started with research on impinging jet and through **drying of paper in 1971, viz 54 years unbroken string of R&D projects- possibly a global record!!**
- **Energy crisis drove initial research, followed by consumer demand for higher quality, safety, sustainability,** etc. Dried products studied: paper, grains, seeds, foods, refractories, wood, sludge, pharmaceuticals, polymers, coal, biomass, berries, roots, coated webs, slurries, proteins, soil, etc
- Dryer types: impingement, through, packed beds, modified fluid beds, pulsed beds, vibrated beds, indirect dryers, solar/ radiation dryers, microwave dryers, ultrasonics assisted, heat pump assisted, hybrid dryers, spray dryers, superheat steam dryers, impinging streams, spouted beds, rotary dryers, encapsulation, etc. Approach: experimental, modelling, CFD, ANN, etc.
- **Recent works: AI-assisted dryers, 3D/4D printing, energy aspects, climate change effects, etc.**

A Success Story of International Cooperation in Research by Prof. Min Zhang and Prof. Arun S. Mujumdar

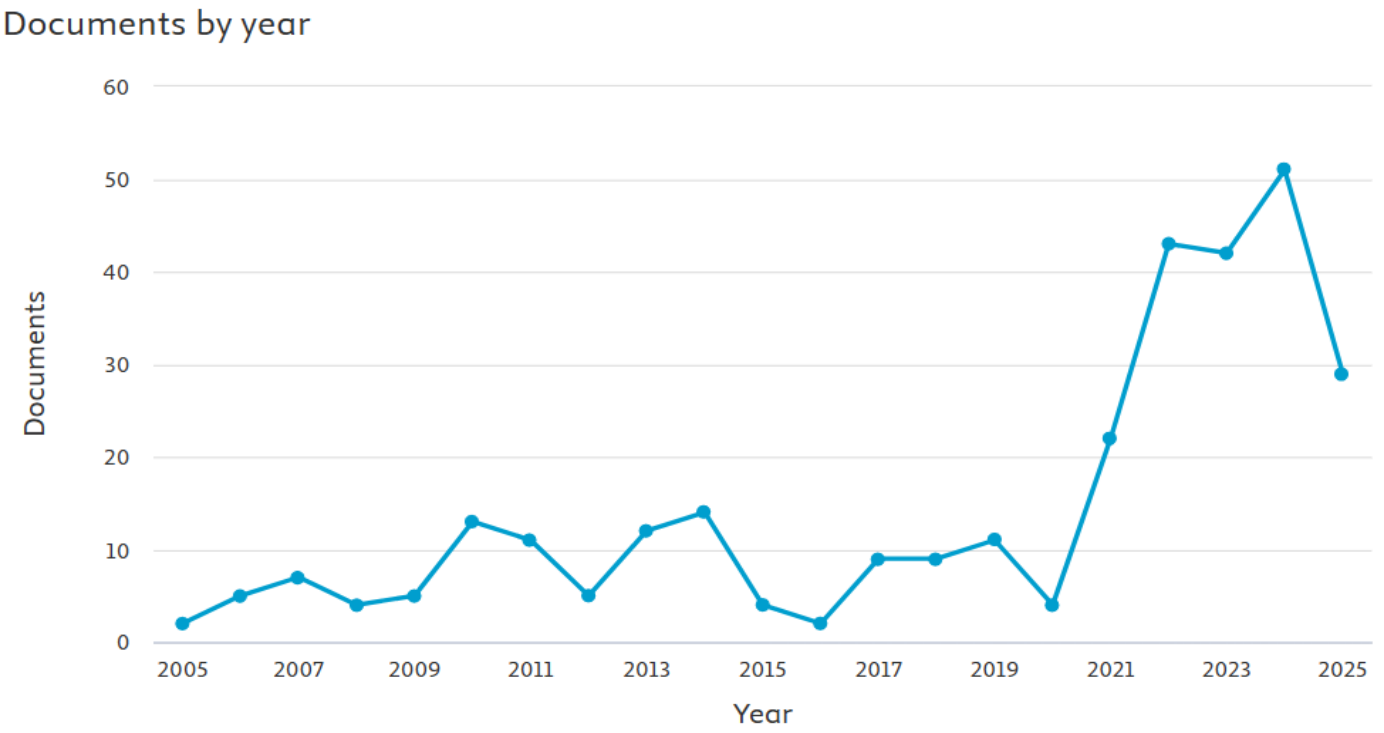
Source: Scopus, Oct 2025

A Success Story of International Cooperation in Research by Prof. Min Zhang and Prof. Arun Mujumdar

304 document results

Select year range to analyze: 2005 to 2025 Analyze

Year	Documents
2025	29
2024	51
2023	42
2022	43
2021	22
2020	4
2019	11
2018	9
2017	9



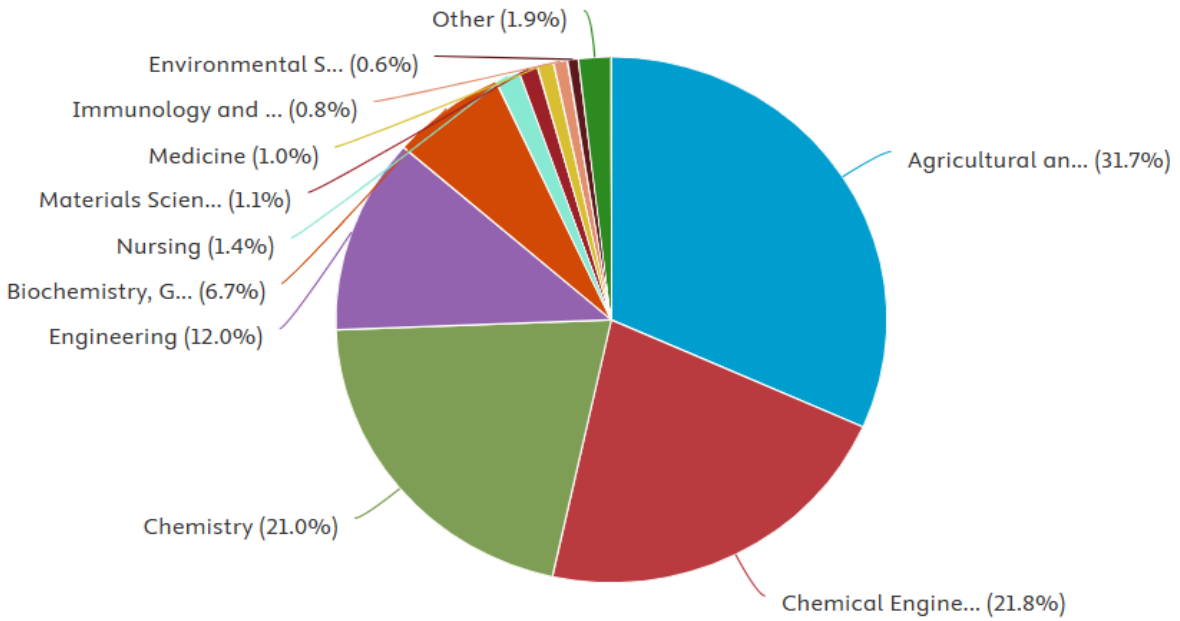
A Success Story of International Cooperation in Research by Prof. Min Zhang and Prof. Arun Mujumdar

304 document results

Select year range to analyze: 2005 to 2025 Analyze

Subject area	Documents
Agricultural and Biological Sciences	198
Chemical Engineering	136
Chemistry	131
Engineering	75
Biochemistry, Genetics and Molecular Biology	42
Nursing	9
Materials Science	7
Medicine	6
Immunology and Microbiology	5

Documents by subject area



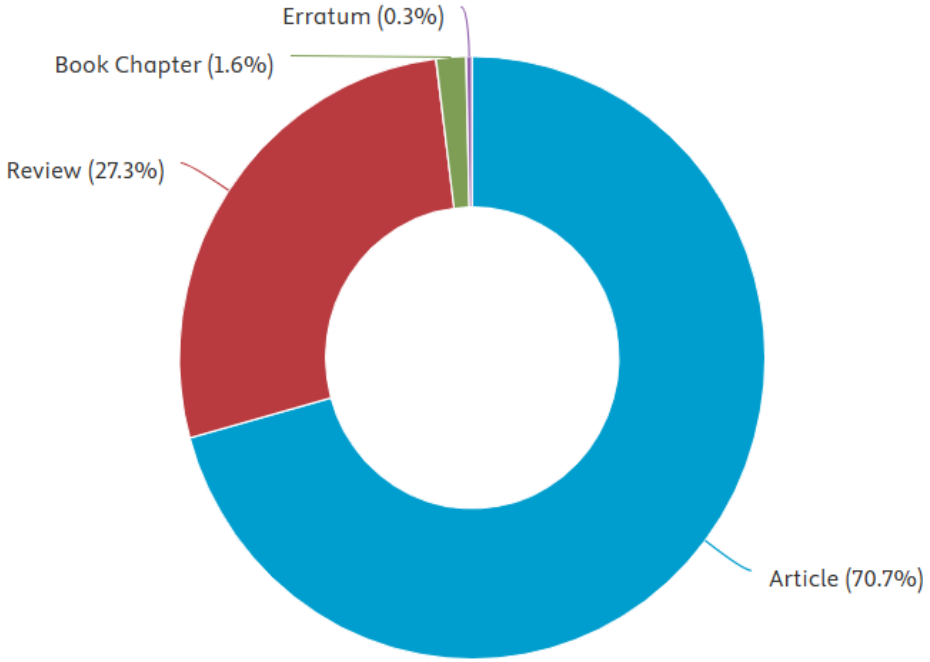
A Success Story of International Cooperation in Research by Prof. Min Zhang and Prof. Arun Mujumdar

304 document results

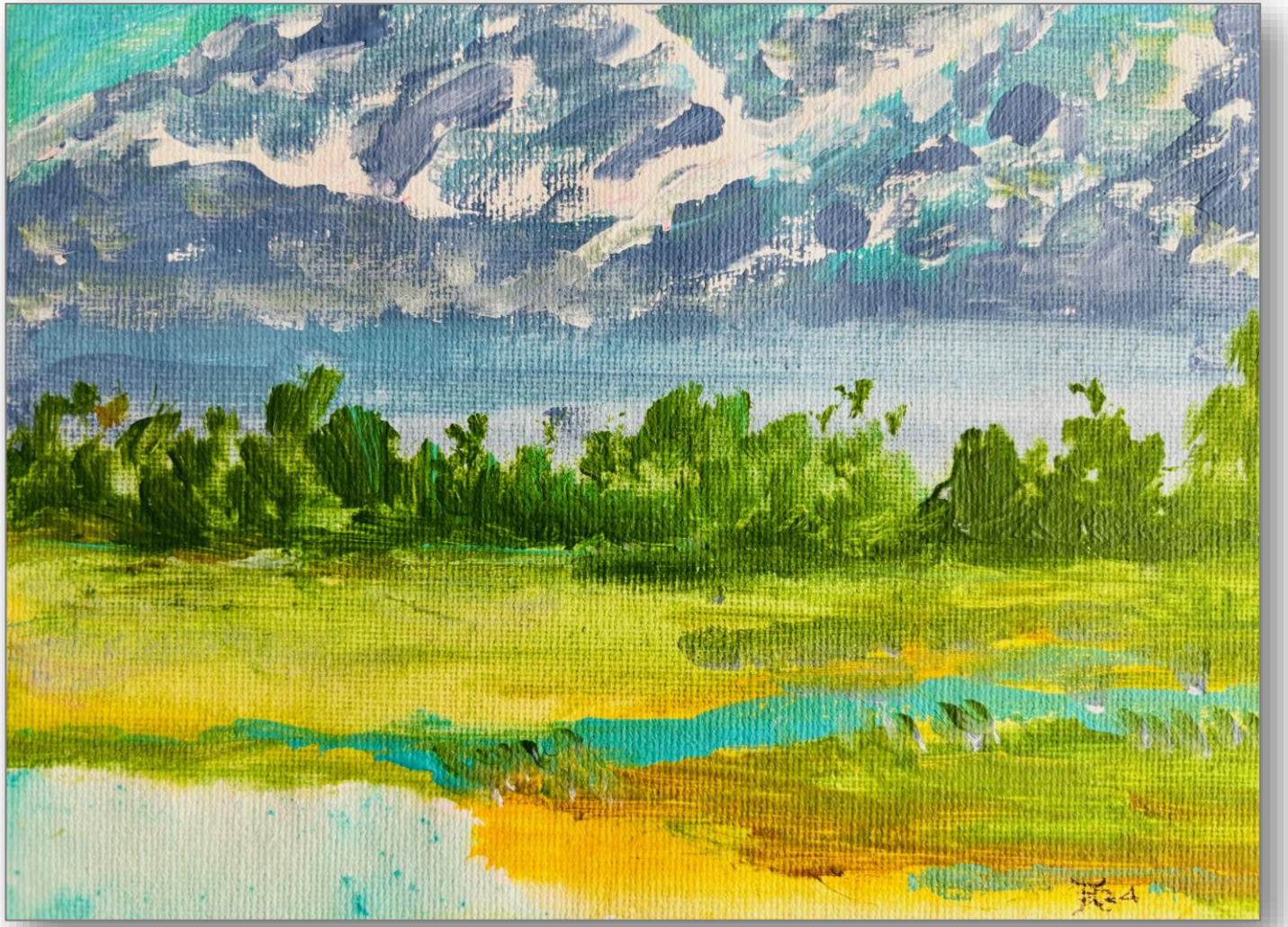
Select year range to analyze: 2005 to 2025 Analyze

Document type	Documents
Article	215
Review	83
Book Chapter	5
Erratum	1

Documents by type



Future Challenges



Future Challenges

- Most of the challenges, needs, and opportunities I listed in my previous plenary lecture still stand!

- More fundamental research - both experimental and computational modeling- is needed to design/ optimize/control industrial dryers reliably.

- Enhance the sustainability of drying operations by lowering energy consumption and utilizing renewable energy.

Closing Remarks

ADC-CDC2025 Plenary Talk: Closing Remarks

- IDS and ADC have been instrumental in promoting R&D in drying science and technology on a global scale.
- Dissemination of new knowledge generated in an international, interdisciplinary, and inter-industrial manner has enhanced the design, quality, reliability, and sustainability of modern dryers.
- Future R&D will utilize better control, AI, and ML as well as Digital Twins.
- International cooperation in science and technology is essential for faster growth of R&D.
- The establishment of IRADSTM is a major initiative that will promote industry-academia cooperation in the coming years.

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

Old Memories

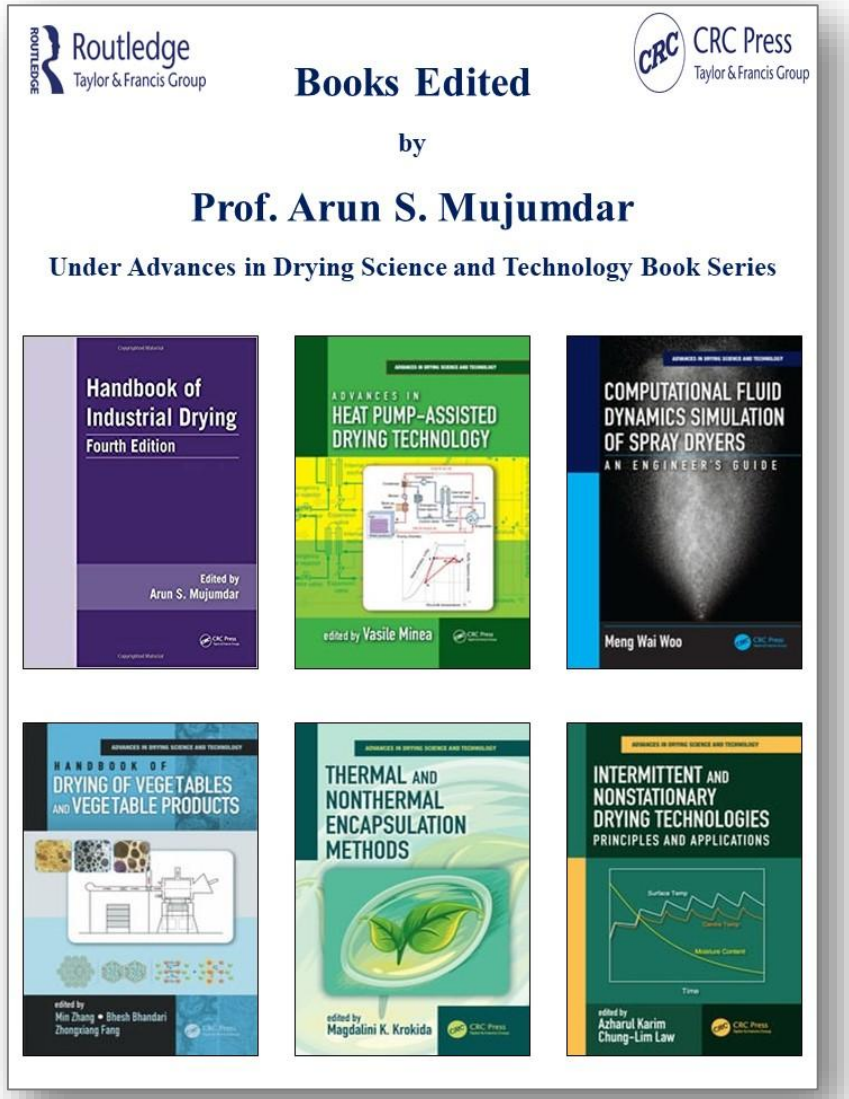
Old Memories

Old Memories

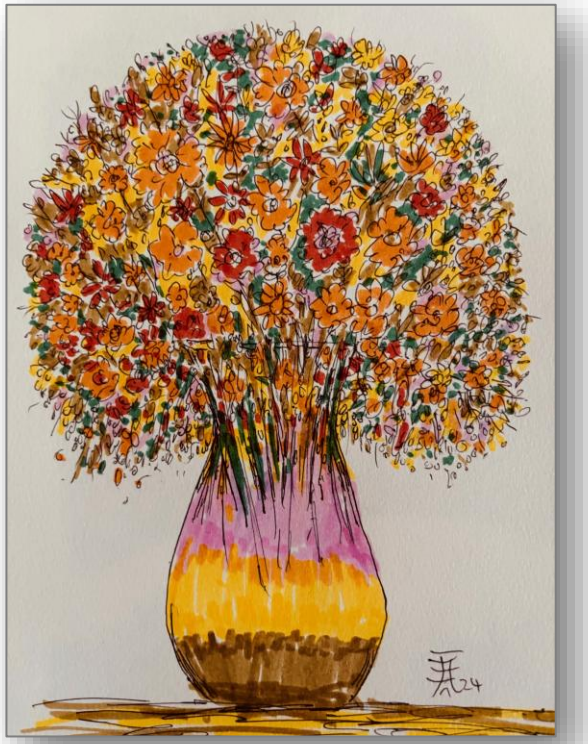
Old Memories

Old Memories

Book Series: Advances in Drying Science and Technology



Book Series: Advances in Drying Science and Technology

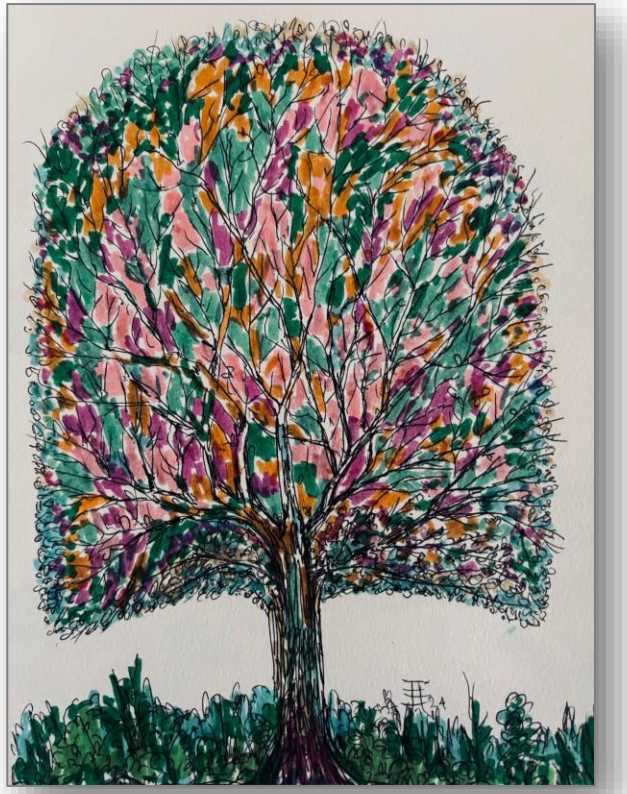


Series Editor:

Prof. Arun S. Mujumdar

Book Series: Advances in Drying Science and Technology

Book Series: Advances in Drying Science and Technology



Series Editor:

Prof. Arun S. Mujumdar

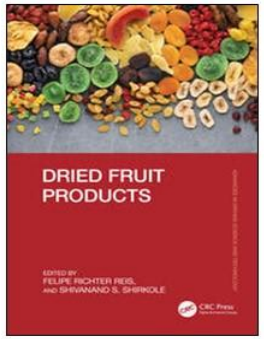
Book Series: Advances in Drying Science and Technology

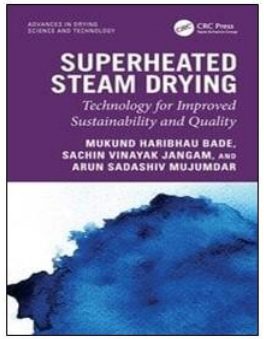
Book Series: Advances in Drying Science and Technology

Series Editor:

Prof. Arun S. Mujumdar

Book Series: Advances in Drying Science and Technology





Please Scan the QR Code for Recent Publication in Advances in Drying Science and Technology Book Series

Book Series: Advances in Drying Science and Technology

Series Editor:

Prof. Arun S. Mujumdar

Modern Drying Technology Series

Modern Drying Technology Series
(Volume I to V)
by
Prof. Evangelos Tsotsas
Prof. Arun S. Mujumdar

Volume 1: Computational Tools at Different Scales
Volume 2: Experimental Techniques
Volume 3: Product Quality and Formulation
Volume 4: Energy Savings
Volume 5: Process Intensification

Modern Drying Technology Series

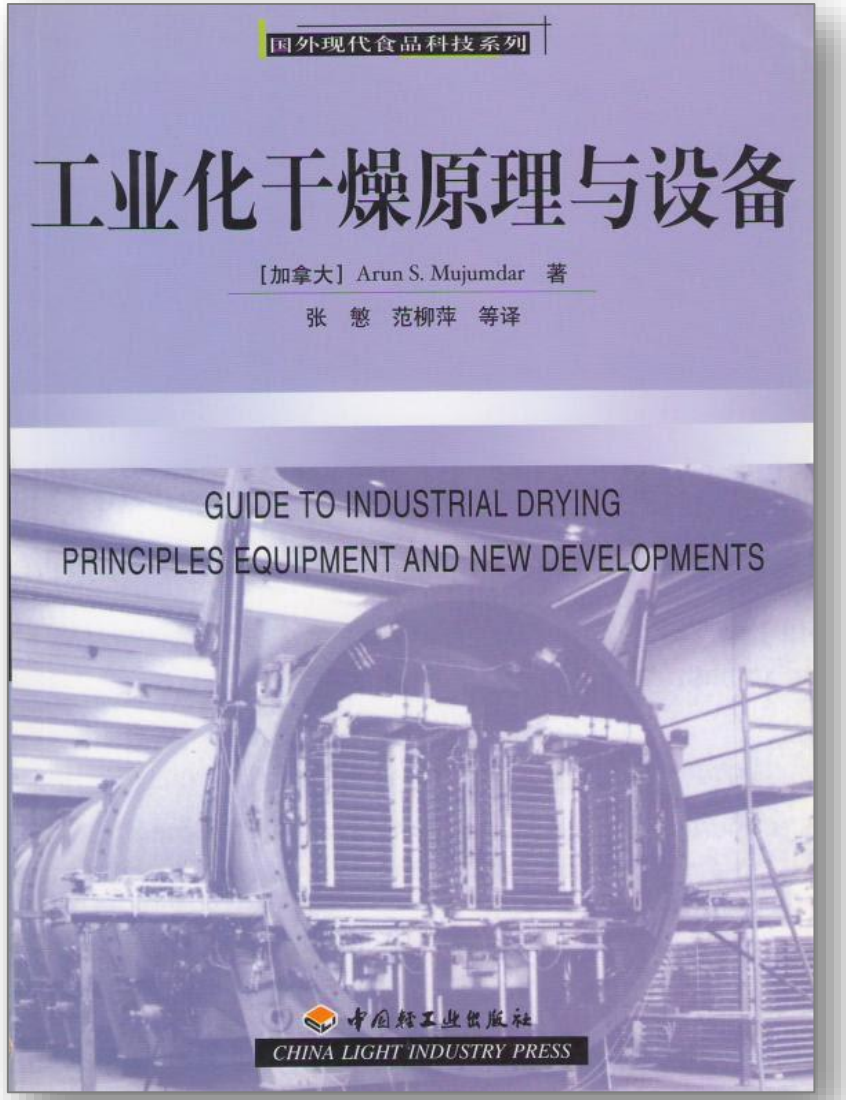
(Volume I to V)

by

Prof. Evangelos Tsotas

Prof. Arun S. Mujumdar

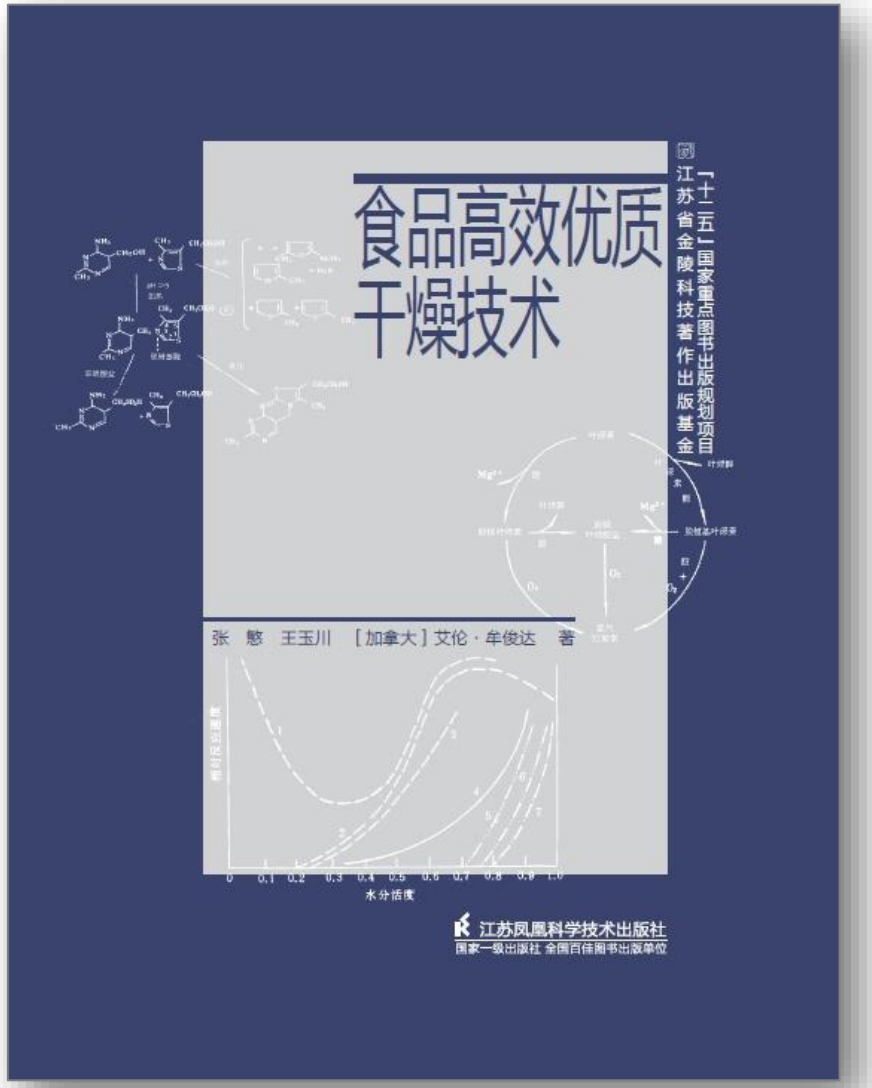
Books Published in Chinese



Chinese Translation of English Book Authored by

Prof Arun S. Mujumdar

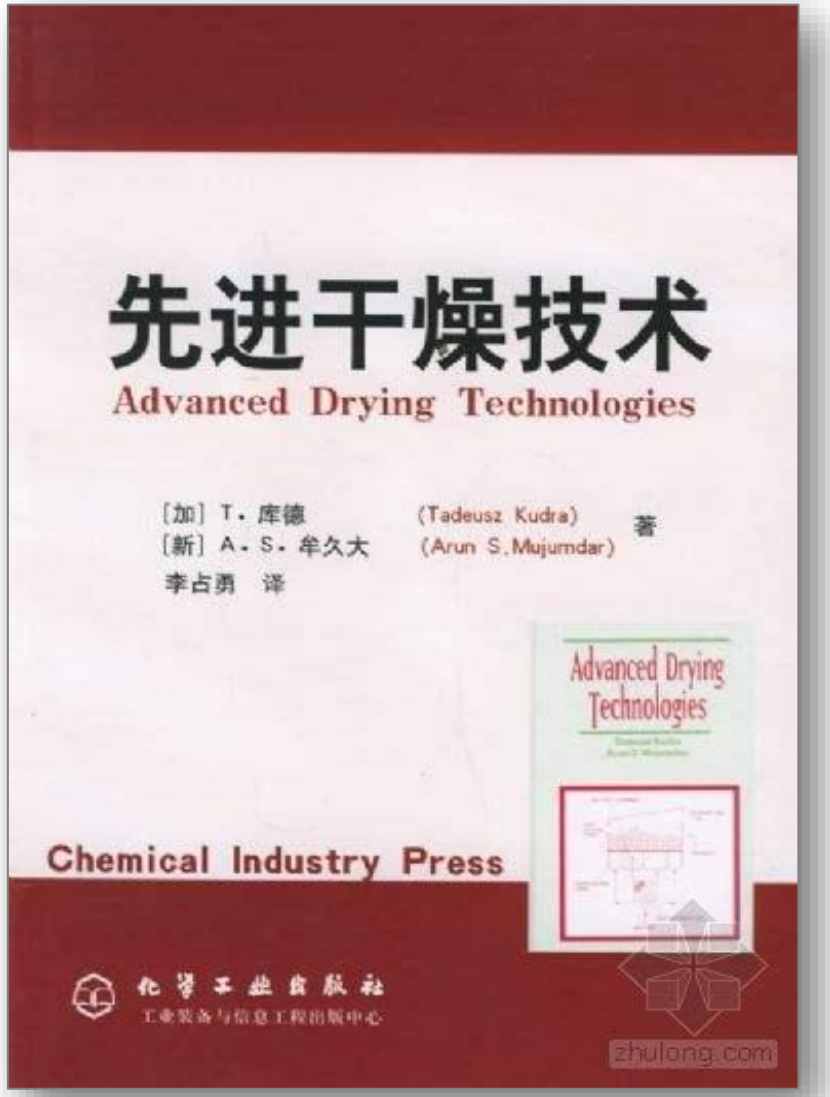
Books Published in Chinese



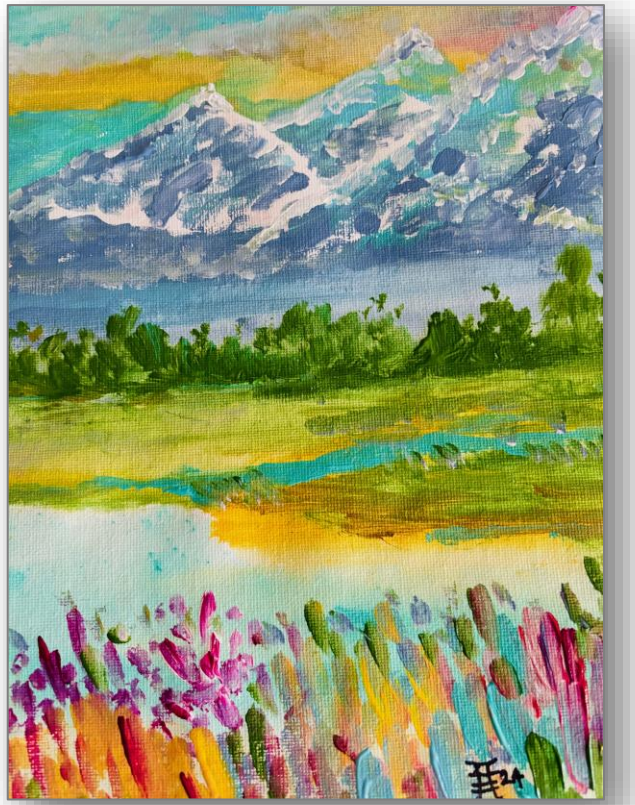
Book in Chinese Coauthored by Professor Min Zhang and Professor Arun S. Mujumdar, Entitled High-Efficiency Hybrid Dryers.

Won a National Award in China in 2019

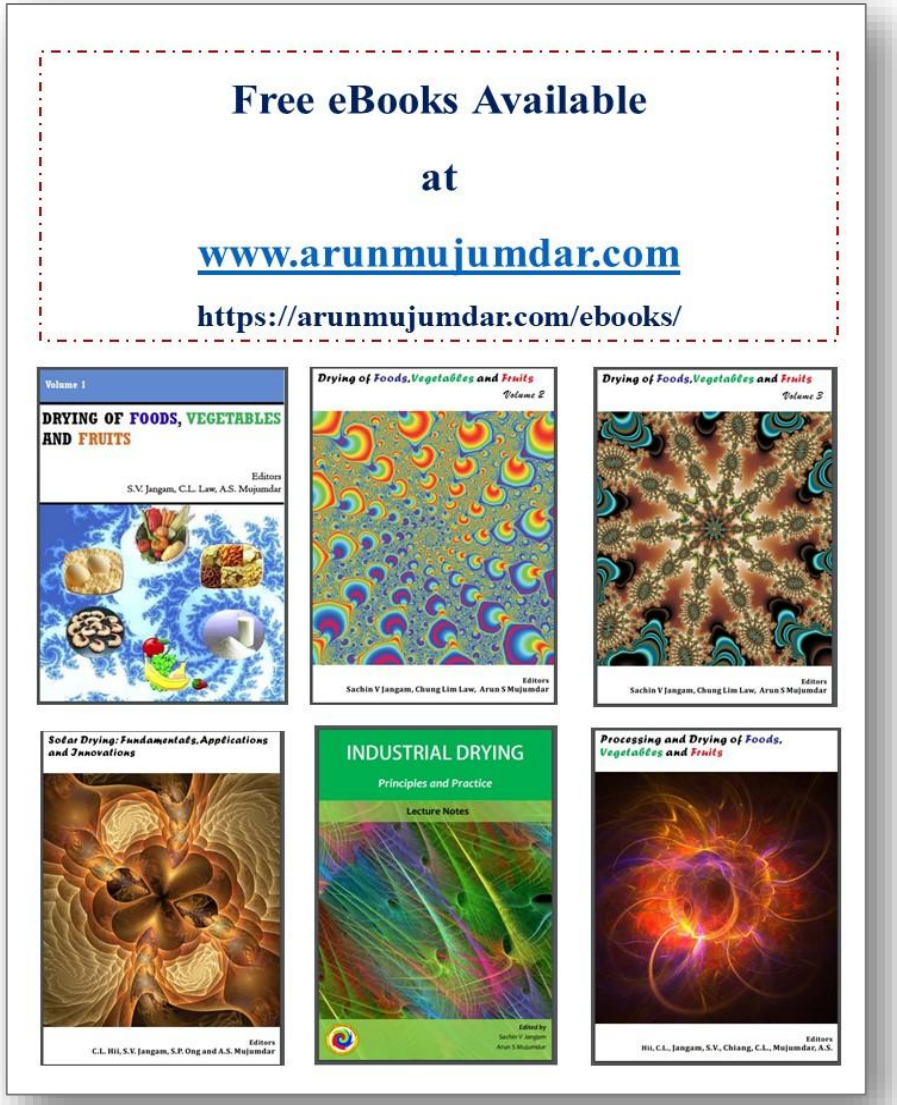
Books Published in Chinese



Chinese Translation of Book Coauthored by T. Kudra and A. S. Mujumdar: Advanced Drying Technologies, 2nd Edition



Free eBooks

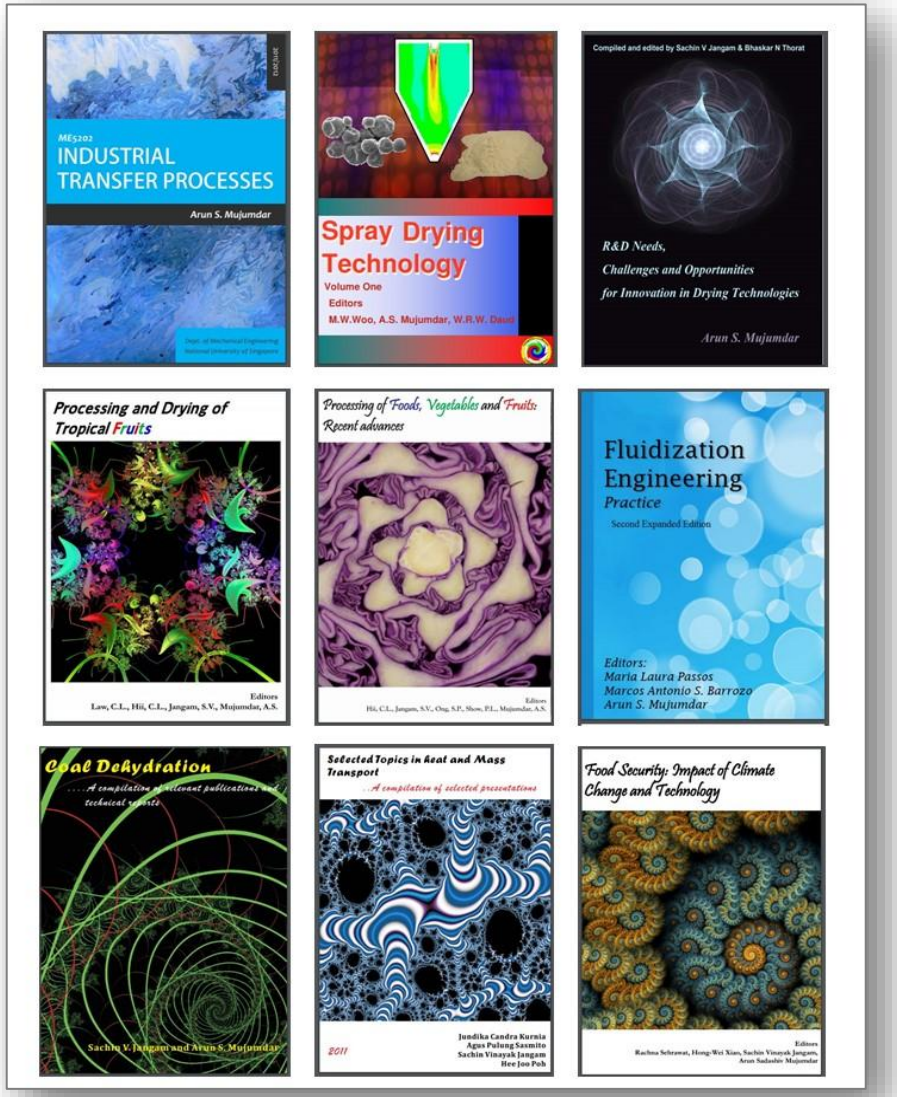


Free eBook by Transport Processes Research Group

Available at:

www.arunmujumdar.com

Free eBooks



Free eBook by Transport Processes Research Group

Available at:

www.arunmujumdar.com

Free eBooks

Please Scan the QR Code to Download Free eBooks

Please Scan the QR Code for Current Updates in Drying Science and Technology

Free eBook by Transport Processes Research Group

Available at:

www.arunmujumdar.com

Acknowledgments

- I am grateful to **Prof. Min Zhang, Prof. Hongwei Xiao, Prof. Wu Zhonghua**, and their associates for the continuous guidance and assistance they freely offered when I needed it.

- Appreciation is due to **Mr. Amirhossein Barzigar** and **Dr. Shivanand S. Shirkole** for their prompt and efficient support at short notice.

- Thanks are due to the **Organizing Committees of the 2nd IRADSTM and ADC/CDC2025** for their enthusiastic support of my participation.

~ Arun S. Mujumdar

Thank You...!!

Prof. Arun S. Mujumdar | arunmujumdar123@gmail.com | www.arunmujumdar.com