

RESUME

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TEACHING AND RESEARCH AREAS OF INTEREST:

Thermodynamics of Phase Equilibria, Supercritical Fluid Extraction Technology, Processing with Supercritical Fluids, Production of Nanoparticles, Food Process Engineering, Cryogenic Engineering

EDUCATION:

- **B.Ch.E.**, (1963), Jadavpur University, Calcutta, India, First Class (First Rank),
- **M.Tech. in Chemical Engineering**, (1965), Indian Institute of Technology, Kharagpur,
Specialisation : **Plant Design and Fabrication**
- **Ph.D. in Chemical Engineering**, (1969), Ohio State University, U.S.A.
- Ph.D. Thesis: **Effects of Molecular Size and Shape on Thermodynamic Excess Functions** (Advisor: Prof. Webster B. Kay).

POSITIONS HELD:

- * **Research Associate**, (1965-69), National Science Foundation, at the Ohio State University, U.S.A.
- * **Assistant Professor**, (1969-83), at Chemical Engineering Departments of three I.I.T.'s at Kanpur, New Delhi, and Bombay.
- * **Associate Professor** (1984-86), at Chemical Engineering Department, IIT Bombay
- * **Professor** (1987-2007), at Chemical Engineering Department, IIT Bombay,
- * **Visiting Scientist** (May-June, 1992), U.S.-INDIA Scientists' Exchange Program, in the area of Supercritical Fluid Technology, at University of Pennsylvania, the John Hopkins University, Cornell University, U.S.D.A. (Philadelphia) and M.I.T.
- * **Visiting Professor** (March-May, 1996), at NJIT, Texas A & M and Texas Tech University.
- * **Editorial Board Member**, Journal Chemical Technology & Biotechnology, London, U.K
- * **Guest Editor**, Journal Chemical Technology & Biotechnology, special edition, March.2008

AWARDS RECEIVED:

- The **Acharya P.C. Ray Award** by the Indian Institute of Chemical Engineers (IChE) in 1964 for the Final Year. B.Ch.E. Design Project

- The **NOCIL Award** by the Indian Institute of Chemical Engineers (IChE) for Excellence in Process Plant and Equipment Design in 1997
- The **Suman Sharma National Design award** by the Institution of Engineers (India) for the performance as the **Best Woman Design Engineer** in 1999.
- **Dr. P.K. Patwardhan Award** for Technology Development and Transfer in 2001
- **The Best Ph.D. Thesis Supervised Award** by the International Society for Advancement of Supercritical Fluids (ISASF), France in 1996.
- **Two Best Research Paper Awards** in Chemocon-2003 by IChE
- **The Herdillia Award for Excellence in Basic Research in Chemical Engineering** by IChE for the Year 2005
- **S. K. Mitra Memorial Award for the 2nd Best Technical Paper published** during the Year 2005 in **Indian Chemical Engineer** by IChE in Dec. 2006

BOOKS/BOOK CHAPTERS AUTHORED:

- **“Natural Extracts Using Supercritical Carbon Dioxide”**, published by **CRC Press LLC**, Florida, USA, June, 2000
- **“Phase Equilibrium in Solid-Liquid-Supercritical Fluid Systems”**, Chapter 2 in **Supercritical Fluid Technology for Drug Product Development**, Marcel Dekker Inc., New York, USA, March, 2004
- **“Fundamentals of Cryogenic Engineering”**, Prentice Hall of India, New Delhi, 2007
- **"Processing spices using supercritical fluids"**, Chapter 12 in "Supercritical fluid extraction of nutraceuticals and bioactive compounds", CRC Press, LLC, Florida, U.S.A., 2007

PATENTS :

- **“Process for Supercritical Fluid CO₂ Extraction of Fragrances (absolute or essential oils) from Jasmine flowers,”** Indian Patent 183454 (72/Bom/96).
- **“Process for Sequential Supercritical CO₂ Extraction and Fractionation of Neem Oil Enriched with Azadirachtin from Neem kernels”**, Indian Patent 182587 (428/BOM/97).
- **“Sterilization and Preservation of Liquid Food Products with Supercritical Fluids at Moderate Conditions”**, Indian Patent (543/MUM/2004).
- **“A Novel Method for Production of Nanoparticles using Sub-critical Carbon Dioxide”**, Indian Patent (544/MUM/2004).
- **“A Novel Process for Nutraceutical Concentrate using Supercritical Fluid Extraction”**, Indian Patent (545/MUM/2004).
- **“Lipoxygenase-Inactivated and Sterilised Legumes and Cereal Products”** Provisional Indian Patent (540 /MUM/2005)

- “A Novel processing protocol for making natural sweetener from stevia leaves” (in progress)

MEMBERSHIP IN PROFESSIONAL SOCIETIES:

- **Member**, International Society for the Advancement of Supercritical Fluids (**I.S.A.S.F.**)
- **Member** (121424), American Institute of Chemical Engineers (**A.I.Ch.E.**)
- **Life Member** (07439), Indian Institute of Chemical Engineers (**I.I.Ch.E.**)
- **Member**, Society of Chemical Industry, John Wiley & Sons, London, U.K.

SPONSORED RESEARCH GRANTS :

Sponsoring Agency	Duration	Title
1. Council of Scientific and Industrial Research, New Delhi.	1970-73	“ Studies on Thermodynamic Properties and Phase Behaviour ”
2. Engineers India Ltd., New Delhi.	1985-88	“ LLE for Dearomatisation of Petroleum Fractions from Bombay High Crude ”
3. Dominus Engineers Ltd., Bombay.	1985	“Selection of Process Parameters and Design of Process Plant for Production of Resorcinol”
4. The Ministry of Environment and Forests, Govt. Of India.	1992-95	“ Separation of Hazardous Organics from waste water by SCCO₂ Processing ”
5. The Ministry of Human Resources and Development, Govt. of India..	1993-99	Food Process Engineering Technology Development and Transfer Mission on “ Supercritical Fluid Extraction Systems Design ”
6. The Ministry of Human Resources and Development, Govt. of India..	2003-2005	TAT Project :“ Micronisation of Pharmaceuticals using Supercritical Carbon Dioxide ”
7. User Industries for SCFE Products	1999-2008	“ Supercritical Fluid Extraction Systems Development ”(continuing)

SUMMARY OF TEACHING AND RESEARCH CONTRIBUTIONS :

- **Teaching** of several core courses **and development** of a large number of new interdisciplinary courses at graduate and undergraduate levels. Development of thermodynamic laboratories for teaching and research at three IIT’s. Supervision of several B.Tech., M.Tech. and Ph.D. projects over a period of 38 years (1969-2007) has resulted more than 135 publications in reputed international journals and conference proceedings, seven patents, two books and two book- chapters. Consultations to a number of industries and successful completion of several sponsored projects in the area of process technology development, process design and thermodynamic data generation.
- **Development of computational models** for generation of Thermodynamic and Phase equilibrium properties, using the EOS and activity coefficient approaches from limited or no experimental data at all. Process design and simulation studies involving separation processes,

such as, distillation, extraction, extractive distillation, and supercritical fluid extraction. Setting up of experimental rigs for accurate measurement of vapor pressures, dew point and bubble point pressures, P-V-T-X data, critical constants, S-L-E, L-L-E, V-L-E, G-L-E and S-F-E data.

- **Development of in-house experimental rigs** for batch, semi-continuous and continuous supercritical extraction of natural products.
- **Development of SCFE processes** with innovations for the recovery of (i) essential oils and oleoresins from spices such as, cumin, fenugreek, ajwain, clove, fennel, red pepper, ginger, carrot (ii) fragrances from flowers, such as, jasmine, tube rose, (iii) herbal extracts from neem, basil, (iv) antioxidants from various plant sources, (v) free fatty acids and tocopherol from vegetable oils (vi) toxic organic contaminants from waste water and spent adsorbents for regeneration. Development of methodologies for screening of optimum process conditions and thermodynamic models with new mixing rules for generation of fluid-phase equilibrium data for complex natural product systems. Evaluation of mass transfer models for semi-continuous supercritical extraction process.
- **Development of updated and cost-effective SCFE Technology** for (i) Design and Development of SCFE Pilot Plant (commercial prototype) with two 10-litre Extractors for Processing of Multiple Natural Raw Materials (ii) Technology of Commercial-scale SCFE plant and its Transfer for Manufacture and Marketing
- **Development of Pressurized Hot Water Extraction (PHWE) Technology for recovery of Nutraceuticals**, e.g., Alpha-hydroxy citric acid from kokum (*Garcinia indica choisy*) rinds, Steviol glycosides from Stevia (*Stevia rebaudiana*) leaves, glycyrrhizic acid from licorice (*Glycyrrhiza glabra*) roots, etc.
- **Research Investigations** on *cyclohexane oxidation* in SCCO₂ medium with simultaneous phase separation and generation of multi-component phase equilibrium data at high pressures. Study on the influence of solvent effects, thermodynamic state of the reaction mixture, and proximity to the critical point, on the reaction mechanism, selectivity of conversion, and rates. *Sterilization and stabilization* of solid and liquid food products for enhancement of safety and shelf-life by deactivating microorganisms and enzymes using supercritical CO₂. *Supercritical drying of silica aerogels* using supercritical CO₂ and mathematical modeling for crack-free drying of alcogels by avoiding vapor-liquid interface.

TECHNOLOGY DEVELOPMENT OF COMMERCIALY VIABLE SCFE IN INDIA

Though SCFE technology had been successfully commercialized in developed countries for more than twenty five years, it was not commercially viable for India due to the following main deterrent factors, namely

- (i) SCFE is comparatively more capital-intensive, due to the requirements of high pressure operation (100-350 bar) and very accurate process control,
- (ii) high premium charged by foreign equipment suppliers based on novelty of this technology substantially increases the costs of SCFE plants.

Accordingly a MHRD-sponsored technology development mission project was undertaken at IIT, Bombay for indigenous innovative design, development and manufacture of SCFE plant and equipment so as to optimize the capital investment of SCFE technology and make it commercially viable.

For the first time in India Supercritical Fluid Extraction Technology was indigenously developed, demonstrated and made commercially viable. As the Principal Investigator of the **Food Process Engineering-Technology Development Mission Project**, sponsored by M.H.R.D., New Delhi, successfully executed the **Supercritical Fluid Extraction Systems Design Project** (1993-1998), with the following accomplishments:

- **Prototype SCFE pilot plant** (with 2 x10L Extractors) with fully automated instrumentation and control system for supercritical extraction of natural products with innovative design features aimed at substantial cost reduction.
- **Commercial scale plant** (up to 500L Extractor) for multiple products, such as spice oil and oleoresins, natural colors, antioxidants, lipids, nutraceuticals and herbal medicines
- **Transfer of the developed Supercritical Fluid Extraction Technology** to our Industrial Partner for commercialization.
- **Supply of Turn-key SCFE plants** (<http://www.che.iitb.ac.in/scfe/index.htm>) in India and abroad through our Industrial Partner to the user industries.

The **principal innovative features** of both the pilot plant and commercial-scale plants developed by IIT Bombay are:

- New process configuration (in terms of SCF solvent flow pattern within extractors)
- Optimization of Pressure Vessel Design based on Finite Element Stress Analysis
- Innovative design of *internals* for extractors and separators
- Cost-effective and easy-to-fabricate design of heat exchangers
- Modeling and simulation of SCFE processes for complex natural products

- Innovative processing protocols of natural products (in terms of extraction and pretreatment)
- Development of cost effective pre-treatment and post-treatment processing
- Inherently Safe Design, Development of user friendly / inherently safe control logic and safety interlocks
- Substantial reduction of cost from the imported equivalent: thus making the SCFE technology economically viable. The cost-reduction was possible by:
 - (i) innovative cost saving design features for process and equipment
 - (ii) use of low-cost, in-house, high-quality engineering expertise
 - (iii) low-cost manufacturing process for the plants.

This technology development effort has resulted in *generation of expertise and vendor development for engineering and manufacture of very high pressure systems conforming to international standards*. (For example, high-pressure CO₂ pumps are now manufactured by *vendors developed by IIT Bombay*;

The technology has already been transferred to an Indian commercial organization and **12 commercial units** (laboratory, pilot and production scale plants) have been manufactured and marketed within India as well as abroad.

CURRENT R&D ACTIVITIES

1. “Technology Development for Direct Supercritical Fluid Extraction of Metal Oxides from Spent Nuclear Fuel”

A collaborative research project proposal is in progress with the Nuclear Recycle Group, Bhabha Atomic Research Centre (BARC), Department of Atomic Energy, the Government of India.

2. “Processing of Soybeans with Supercritical Carbon Dioxide”

The objectives of the Project include:

- (i) Process development and optimisation of process parameters for sterilisation and stabilisation of soybeans by pretreatment using supercritical carbon dioxide in a Pilot plant
- (ii) Process development of various soy products from the pretreated soybeans, and
- (iii) Characterisation of different products and co-products by standard analytical techniques

3. “Efficient Recovery of High Quality Edible Oils from Soy Bean, Rice Bran and Oil Cake by Processing with Supercritical Carbon Dioxide”

The objectives of the Project include:

- (i) Processing of Soy bean, Rice bran, and oil cake with supercritical carbon dioxide for deactivation of lipoxygenase and lipase enzymes and the anti nutritional factor

- (ii) Supercritical carbon dioxide extraction/ fractionation from the pre-treated feedstock for efficient recovery of high quality edible oils and valuable co-products, and optimisation of process parameters needed to obtain consumer-acceptable cost-effective edible oil, and
- (iii) Characterisation of the products for standardisation and benchmarking.

4. “**Production of Pharmaceutical Nanoparticles With Subcritical Carbon Dioxide**”

An experimental R&D Project is in progress with an internationally reputed pharmaceutical company to utilize a unique innovative process without using a spraying nozzle and any high pressure pumps.

TECHNOLOGY TRANSFER IN PROGRESS:

- (i) **Production of submicron particles** from solutions using subcritical carbon dioxide without any high pressure pumps or nozzles in a short span of time.
- (ii) **Sterilization and preservation of food and botanical products** (e.g., milk, tomato juice, sugarcane juice, coconut water, aloe vera and fruit juice) using supercritical carbon dioxide at moderate conditions
- (iii) **Production of ‘ready-to-use’ dehulled soybeans and instant soymilk** free of beany flavour and chalky mouth-feel by a novel pretreatment technique with supercritical carbon dioxide
- (iv) **Production of nutraceutical concentrates** enriched with lycopene and lutein, the two natural color compounds, and β -carotene, a precursor to vitamin A, from the plant sources: tomato, marigold flower, and carrot respectively using supercritical carbon dioxide
- (v) **Production of High-value lecithin** from crude lecithin in a single step with subcritical carbon dioxide.
- (vi) **Production of Natural Sweetener** from Stevia Leaves using pressurized hot water and subcritical carbon dioxide

RESEARCH PROJECTS -RECENTLY CONCLUDED

- (i) **Production of nanoparticles** of Pharmaceuticals using supercritical CO₂ and subcritical CO₂; Analysis of mechanism, mathematical modeling and simulation of precipitation by pressure reduction of gas-expanded liquids (PPRGEL) for production of nanoparticles - Ph.D.Project (April, 2007)
- (ii) **Development of a new ligand-assisted SCFE process** with in-situ chelation of metal ions for direct extraction from oxides in order to avoid the usage of nitric acid as in the PUREX process and to overcome co-generation of high level liquid wastes -Ph.D.Project (January, 2007)
- (iii) **Process innovations in SCFE technology** using supercritical carbon dioxide (CO₂) for selective recovery and purification of natural concentrates / nutraceuticals enriched with active ingredients -M.Tech. Project (July, 2006)

(iv) Micronisation of pharmaceuticals using supercritical Carbon Dioxide -MHRD-sponsored TAT Project 03MH017-(July 2006)

(v) Recovery of Helium from Ammonia Synthesis Purge Gas based on Natural Gas

A collaborative project with the Heavy Water Board, Mumbai to evaluate different alternative routes and their feasibility studies by modeling and simulation. The project is of unique importance as Helium is available in traces (40 ppm) in Indian natural gas, which is the only large and sustainable source of helium in the country-(July 2006)

(vi) Sterilization and stabilization of solid and liquid food products for enhancement of safety and shelf-life by deactivating microorganisms and enzymes using supercritical CO₂ -Ph.D.Project (Sept., 2005)

(vii) Supercritical drying of silica aerogels using supercritical CO₂ and mathematical modeling for crack-free drying of alcogels by avoiding vapor-liquid interface -M.Tech.Project (July, 2005)

SELECTED PUBLICATIONS:

A. In Peer-reviewed Journals

1. Mamata Dutta, "The Effect of Molecular Size on Thermodynamic Excess Functions", Indian Chemical Engineer, Transactions, Vol.13, no.2, 29, April 1971.
2. Mamata Mukhopadhyay, "Uncertainties in Vapour-Liquid Equilibrium Studies", Indian Chemical Engineer, Transactions, Vol.15, no.1, 40, January 1973.
3. Mamata Mukhopadhyay, A.K. Mukhopadhyay, "Process Optimization by Experimentation", Chemical Age of India, Vol.24, No.8, 539, August, 1973.
4. Mamata Mukhopadhyay, A.K. Mukhopadhyay, Nonhydrocarbon Constituents in Petroleum, Chemical Age of India, Vol.25, no.2, 103, February, 1974.
5. Mukhopadhyay, Mamata Mukhopadhyay, "Benzene from Toluene", Chemical Age of India, Vol. 25, no.5, 282, May, 1974.
6. Mamata Mukhopadhyay, A.K. Mukhopadhyay, "Lube Aromatic Extracts as Base-Stock for Rubber Plasticizers and Extender Oils", Indian Chemical Engineer, Vol.16, no.2, 24, April, 1974.
7. Ashok Khanna, Amitabha Mukherjee, Mamata Mukhopadhyay, "Isobaric Vapour-Liquid Equilibria of C₇ Hydrocarbon-Alcohol Systems", Indian Journal of Technology, Vol.12, 239, June, 1974.
8. Mamata Mukhopadhyay, "Prediction of Binary Azeotropes", I. and E. C., Process Design and Development, Vol.14, 195, Feb. 1975.
9. Ashok Khanna, Mamata Mukhopadhyay, "Prediction of Isobaric and Isothermal Vapour-Liquid Equilibria from limited experimental data", Journal of Applied Chem. and Biotech., Vol.25, No.12, 935, 1975.
10. C.P. Agarwal, Mamata Mukhopadhyay, "Prediction of Azeotropic Locus on P-T-X space", Indian Chemical Engineer, Trans., Dec. 1975.
11. Mamata Mukhopadhyay, A.K. Mukhopadhyay, "A Thermodynamic Method for Optimization of Process Conditions", Chemical Age of India, Vol.27, No.8, 696, Aug., 1976.
12. Mamata Mukhopadhyay, "A Method for Prediction of Thermodynamic Properties and Vapour-Liquid Equilibria", Chemical Age of India, 261, Vol.29, No.4, April, 1978.
13. A.K. Mukhopadhyay, Mamata Mukhopadhyay, "R & D in Cryoengineering in India", Indian Chemical Engineer, Vol.20, No.4, 12, Oct. 1978.

14. Mamata Mukhopadhyay, "A Thermodynamic Method for Selection of Solvents and Process Conditions for Aromatics Extraction", *Journal of Chemical Technol. and Biotech.*, Vol.29, 634, 1979.
15. M. Mukhopadhyay, "Helium Sources and Recovery Processes", *Cryogenics*, 244, May, 1980.
16. M. Mukhopadhyay, R.C. Awasthi, "K-value predictions for the Methane-Ethane-Propane System", *Cryogenics*, 345, June, 1981.
17. M. Mukhopadhyay, K. Sahasranaman: "Computation of Multicomponent Liquid-Liquid Equilibrium Data for Aromatics Extraction Systems", I. and E.C., *Process Design and Development*, Vol.21, 632, Oct., 1982.
18. M. Mukhopadhyay, K. Dongaonkar, "Prediction of L-L-E in Multicomponent Aromatics Extraction Systems using the UNIFAC Group Contribution Model", I. and EC, *Process Design and Development*, Vol.22, no.3, 521, 1983.
19. M. Mukhopadhyay, P.S. Kanagali, "Argon Sources and Recovery Processes", *Chemical Age of India*, Vol.34, no.12, 769, 1983.
20. M. Mukhopadhyay, A.S. Pathak, "Infinite Dilution Activity Coefficients from Ebulliometric Isobaric Boiling Point-Composition Data", *J.Chem.Engg. and Data*, April, Vol.31, 1986.
21. M. Mukhopadhyay, A.S. Pathak, "L-L-E Data for Process Engineering Calculations in Aromatics Extraction Systems Using the Modified UNIFAC MODEL", I and EC, *Process Design and Development*, Vol.25, no.2, 1986.
22. M. Mukhopadhyay, B.D.Malleswara Rao: "Studies on Selectivities of Solvents for Liquid-Liquid Extraction of C₇-C₁₀ Aromatics, *Trans.Indian Chemical Engineer*, Vol.29, no.4, 52, Oct. 1987.
23. M. Mukhopadhyay: "Recovery, Purification and Liquefaction of CO₂ from Distillery Waste Gases", *Chemical Engineering World*, Vol.23, no.8, 59, August, 1988.
24. M. Mukhopadhyay, M. Sohani: "Solvent Extraction of Resorcinol", *Journal of Chemical Engineering and Data*, March, 1989.
25. V. S. Gangadhara Rao, M. Mukhopadhyay, "Influence of Binary Interaction Parameter on the Prediction of SCF Phase Equilibrium Data", *Trans. Indian Chemical Engineer*, Vol.31, no.3, 27, July, 1989.
26. V. S. Gangadhara Rao, M. Mukhopadhyay, "Effect of Co-volume Dependency of the Energy Parameter on the Predictability of SCFE Data Using PR EOS", *The Journal of Supercritical Fluids*, Vol.2, no.1, 22, March, 1989.
27. R. D Mithani, M. Mukhopadhyay, "Utilisation of Alternative Energy for Preservation of Fruits - A Case Study" *Chemical Engg. World*, Vol.25, 19, 1990.
28. V. S. Gangadhara Rao, M. Mukhopadhyay, "Solid Solubilities in Supercritical Fluids from Group Contributions", *The Journal of Supercritical Fluids*, Vol.3, no.2, 66, June 1990.
29. M. Mukhopadhyay, Y.S.N. Malleswara Rao, "Solvency-Selectivity Behavior of Mixed Solvent for Aromatics Extraction", *Indian Chemical Engineer, Trans.* Vol.33, no.4, T 141, Oct. 1991, 81.
30. M. Mukhopadhyay, et al. "Modeling Specific Interactions for Supercritical Extraction of Fragrances", *The Journal of Supercritical Fluids*, Vol.5, no.1, 19, March 1992.
31. S. V. G. K. Sastry, M. Mukhopadhyay: "Modeling Dilute Supercritical Mixtures Utilising Solvent - Cluster Interactions", *The Journal of Supercritical Fluids*, Vol.6, 21-30, March, 1993.
32. M. Mukhopadhyay and G. V. R. Rao,: "Thermodynamic Modeling for Supercritical Fluid Process Design", *Ind. Eng. Chem. Res*, Vol.32, 922-930, May 1993.
33. P. Srinivas, M. Mukhopadhyay: "Oxidation of Cyclohexane in Supercritical Carbon dioxide Medium", *Ind. Eng. Chem. Res*, Vol. 33, 3118-3124, November 1994.
34. S. V. G. K. Sastry. M. Mukhopadhyay, "Fragrance Extraction from Jasmine Flowers Using Supercritical Carbon dioxide", *Indian Chemical Engineer Trans.*, Vol. 36, No. 4, 167, 1994.
35. S. V. G. K. Sastry , M. Mukhopadhyay, "Solubility Behaviour of Supercritically extracted Jasmine Fragrance and constituents in Dense CO₂ ", *J. Separation Science and Technology*, Aug. 1995.
36. M. Mukhopadhyay , M.K. Nath: "Removal of free fatty acids from Rice bran and cotton seed oils by SC CO₂" *Indian Chemical Engineer*, Vol.37, No.1, 53, 1995.

37. M. Mukhopadhyay, P. Srinivas, "Multicomponent Solubilities of Reactants and Products of Cyclohexane Oxidation in Supercritical Carbon Dioxide", *Ind. Eng. Chem. Res.*, 35, 4713-4717, Dec. 1996.
38. M. Mukhopadhyay, Shyamal K. De: "Fluid Phase Behaviour of Close Molecular Weight Fine Chemicals in SC CO₂", *Journal of Chemical Engg. and Data*, Vol. 40, No. 4, 909, July 1995.
39. M. Mukhopadhyay, Rajeev Kumar: "Parametric Study and Mass Transfer Modeling of Supercritical CO₂ Extraction of Clove Oil", *Indian Chemical Engineer*, Vol.40, No. 2, 109, 1998.
40. P. Srinivas and M. Mukhopadhyay and: "Influence of Thermodynamic State on Cyclohexane Oxidation Kinetics in Carbon Dioxide Medium", *Ind. Eng. Chem. Res.*, Vol. 36, 2066-2074, June, 1997.
41. M. Mukhopadhyay, S. Roy, S. Pandit, S. Baser, "Emergence of SCFE as Cost Effective and Eco-friendly Technology," *Indian Chemical Engineer*, Sec. B, Vol. 39 (3), July- Sept. 1997
42. M.Mukhopadhyay, S.Roy, S. Pandit, S.Baser, "Supercritical Fluid Extraction Systems Design and Commercialisation", *Chemical Weekly*, Nov. 18,1997
43. K. S.Ray, M.Chheda, M. Mukhopadhyay. " Performance of Conventional and Supercritical Extraction Methods for β -Carotene Recovery from Non-edible Leaves", *Journal Food Science and Technology*, Vol.37, no.5, 514-516, 2000
44. M. Mukhopadhyay, Niyati Bhattacharya, " Supercritical Fluid Dyeing of Textile Fibres with Natural Dyes",: *Colourage*, 21, August 2001
45. Mamata Mukhopadhyay, Sandip Roy, "Supercritical Technology-An Overview" *Chemical Engineering World*, 26-28, June 2002
46. M.Mukhopadhyay, "Partial Molar Volume Reduction of Solvent For Solute Crystallization Using Carbon Dioxide as Antisolvent", *The Journal of Supercritical Fluids*, vol. 25, No.3, 213-223, April 2003
47. M.Mukhopadhyay , S.V. Dalvi, " Partial Molar Volume Fraction of Solvent in Binary (CO₂-Solvent) Solution for Solid Solubility Predictions", *The Journal of Supercritical Fluids*, Volume 29, Issue 3 , 221-230, May 2004
48. M.Mukhopadhyay, Nitin Joshi, " Supercritical Carbon Dioxide Fractionation of Vitamins E & A from Vegetable Sources" *Indian Chemical Engineer*, Section A, Vol. 45, No.3, July-September, 2003
49. M. Mukhopadhyay, Sanjay Singh, "Refining of Crude Lecithin Using Dense Carbon dioxide as Antisolvent", *The Journal of Supercritical Fluids*, Volume 30, Issue 2 , 201-211, July 2004
50. Mukhopadhyay , S.V. Dalvi, "Mass and Heat Transfer Analysis of SAS: Effects of Thermodynamic States and Flow Rates on Droplet Size", *The Journal of Supercritical Fluids*, Volume 30, Issue 3 , 333-348, August 2004
51. M.Mukhopadhyay, S.V. Dalvi, "Analysis of Supersaturation and Nucleation in a Moving Solution Droplet with Flowing Supercritical Carbon Dioxide, *J.Chem Technol Biotechnol*, Vol. 80, 445-454, February 2005.
52. M.Mukhopadhyay, S.V. Dalvi, "A New Prediction Method for Ternary Solid-Liquid-Vapor Equilibrium from Binary Data", *the Journal of Chemical and Engineering Data*, no. 4,1283-1289, June 2005
53. Subhashis Ghosh, Chiranjib Bhattacharjee, Mamata Mukhopadhyay, "Polymerisation in Supercritical Carbon Dioxide: A Review", *Indian Chemical Engineer*, Section A, Vol.47, no.4, October-December, 2005, 224-234
54. Anuradha Chakraborty and Mamata Mukhopadhyay, " The Juicy Trail Using Supercritical Carbon Dioxide to Preserve Aloe Juice", *Modern Food Processing*, Nov-Dec, 2005, 36-39
55. Mamata Mukhopadhyay, *Novel Processes Utilising Unique Properties of Carbon dioxide*, Update, No.1, 2006, IRCC Publication, IIT Bombay
56. Sameer V. Dalvi and M.Mukhopadhyay, "Parameters Controlling Supersaturation by DELOS Using Carbon Dioxide" *Journal of Chemical and Biotechnology*, volume 81 (7), 2006, 1267-1270
57. A. Chakraborty Chatterjee, M.Mukhopadhyay, "A healthier and Tastier Way to Soy milk, *Modern Food Processing*, Vol. 2, No. 2, 2006, 46-50.

58. Sameer V. Dalvi and Mamata Mukhopadhyay, "A New Generalized Method for the Predictions of Liquid Molar Volumes of CO₂-expanded Solvents", *Industrial and Engineering Chemistry Research*, volume 46, 2007, page 8282-8287
59. Sameer V. Dalvi and Mamata Mukhopadhyay, "Large and Rapid Temperature Reduction of Organic Solutions Using Subcritical Carbon Dioxide, Volume 53, No. 11 A.I.Ch.E.J. November, 2007
60. Mamata Mukhopadhyay and Hiren Karamata, "A Novel Process for Supercritical Fluid Extraction of Nutraceuticals Enriched with Carotenoids" *Indian Chemical Engineer* (in press) Oct., 2007
61. Mamata Mukhopadhyay, Chetan K.R. Patel, "'Purification of phytochemicals by gas antisolvent precipitation with carbon dioxide" *Indian Chemical Engineer* (in press), Nov. 2007
62. Tessa Vincent, Mamata Mukhopadhyay and P.K. Wattal, " Supercritical Direct Extraction of Neodymium Using TTSa and TBP", *The Journal of Desalination*, 2007-special issue (Accepted for publication)
63. Tessa Vincent, P.K. Wattal and Mamata Mukhopadhyay, "In-situ Direct supercritical fluid extraction of metal oxides using mixed ligands" *The Journal of Supercritical Fluids* (Under Publication).
64. Sameer V. Dalvi and Mamata Mukhopadhyay, "Precipitation of Ultra-fine Particles of Cholesterol using Sub-critical CO₂" Communicated to *AIChEJ*
65. Sameer V. Dalvi and Mamata Mukhopadhyay, "Precipitation of Zinc Acetate Nanoparticles with Narrow Particle Size Distribution using Sub-critical CO₂" Communicated to *Crystal growth and Design*
66. Sameer V. Dalvi and Mamata Mukhopadhyay, "Enhancement of Control of Rapid and Instantaneous Temperature Drop of Organic Solutions Produced Using Subcritical CO₂" To be communicated to *AIChEJ* as R&D Notes
67. Sameer V. Dalvi and Mamata Mukhopadhyay, "Analysis of Precipitation by Pressure Reduction of Expanded Organic Solutions of High Molecular Weight Solids Using Subcritical CO₂" To be communicated to *Chemical Engineering Science*
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