

BIODATA SUMMARY OF H.S. SHANKAR

Prof. Shankar studied at National High School (1963), Calcutta, St. Xavier's College, Calcutta (1964). He took his BTech. (Hons.) From IIT Kharagpur (1969), M.Tech from IIT Kanpur (1971), PhD from Monash University, Melbourne (1976) all in Chemical Engineering.

He served as faculty at Royal Melbourne Institute of Technology (1977), Pool Officer National Chemical Laboratory (1978) and joined IIT Bombay as Asst. Professor (1978-86), served as Assoc. Prof. (1986-89) and as Professor since 1989.

He teaches Chemical Reaction Engineering, Biochemical Engineering, Chemical Processes, Modelling & Simulation. He has over 59 publications, supervised 10 PhDs, 35 M. Techs and several are in progress.

He has completed several Govt and industry sponsored projects. The organic waste conversion IP popularly known as Soil Biotechnology initially supported by Department of Biotechnology, New Delhi (Vermiculture Bioconversion) is a technology now being adopted for waste conversion both solid and liquid by Industry, Housing Society, Corporations.

IIT Bombay holds the US and India patents taken on the basis of this IP.

He is a recipient of Certificate of merit for teaching (RMIT, Melbourne 1977), Hindustan Dorr Oliver Award for Excellence in Application of S&T for Rural Development (IChE 1997), Award for Excellence in Teaching (IIT Bombay, 2001), P.K. Patwardhan Award for Technology Development (IIT Bombay, 2002), Manudhane Award for Applied Research IITB Bombay 2006

He has conducted several major Seminars, Workshops, Congress on S & T during his service at IITB. He is well known in the area of waste conversion Technology Development and serves this segment in various committees. He was a member of Maharashtra State Planning Board Ninth Plan Expert Committee on Water Supply & Sanitation, was a Member IAMR New Delhi Manpower Programme on Biotechnology; Member 11th Plan(2007-12) for Rivers, aquifers, lakes of Planning Commission New Delhi.

As a member of Senate of IITB he has served as a member of several academic bodies.

BIODATA OF PRINCIPAL INVESTIGATOR

1. General Details

- 1.1 Name : HARIHARAN SUBBARAMAN SHANKAR
1.2 Date of Birth : 11 October 1947
1.3 Marital Status : Married with two sons and daughter
1.4 Dependents : Two sons, daughter, wife and father
1.5 Present Position : Professor
Department of Chemical Engineering
Indian Institute of Technology Bombay
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2. Educational

- 2.1 School Leaving Certificate, National High School, Calcutta, 1963, overall score 70%.
2.2 Pre-University Course, St. Xaviers College, Calcutta, 1964 overall score 70%.
2.3 B.Tech. (Hons) Chemical Engineering, IIT Kharagpur, 1964-1969, overall score 71.5%, Rank 7/43.
2.4 M.Tech. Chemical Engineering, IIT Kanpur, 1969-1971, overall CPI 9/10.
2.5 Ph.D., Chemical Engineering, Monash University, Melbourne, 1976.

3. Honours Awards and Appointments

- 3.1 Proficiency Prize, National High School, Calcutta, 1963.
3.2 Proficiency Prize, St. Xaviers College, Calcutta, 1964.
3.3 Merit Scholarship, Director Public Instruction, West Bengal, 1964-1967.
3.4 Post Graduate Scholarship, IIT Kanpur, 1969-70.
3.5 Junior Research Assistant, Chemical Engineering Department, IIT Kanpur, 1970-71.
3.6 Monash Graduate Scholarship, 1971-76.
3.7 Lecturer, **Royal Melbourne Institute of Technology, Melbourne**, Australia, March – July 1977 and **certificate of teaching proficiency**.
3.8 Pool Officer, National Chemical Laboratory, Pune, December 1977 – May 1978.
3.9 Assistant Professor, Chemical Engineering Department, IIT Bombay, June 1978 – May 1986.
3.10 Associate Professor, Chemical Engineering Department, IIT Bombay, May 1986 – May 1989.
3.11 Professor Chemical Engineering Department, IIT Bombay, 30 May 1989 onwards.

- 3.12 Senior Research Fellow, Department of Chemical Engineering, Monash University Melbourne 24 June – 24 August, 1992.
- 3.13 **Member, Task Force, Bio-Technology Manpower Programme, Institute of Applied Manpower Research, Planning Commission**, Indra Prastha Estate, New Delhi – 110 002, July 1992 onwards.
- 3.14 **Member, Maharashtra State Planning Board Study group, Water Sewerage and Sanitation**, Ninth Plan 1997-2002, Government of Maharashtra, Mumbai.
- 3.15 **Hindustan Dorr Oliver Award** – 1997 for Excellence in Application of Science and Technology for Rural Areas, Indian Institute of Chemical Engineering, December 1997.
- 3.16 **Excellence in Teaching Award**, Indian Institute of Technology, September, 2001.
- 3.17 **P.K. Patwardhan Award for Technology Development - 2002**, awarded by IIT Bombay.
- 3.18 **Manudhane Award for Applied Research 2006** IIT Bombay
- 3.19 **Member 11 th Plan(2007-2011) Committee for Rivers, Lakes & Aquifers, Planning Commission** New Delhi.

4. Teaching Activities

- 4.1 **Chemical Research Engineering:** Consists of 28 hours lecture, 28 hours tutorial and is offered as a core component during the 7th Semester of the B.Tech. Programme.
- 4.2 **Introduction to Biochemical Engineering:** consists of 28 hours lecture, 14 hours tutorial and is offered as an elective during the 8th (last) semester of the B.Tech. Programme as an elective.
- 4.3 **Introduction to Transport Phenomena:** consists of 28 hours of lecture and 28 hours of tutorial and is offered as a core component during the 3rd semester of the B.Tech. programme.
- 4.4 **Advanced Reaction Engineering:** Consists of 28 hours of lecture 28 hours of problem session and is offered as a core component in the M.Tech. Programme.
- 4.5 **Process Plant Simulation:** Consists of 28 hours lecture, 28 hours problem session and is offered as an elective in the M.Tech. Programme.
- 4.6 **Non Conventional Sources of Energy II (Part I – Bioenergy):** Consists of 14 hours lectures on bioenergy and 7 hours of problem session and is offered as one half of this course in the M.Tech. Programme in Energy Systems and Engineering.
- 4.7 **Introduction to Energy Engineering (Part I – Bioenergy):** Consists of 14 hours lecture and 7 hours problem session and is offered as one half of this Institute Elective course in the 8th semester of the UG program.

5. Membership of Institute Bodies and Professional Associations

- 5.1 Life Associate Member, Institute of Chemical Engineering, India (LAM 5127).
- 5.2 Trustee, Patriotic and Peoples Science and Technology Foundation, PPST Foundation, P.O.Box 1846, Adyar, Madras 600 020.
- 5.3 Life Member, Pharmaceutical Association of India.

6. Projects , Patents, and Service to Industry and Society

- 6.1 **Hindustan Organic Chemicals:** Reactor design and analysis for fluid bed chlorination of dicyclo-penta-diene to hexachloro-cyclo-penta-diene (1 May – 30 June, 1979).
- 6.2 **Tata Oil Mills Co. Ltd.:** High pressure liquid-liquid hydrolysis of vegetable oil to fatty acid and glycerin. Work includes laboratory determination of kinetics evaluation of design alternatives, scale up, and design, simulation of fatty acid plant September 1980 – February 1981 and September 1983 – October 1985, (Rs. 2.2 Lakh).
- 6.3 **Cadila Chemicals Ltd., Ankleshwar:** In house course on Computer Applications in Process Engineering (December, 1984).
- 6.4 **Cadila Laboratories Ltd., Ahmedabad:** Computer Application in Process Engineering; (June 1985).
- 6.5 **Godrej Soaps Ltd.:** In house course on Design and Analysis of Fat Hydrolysis Reactors (July, 1985).
- 6.6 **Cadila Laboratories Ltd., Ahmedabad:** Retainer Consultant, October 1987 – October 1988.
- 6.7 Vermiculture Bioconversion of Solid Residue: **Sponsored Project, Department of Biotechnology**, New Delhi, April 1988 – March 1992; completed (Rs. 9.08 Lakh).
- 6.8 Waste Management via Vermiculture: **Sponsored Project Bharat Petroleum Corporation Limited**, Mumbai, 1991-95, completed (Rs. 7.5 Lakh).
- 6.9 **Bureau of Industrial Costs and Prices, Ministry of Industry Government of India**, Consultant Fermentation Antibiotics – Cost Price Study, February 1989 – February 1991 (Rs. 1.0 Lakh) completed.
- 6.10 **Colour Chemicals Ltd.** (Subsidiary Hoechst India), 400 kg/d canteen Waste Process Plant inclusive of supply of culture and Design and Commissioning, January 1993 – January 1994 (Rs. 0.50 Lakh), completed
- 6.11 **Larsen and Toubro Ltd.**, Awarpur Cement, Canteen Waste Process Plant. 200 kg/d inclusive of supply of culture and Design and Commissioning Works, July 93 – June 94 (Rs. 0.8 Lakhs), completed
- 6.12 **Kamshet Agro Ltd.** 40 ton/yr agricultural, animal, hotel residues/wastes Process Plant inclusive of supply of culture and Design and Commissioning, completed June 94 (Rs. 0.5 Lakh), completed
- 6.13 **Secretary Congress on Traditional Sciences and Technologies of India**, This congress was a unique event conducted in form of conference session, exhibition and demonstrations covering 11 areas which included agriculture; water management; metals and metallurgy; textiles; architecture and Ayurveda, Siddha and Unani systems of medicine; theoretical sciences which included mathematics, astronomy, logic; and social organisation. The objective of this congress was to capture of the essence of the science of technology heritage of Indian civilisational experience for possible integration with modern streams of inquiry. 28 November – 3 December 1993; (Rs. 38 Lakh), completed.

- 6.14 **Bombay Municipal Corporation** 100 ton/d, Market Waste Process Plant inclusive of supply of culture and Design and Commissioning, May 1993 – June 1995, (Rs. 3.4 Lakh), completed
- 6.15 **Kamshet Agro Ltd.** 200 ton/yr, Agricultural, animal, hotel wastes and residues, Process Plant inclusive of supply of culture and Design and Commissioning, September 1995 – September 1996 (Rs. 1.70 Lakh), completed
- 6.16 **Bombay Presidency Golf Club Ltd.,** Bombay 500 ton/yr Agreiresidues residue Process Plant inclusive of supply of culture and Design and Commissioning, May 1996 – November 1996 (Rs. 3.75 Lakh), completed
- 6.17 **Indira Gandhi Institute for Development Research,** Canteen Waste Process Technology, inclusive of supply of culture and Design and Commissioning 100 kg/d, May 94 – September 1994 (Rs. 1.1 Lakh), completed
- 6.18 **Indira Gandhi Institute for Development Research,** 25 cum./d Waste Water Purification in Vermifilters inclusive of supply of culture and Design and Commissioning, December 1996 (Rs. 1.0 Lakh) completed.
- 6.19 **Bombay Presidency Golf Club Ltd., Bombay,** 120 cum./d process plant for Sewage water purification in vermifilters including supply of culture and Design and Commissioning, December 1996 (Rs. 5.5 Lakh) completed.
- 6.20 **All India Council for Technical Education,** New Delhi, Waste water purification in biofilters, sponsored project towards setting up laboratory facilities for studies in vermicultured biofilters, April 1996 – March 1998 (Rs. 10.0 Lakh) , completed
- 6.21 **Naval Dockyard, Bombay** 10m³/d waste water purification in cultured and planted soil filters, July 1999 (Rs. 1.0 Lakh) completed.
- 6.22 **Kamshet Agro:** Water Conservation, July 2000 (Rs. 0.51 Lakh) completed.
- 6.23 **Naval Dockyard, Bombay:** 50 m³/d sewage purification in cultured and planted Biofilter. ,1999-2000 (Rs. 1.75 Lakh), completed
- 6.24 **Lakshmi Pulp and Paper Mills,** Mumbai: 300 m³/d land treatment of waste water; July 2001 onwards. (Rs. 0.29 Lakh).
- 6.25 Workshop on Solid waste Management UNICEF & Govt of Maharashtra Nov 1997, completed.
- 6.26 Workshop on Solid waste Management Ministry of Urban Affairs New Delhi Nov 1998, completed.
- 6.27 **Bombay Presidency Golf Club Ltd, Bombay,** 500 kL/d sewage purification plant, 2001-02 ,Rs 3.26 Lakhs, completed
- 6.28 **Naval Dockyard Mumbai** 50 kL/d sewage purification Rs 3.89 lakhs, 2002-03, completed
- 6.29 **Dairy Development Corporation Govt of Maharashtra ,** Dairy waste water purification, 2002-03 ,Rs 3.9 lakhs
- 6.30 **Naval Dockyard , Mumbai,** Solid waste management, 2001-02 Rs (Rs12000) , completed
- 6.31 Nitrogen Control in waste water, **One nature Bombay** 2001- 02 ,Rs 1.64 lakhs (sponsored project) completed
- 6.32 3 MLD Sewage purification plant Lovegrove pumping station, Bombay Municipal Corporation, **Onenature Bombay,** Rs 28.3 Lakhs (only Rs9.5 Lakhs received), 2004-05.

- 6.33 Sewage purification 270 kL/day **Lifelink, Bombay, 2003-04** , Rs 1.5 Lakhs, completed
- 6.34 Sewage purification 120 kL/day, **Vision Earthcare Pvt Ltd** (incubatee SINE IIT Bombay),Rs 1.5 lakhs, 2005-06 , completed.
- 6.35 Treatment of Wastewater from **Gujarat Organic Chemical Ltd, Ahemadabad, Gujarat, 2007-08**
- 6.36 Workshop on Soil Biotechnology July 2002 for **Water Supply & Sewerage Board, Govt of Gujarat & UNICEF**, Gandhinagar, Rs 1.8 Lakhs, completed
- 6.37 Workshop on Soil Biotechnology June 2002 for **UNICEF & Gov of Maharashtra, Bombay** Rs 1.8 Lakhs,completed
- 6.38 Sewage Purification 120 kL/d AAI Udaipur completed

Patents

- 6.39 US Patent No: 6890438" Process for treatment of organic wastes" H. S. Shankar, B. R. Patnaik, U.S. Bhawalkar, issued 10 May 2005
- 6.40 US patent: product patent awaited.
- 6.41 "Process for treatment of Organic residues" India Patent Application MUM/384/26 April 2002, .S. Shankar, B. R. Patnaik, U. S. Bhawalkar
- 6.42" Process for treatment of waste water" India Patent Application MUM/383/26 April 2002, H. S. Shankar, B. R. Patnaik, U. S. Bhawalkar

7. Referees

- 7.1 Misra, A., Professor & Director, Indian Institute of Technology, Bombay, Powai, Mumbai 400 076 , Tel 91-22-25767000, email: amisra@iitb.ac.in
- 7.2 Parekh, K., Professor, Member Planning Commission, Yojana Bhawan, Sansad Marg, New Delhi 110001, Tel : 91-11- 23096568/69
- 7.3 Sridhar, T., Professor ,Dean of Engineering, Monash University, Clayton 3168, Melbourne Australia , email: tam.sridhar@eng.monash.edu

8. Ph.D. and M.Tech. Projects Completed

A. Ph.D. Projects

- 8.1A Patil, T.A., "*Thermal Hydrolysis of glycerine oils and fats*", 1986.
- 8.2A Joshi, P.A., "*Studies in circulating fluidised bed reactors – regenerator system*", 1985.
- 8.3A Sivakumar, S. "*Analysis of Transport reactors*", 1988.
- 8.4A Hessari, F.H., "*Reaction Rate Hysteresis in partially internally wetted porous catalysts*", 1994.
- 8.5A Chakravarthy, D.K., "*Crystallisation of Calcium Carbonate, in continuous stirred crystalliser*", 1994.
- 8.6A Kumar Ramchandran, "*Reaction Engineering of Penicillin G Hydrolysis*", 1995.
- 8.7A Bhawalkar, U.S., "*Vermiculture Bioconversion of solid residues*", 1996.
- 8.8A Patnaik, B.R., "*Studies in Waste Water Processing in Biofilters*", 2001.
- 8.9A Banerjee, R., "*Studies in treatment of high nitrate industrial waste water*".
- 8.10A Kadam, A., "*Wastewater Purification using Constructed Soil Filter System*".(2008).
- 8.11A Nemade, Pravin Dinkar "*Flow & Reaction in Porous Media- Arsenic Removal from Water*", PhD project in progress

B. M.Tech. Projects

- 9.1B Joshi, S.V., "*Oxidation of Toluene to benzaldehyde over V2O5*", 1980.
- 9.2B Kshirsagar, M.M., "*Enzymatic hydrolysis of castor oil using castor lipase*", 1981.
- 9.3B Paripatyadar, S.A., "*Studies in the conversion of furfural to furan over Palladium Catalyst*", 1981.
- 9.4B Nichat, B.M., "*Development of dual bed circulating system*", 1982.
- 9.5B Nazar, K.A., "*Enzymatic hydrolysis of vegetable oils*", 1982.
- 9.6B Tare M.M., "*Enzymatic hydrolysis of vegetable oils using castor lipase*", 1983.
- 9.7B Butala, D.N., "*Thermal hydrolysis of vegetable oils*", 1983.
- 9.8B Belapurkar, V.G., "*Extraction of vegetable oils using normal heptane as solvent*", 1984.
- 9.9B Desai, R., "*Deacidification of crude rice bran oil by double solvent extraction*", 1984.
- 9.10B Kulkarni, J.K., "*Mass transfer with chemical reaction in liquid-liquid system*", 1984.
- 9.11B Venkatesan, K.N., "*Deacidification of rice bran oil*", 1985.
- 9.12B Lakshminarayanan, S., "*Microbial degradation of lignin*", 1986.
- 9.13B Namdev, P.D., "*Simulation of continuous counter current spray column hydrolysis*", 1986.
- 9.14B Venkatesh, A.R., "*Enzymatic hydrolysis of starch to glucose by amylase*", 1986.
- 9.15B Modak, V., "*Control of anaerobic digesters*", 1988.
- 9.16B Singh, A., "*Circulating Fluidised beds*", 1989.
- 9.17B Acharya, R.V., "*Studies in Solid State reaction between Barium carbonate and Cupric oxide*", 1991.
- 9.18B Daga, P., "*Purification of Wastewaters in Vermicultured, Biofilters*", 1992.
- 9.19B Desai, P., "*Studies in Liquid Waste Processing using additives*", 1997.
- 9.20B More, S., "*Organic fouling of ion exchange resins*", 1997.
- 9.21B Murlidhar, K., "*Colour removal from waste water*", 1997.
- 9.22B Natrajan, Mahesh, "*Waste water processing using additives*", 1998.
- 9.23B Mondal, Uttam, "*Waste water processing using additives*", 1999.

- 9.24B Bansal, Pratik, “Waste water processing using additives”, 1999.
- 9.25B Indalkar, Sagar, “Waste water processing using additives”, 2000.
- 9.26B Sahasrabudhe, Prabhakar, “Waste water processing using additives”, 2001.
- 9.27B Sanjay Gupta, “Waste water processing using additives”, 2002.
- 9.28B Amit Gupta, “Studies in Pulsating Flow for Gas Solid reactions”, 2003.
- 9.29B Rajkumar, “Studies in nitrogen removal from waste water”, 2003.
- 9.30B. Gandhi, R. K., " studies in pulsating flow" 2004
- 9.31B Yeole, Umesh Prabhakar" *Soil Biotechnology Process Simulation using Computational Fluidynamics*" 2004
- 9.32B Bhudhiraja, Sudheendra., "*Soil Biotechnology Process simulation using Computational Fluidynamics*" 2005
- 9.33B Sathy Murthy “Studies in oxygen transfer & RTD in soil filters”, 2006.
- 9.34B Supritam M. Dutta, “Residence Time Distribution and Oxygen Transfer Studies in Constructed Soil Filter”, 2007.
- 9.35B A S S Nookapathi, *Removal of Nitrate from Water by Constructed Soil Filter*, 2008

9. International Conference Publication and Others

- 9.1 Modi, R.I., Kacchy, A.N., Shankar, H.S., “Continuous fermentation of molasses to ethanol using a strain of *Saccharomyces cerevisiae*”, Paper presented at the 8th International Specialised Symposium on Yeasts, Bombay, 25-28 January 1983.
- 9.2 Desai, S.M., Raghunathan, T.S., Shankar, H.S., “Hydrolysis of fats, *Proceedings*” International Chemical Reaction Engineering Congress, Pune, January 1984 in *Frontiers in Chemical Engineering*, Ed. Doraiswamy, L.K., Mashelkar, R.A., Vol. I, page 523-530, John Wiley, New Delhi, 1984.
- 9.3 Shankar, H.S., Narayanamurthy, S.L., Kudchadkar, A.P., “Hydrolysis of castor oil by castor lipase”, *Proceedings International Chemical Reaction Engineering Congress, Pune, January 1984, in Frontiers in Chemical Reaction Engineering*, Ed. Doraiswamy, L.K. Mashelkar, R.A., Vol. I, page 499-505, John Wiley, New Delhi, 1984.
- 9.4 Joshi, P.A., Chidambaram, M., Shankar, H.S., “Analysis of non-catalytic reactions in circulating reactor regenerator systems”, Paper presented First International Conference on Circulating fluidised beds, Halifax, November 18-20, 1985, in “Circulating Fluidised Beds”, Ed. P. Basu, Academic Press, pp 423-429, 1986.
- 9.5 Joshi, P.A., Namdev, P.D., Venkatesan, K.N., Chidambaram, M., Shankar, H.S., “performance of Circulating fluidized bed reactor – regenerator system, *Recent Trends in Chemical Reaction Engineering*”, (Ed) Kulkarni, Vol. II, pp 391-396, Wiley Eastern, Bombay, 1987 *Proceedings of ICREC II, National Chemical Laboratory, Pune.*
- 9.6 Sivakumar, S., Chidambaram, M., Shankar H.S., “Transient behaviour of vertical upflow, downflow, and horizontal transport reactors”, World Congress III of Chemical Engineering, Japan, Part IV, pp 199-202 (1986).
- 9.7 Sivakumar, S., Chidambaram M., Shankar, H.S., “Periodic operation of transport reactors for non catalytic gas solid reactions”, In *Recent Advances in Chemical Reaction*

- Engineering (Ed.) Kulkarni, B.D., Mashelkar, R.A., Sharma, M.M., Wiley Eastern, Vol. I, pp 335-359, 1987.
- 9.8 Sivakumar, S., Chidambaram, M., Shankar, H.S., In recent Advances Catalytic Reaction Engineering, (Ed.), Kantarao, R.R.L., pp 162-172 (1986).
 - 9.9 Congress on Traditional Sciences and Technologies Proceedings, 28 November – 3 December 1993, Ed. Shankar, H.S., Jhunjhunwala, A., IIT Bombay, (300 pages).
 - 9.10 Scot Fogler, H., Hamshire, S.V., Shankar H.S., Sachdev, A., “*Solution Manual for Elements of Chemical Reaction Engineering*”, 2nd Edition, Prentice Hall, (1987).
 - 9.11 Patnaik, B.R., Bhawalkar, V.S., Shankar, H.S., “*Waste Processing in Engineered Ecosystems*”, 4th World Congress on Chemical Engineering, 23-27, September 2001, Melbourne, Australia (to be presented).
 - 9.12 Patnaik, B.R., Bhawalkar, U.S., Shankar, H.S., “*Soil Biotechnology for Solid Waste Treatment and utilization*”, 18th International Conference of Solid waste technology and management, 22-26, March, 2003, Philadelphia, USA.
 - 9.13 Patnaik, B.R., Bhawalkar, U.S., Kadam, A., Shankar, H.S., “*Soil Biotechnology for Waste Water Treatment and utilization*”, 13th ASPAC 2003, International Water Works Association Conference 13-18, October, 2003, Quezon City, Philippines
 - 9.14 Yeole, U. R., Patnaik, B.R., Shankar, H.S., " *Soil Biotechnology process simulation using computational fluid dynamics*" Session Advanced Computations for Environmental Applications II" AIChE Annual Meeting, 7-12 Nov 2005, Austin Texas, USA
 - 9.15 Patil, Kiran., Jain, S., Gandhi, R.K., Shankar, H.S., " *Calcium carbonate decomposition under external pressure pulsations*" Session Multiphase reaction Engg , AIChE Annual Meeting, 7-12 Nov 2005, Austin, Texas.
 - 9.16 Kadam A.M., Oza G.H. Nemade P.D., Shankar H.S., (2006). *Reuse of Municipal Wastewater by Soil Biotechnology system-a case study*. Trombay symposium on desalination and water reuse (TSDWR 07), February 7-9, 2007, Mumbai.
 - 9.17 Kadam A.M., Oza G.H, Shankar H.S., 2005. “*Carbon, Nitrogen and Pathogen removal using soil filter device*” in 9th International Conference, 25-26th November, 2005, Mumbai, India.
 - 9.18 Nemade P.D, Shankar H.S., Kadam A.M., Oza G.H. (2007). *Removal of Arsenic from Drinking Water: Recent Trends and Development*. Third International groundwater conference (IGC-2007) on Water, Environment and Agriculture Present Problems and Future Challenges (Feb. 7-10, 2007), at Coimbatore, Tamilnadu, India.
 - 9.19 Nemade P. D, Kadam A.M., Oza G.H, Dutta S. M., Shankar H.S. (2007). *Adsorption of Arsenite As (III) by Soil Biotechnology and Hydrous Ferric Oxide*. International Conference on Water Management and Technology Applications in Developing Countries, Kuala Lumpur 14 - 16 May 2007, Malaysia.
 - 9.20 P. D. Nemade, A. M. Kadam, G. H. Oza, S. M. Dutta, H. S. Shankar. (2007). *Adsorption of Arsenite from Water by Soil Biotechnology*. 2nd IWA ASPIRE, Asia-Pacific regional Group conference & Exhibition on Water and Sanitation in the Asia-Pacific region: opportunities Challenges and Technology, 28 Oct-1 Nov 2007, Perth Convention Centre, Australia.
 - 9.21 Pravin D. Nemade, Avinash M. Kadam, Goldie H. Oza, Supritam M. Dutta, H. S. Shankar. (2007). *Arsenic Adsorption onto Hydrous Ferric Oxide (HFO) from Water*. 2nd IWA ASPIRE, Asia-Pacific regional Group conference & Exhibition on Water and Sanitation in the Asia-Pacific region: opportunities Challenges and Technology, 28 Oct-1 Nov 2007, Perth Convention Centre, Australia.

- 9.22 Nemade P. D., A. V. Kadam, H. S. Shankar (2007). *Removal of As (III) from Water by Constructed Soil Filter System*. Int. Conference on Environment Management: Scenario & Strategies to 2020, EMASS 2020, Ujjain, 26, 27 Dec 2007.
- 9.23 Kadam A. M., Nemade P. D., Oza G. H., Sathyamoorthy M. V., Dutta S. M., Shankar H. S. (2007). *Wastewater Purification Using Soil Biotechnology System*, National Conference on at Govt. College of Engineering, Amravati, Maharashtra.
- 9.24 Pravin D. Nemade, A. M. Kadam, H. S. Shankar. (2008). *Removal of Arsenic from Water in presence of Phosphate by Constructed Soil Filter (CSF)*, 8th Specialized Conference on Small Water and Wastewater Systems (SWWS) and 2nd Specialized Conference on Decentralized Water and Wastewater International Network (DEWSIN), Kumaraguru College of Technology, Coimbatore, India February 5 to 9, 2008.
- 9.25 P. D. Nemade, A. M. Kadam, H. S. Shankar. (2008). *Remediation of Arsenic & Iron Contaminated Groundwater Using Novel Constructed Soil Filter (CSF) System*, International groundwater Conference on Groundwater Dynamics & Global Change, March 11-14, 2008, University of Rajasthan, Jaipur.

10. Journal Publications

- 10.1 Shankar, H.S., Agnew, J.B., **Kinetics of acetylene hydrochlorination over mercuric chloride catalyst**, *IEC Prod. Res. Dev.*, 19, pp 232-237 (1980).
- 10.2 Shankar, H.S., Agnew, J.B., **Catalytic Deactivation in acetylene hydrochlorination over mercuric chloride catalyst**, *IEC Prod. Res. Dev.*, 25, pp 19-22 (1986).
- 10.3 Lagoo, C.K., Shankar, H.S., Narayanamurthy, S.L., **Mass Transfer studies in liquid membrane separation of hydrocarbon mixtures**, *Indian Chemical Engineer*, 27(2), pp 52-54, (1985).
- 10.4 Joshi, P.A., Shankar, H.S., **Comments on population balance and residence time distribution models for well mixed reactor regenerator systems**, *Chemical Engineer, Science* 39(12), pp 1820-1921, (1984).
- 10.5 Sivakumar, S., Chidambaram, M., Shankar, H.S., **Comparison of vertical upflow, downflow, and horizontal transport reactors for non catalytic**, *The Chemical Engineering Journal*, 33, pp 103-107, (1986).
- 10.6 Butala, D.N., Patil, T.A., Raghunathan, T.S., Shankar, H.S., **Thermal Hydrolysis of Vegetable Oils Part I : Reaction Kinetics**, *Industrial and Engineering Chemistry Research*, 27(5), pp 727-735, (1988).
- 10.7 Patil, T.A., Raghunathan, T.S., Shankar, H.S., **Thermal Hydrolysis of Vegetable Oils and fats, Part II : Hydrolysis in a stirred tank reactor**, *Industrial Engineering Chemistry Research*, 27(5), pp 735-739, (1988).
- 10.8 Namdev, P.D., Patil, T.A., Raghunathan, T.S., Shankar, H.S., **Thermal Hydrolysis of Vegetable Oils and Fats, Part III : Analysis of Design Alternatives**, *Industrial Engineering Chemistry Research*, 27(5), pp 739-743, (1988).
- 10.9 Bajaj, J.K., Shankar, H.S., **An inquiry into traditional and modern energy resources of India**, Annual Member, *Chemical Weekly*, Bombay (1982).
- 10.10 Bajaj, J.K., Shah, S., Shankar, H.S., **Impact of MODernisation of Milk and Oil Seeds Economy Part I : Changes in Bovine Stock and Milk Economy**, *PPST Bulletin* No. 10, pp. 15-58 (1987).

- 10.11 Bajaj, J.K., Shah, S., Shankar, H.S., **Impact of Modernisation of Milk and Oil Seeds Economy Part II : Changes in Oil Seeds Economy**, *PPST Bulletin* No. 11, pp 20-46 (1987).
- 10.12 Sivakumar, S., Yethiraj, A., Chidambaram, M., Shankar, H.S., **Analysis of Transport reactors : Comparison of Vertical upflow, downflow and horizontal transport reactors**, *Hungarian Journal of Industrial Chemistry*, 15, pp 323-332 (1987).
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