Dr. Sundar S K

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Objective:

To pursue an opportunity in research/teaching in a reputed concern by making long term commitment through which I can dedicate my technical skills for the growth of the organisation and willingness to walk an extra mile to achieve level of excellence.

Teaching Experience:

a) Assistant Professor, Department of Chemical Engineering, SVNIT (2019 onwards).
b) Associate Professor, Department of Chemical Engineering, KARE (2018-2019).
c) Assistant Professor-III (Sr.), Department of Chemical Engineering, KARE (2017-2018).
d) Assistant Professor, Department of Chemical Engineering, PMIST (2015-2017).

Ph.D positions available in:

1. Electrospun nanofibers and its applications such as packaging, water treatment, biomedical, etc.
2. Wastewater treatment (Enzymatic/Biosorbent based).
3. Green synthesis of nanoparticles and its applications.
4. Smart materials.
5. Rheology.

   & Allied areas of Chemical Engineering

Research Projects:

S.No.	Project title	Duration	Role	Sponsoring Agency
1	Nanoemulsions and their stability aspects for efficient delivery of micronutrients	2 years (Jan 2021 onwards)	PI	SVNIT
2	Synthesis and rheological characterization of liposome stabilized emulsion-hydrogel matrix for controlled release of essential oil	3 years (May 2022 onwards)	PI	GUJCOST
3	Development of drug delivery systems based on phase change materials	3 years (Feb 2022 onwards)	Co-PI	DST-SERB

Few Research Interests:

a) Drug delivery systems (Biodegradable smart polymers)

b) Nanomaterials

c) Colloids and Interfaces / Surfactants / Rheology

d) Modelling and simulation/MD simulations

e) Biochemical Engineering (Fermentation/Enzyme Technology)

f) Waste to Wealth

Research Experience:

a) PhD Research Scholar

January 2008 - May 2015

Indian Institute of Technology Bombay, Mumbai, Maharashtra

Title of Research work: Self Assembly and Dewetting of Lipid Bilayers.

Supervisor: Prof. Mahesh Tirumkudulu.

The research work focused on interdisciplinary topic involving the principles of chemical engineering, colloids and interfacial science, biotechnology and material chemistry. The purpose is to understand the biophysics of liposome (vesicle) formation through self assembly via hydration inside microfluidic channels by developing a device that could be

operated in a continuous mode to produce sub-100-nm liposome formulation in a single step while encapsulating a bioactive ingredient. Liposomes are association colloids formed from double tailed surfactants called phospholipids and is composed of lipid bilayers enclosing an aqueous compartment. The size of a liposome may vary from 20 nm up to several micrometres and could be composed of single or multiple bilayer membranes referred to as unilamellar or multilamellar liposome, respectively. While there are many traditional methods for liposome synthesis, the liposomes produced are polydisperse and cannot be commercialized. Further, they require additional post-processing steps such as filtration and extrusion that are time consuming and there is loss of liposomes. Hence the present research focusses on single step process to produce liposomes. The procedure involves preparation of porous packed bed using colloidal alumina nanoparticles that are immobilized. The lipid dissolved in an organic solvent is coated over the packed bed of colloidal particles and hydrated with water to produce liposomes. Experiments were carried out to find the effect of process parameters on the liposome size. The liposome size was around 50 nm and it is monodispersed with PDI<0.3. Our experiments show that the size of the liposome is independent of the particle size or the pore size. The robustness of the process and the extremely tight control on the liposome size range make it amenable to various biotech applications involving liposomal delivery systems. We speculate that the tortuous channels present inside the packed bed coupled with surface topography leads to monodisperse liposome formation and plays significant role in size selection mechanism.

Efforts were also made to estimate the volume fraction of liposomes in terms of its encapsulation efficiency using fluorescent dye by presenting a simple model.

Finally, in order to understand the mechanism of liposome formation by hydration, we have examined the behaviour of lipid bilayer (coated over glass substrate) under the influence of intermolecular forces at the interface. The phenomena was examined using four different lipid molecules and two different solvents. It was observed that such a layer undergoes instability leading to hole/domain formation throughout the area of the film. From the morphology of the holes, lipid film thickness, characteristic length scale of the holes and number density of the holes we conclude that hole forms via spinodal decomposition driven by attractive intermolecular forces.

Practical application: The liposome has been exploited for numerous applications such as penetration enhancer in cosmetics, encapsulation of micronutrients, flavours/fragrance, food industry, and most commonly for encapsulating drugs for targeted delivery to the afflicted sites. Supported lipid bilayers find applications in novel biomaterials and biosensors.

b) Research Assistant cum Lab Instructor

November 2006 - December 2007

Institute of Bioinformatics and Applied Biotechnology (IBAB),

Bangalore, Karnataka.

Supervisor: Dr. Kshitish Acharya, Faculty Scientist.

Research work: Lysozyme kinetics

Lysozyme kinetics was evaluated using Micrococcus luteus cells as substrate. The concentration of bacterial cell suspension was expressed in terms of its optical density. To a definite concentration of substrate, lysozyme was added and the change in optical density was measured for every 30 seconds over total duration of 5 minutes. The experiment was repeated for various initial concentrations of the substrate by keeping the lysozyme concentration constant. The velocity of the reaction was obtained by plotting optical density vs time for the various substrate concentrations and the Michaelis-Menten kinetic parameters were evaluated from the plot of 1/[V] vs 1/[S].

c) Industrial Trainee – Sponsored by DBT, Govt. of India.

November 2005 – April 2006

Oncophyta Labs Private Limited,

Madurai, Tamilnadu

d) M.Tech Dissertation

January 2005 – May 2005

National Environmental Engineering Research Institute,

Nagpur, Maharashtra.

Title of Research work: Bioremediation/Phytoremediation of wastewater containing high organics to reduce pollution using plant based enzymes.

Supervisor: Dr. R.A. Pandey, Chief Scientist.

The purpose of the research work was to reduce the environmental pollution caused due to industrial wastewater. While there were many routes available for wastewater treatment such as physico-chemical and aerobic, the plant operation requires extra power

input, agitation, mixing and also long residence times of the effluent for effective treatment. Hence there is a need for novel biological treatment as it does not require aeration equipment. Moreover, high rates of organic loading are possible while generating lesser amount of sludge. This type of anaerobic treatment can give valuable by-products during the process, such as volatile fatty acids. The investigation was done on dairy wastewater along with the recovery of volatile fatty acids from the effluent. Pre-treatment involves analyzing the COD and BOD of wastewater using standard analytical methods to monitor environment quality standards. The effluent generated after anaerobic treatment needs to be further treated to meet legislation standards. This type of post-treatment should be environment friendly and hence research was carried out using plant-based enzymes (oxidoreductases). Enzymes were extracted from bitter gourd, carrot and beetroot using standard analytical procedures and were used to treat dairy wastewater. The comparative study showed maximum COD reduction with bitter gourd (53%). Efforts were also made to study the Michael-Menten Kinetics of oxidoreductases.

Practical application: The pollution due to wastewater generated from any industry needs to be averted and the wastewater should be treated before it can be sent out of the industrial unit. The research with plant-based enzymes is eco- friendly, cost effective and is applicable to any type of industrial wastewater to minimize pollution.

e) B.Tech Project Work

January 2002 – April 2002

Shanmugha College of Engineering (Presently, SASTRA University)

Thanjavur, Tamilnadu.

Title of Research work: Manufacture of Cumene from Benzene and Propylene.

Supervisor: Dr. K.S. Rajan.

Education:

PhD Chemical Engineering (82.5%)

Indian Institute of Technology Bombay, Mumbai – 400076, Maharashtra, India.

January 2008 - April 2015

M.Tech Biotechnology (79.13%)

Centre for Biotechnology, Anna University, Chennai – 600025, Tamilnadu, India.

July 2003 - April 2005

B.Tech Chemical Engineering (79.19%)

Shanmugha College of Engineering (Presently, SASTRA University),

Thanjavur – 613402, Tamilnadu, India.

September 1998 - April 2002

Higher Secondary – XIIth (85.25%)

TVS Lakshmi Matriculation Higher Secondary School, Madurai, Tamilnadu, India.

June 1996 - April 1998

Secondary School Leaving Certificate - Xth (81.6%)

Railway Mixed Higher Secondary School, Madurai, Tamilnadu, India.

April 1996.

Conference/Workshop/FDP:

- Presented a poster "Synthesis of liposomes from dried multilamellar layers of lipid in a thin capillary" in Research Scholars' Symposium and awarded **Best Poster Prize** (2011).
- Participated in the American Chemical Society Colloids and Surface Science Symposium held in University of California from 23rd - 26th June 2013 and gave **oral presentation** on "Nanometer range liposome synthesis via hydration in packed beds." (International travel grant provided by Department of Biotechnology, GOI, India.)
- Attended **Faculty Development Programme** on "How to Bring Creativity in Students" and "Question Paper Setting" organized by PMIST (2015).

- Attended **Faculty Development Programme** on "Teaching and Learning" organized by PMIST (2017).
- Coordinator for **Faculty Development Programme** on "Application of Chemical Engineering Principles in Biotechnology" in KARE (2017).
- Attended **one day workshop** on "Entrepreneurship cum new product development" organized by KARE (2017).
- Coordinator for **National Level Technical Symposium combined with workshop** on "Bioreactors-Operation and Maintenance" KARE (2018).
- Poster presentation on "Removal of pharmaceuticals from water by adsorption on carbon derived from agricultural waste materials" A. Ganesh, Dr. Sujata Mandal (CLRI, Chennai) & Dr. S.K. Sundar. ICORTAC 2018 held in University of Madras (2018)
- Coordinator for **Faculty Development Programme** on "Research Scenario in Chemical Engineering" KARE (2018).
- Mentor for students' project on "Power from waste using microbial fuel cell". The students received financial support of Rs. 4000 from KARE.
- Attended **Faculty Development Programme** on "Design of Experiment and Artificial Neural Network" organized by SVNIT, Surat (2019).
- Coordinator for **STTP** on "Recent Trends in Energy and Environment" organized by Department of Chemical Engineering, SVNIT, Surat (2020).
- Coordinator for **STTP** on "Risk Assessment and Management in Process Industries" organized by Department of Chemical Engineering, SVNIT, Surat in collaboration with MMMUT, Gorakhpur (2020).
- Coordinator for International Conference (virtual) on "Green Chemistry and Engineering towards Sustainable Development-An Industrial Perspective (GCESDIP)" organized by Department of Chemical Engineering, SVNIT, Surat (2021).
- Coordinator for National Conference (virtual) on "Recent Advance in Chemical Engineering towards Sustainable Future" organized by Department of Chemical Engineering, SVNIT, Surat (2022).
- Attended National Level Workshop on **"Curriculum Framework 2022 for Universities, Engineering Colleges and Degree Colleges"** for implementation of NEP by Institute of Academic Excellence, Hyderabad (2022).

Membership in Professional Bodies:

(a) Member of 'Indian Institute of Chemical Engineers' (No. LAM61447)
(b) Member of 'The Institution of Engineers' (No. AM170254)

Publications (SCI/Scopus):

Journal Publication:

a) S.K. Sundar and Mahesh S. Tirumkudulu "Synthesis of sub-100nm liposomes via hydration in a packed bed of colloidal particles", Industrial and Engineering Chemistry Research, 2014, 53(1), 198-205, ACS Publications.

b) S.K. Sundar and Jigisha K. Parikh "Advances and trends in encapsulation of essential oils", International Journal of Pharmaceutics, 635, 122668, Elsevier.

Book Chapters:

a) S.K. Sundar and Mahesh S. Tirumkudulu, "Novel Method for Synthesizing Monodisperse Dispersion of Nanometer Liposomes", Book Chapter in Nanoscale and Microscale Phenomena: Fundamentals and Applications, Springer Publications.

b) S.K. Sundar and Mahesh S. Tirumkudulu, "Dewetting and hole formation in spin-coated films of lipid bilayers", Book Chapter in Nanoscale and Microscale Phenomena: Fundamentals and Applications, Springer Publications.

Patent:

a) S.K. Sundar and Mahesh S. Tirumkudulu, "Single pass process for synthesizing sub-100 nm liposomes from packed bed of colloidal particles" (Patent No: 348361).

PRIOR TO JOINING SVNIT	AT SVNIT
Subjects taught (> = 2 years): Transport Phenomena, Chemical Reaction Engineering, Process Calculations, Heat and Mass Transfer, Chemical Engineering Thermodynamics, Biochemical Engineering. Responsibilities (> = 1 year): Class coordinator, faculty advisor, NIRF/NBA coordinator (department) B.Tech projects guided: a) Manufacture of methyl ethyl ketone from secondary butyl alcohol. b) Cementitious material from bagasse. b) Synthesis of starch microspheres c) Biofertilizer from phosphorus solubilizing bacteria. d) Power generation from waste. e) Extraction of lactic acid from fruit waste. f) Removal of pharmaceuticals from water by adsorption on carbon derived from agricultural waste.	Subjects taught: Introduction to Chemical Engineering (theory and practical), Colloids and Interfacial Engineering, Mechanical Operations (theory and practical), Engineering Mathematics (Numerical Methods), Chemical Reaction Engineering, Heat Transfer (tutorial), Mass Transfer Operation (practical). Responsibilities (department): **Coordinator:** NBA accreditation, Newsletter, NIRF. **Co-Lab in charge:** CRE lab, MO lab and Analytical lab. B.Tech projects guided: a) Oxalic acid b) Diethyl Ether c) Ammonium Nitrophosphate d) Glycerin e) Isopropyl Alcohol f) Polystyrene g) Green Diesel h) Calcium Carbonate i) Acetone

Sundar S.K.
27th April 2023