

SPARK

**Newsletter of the
Department of Chemical Engineering**

Edition 23

August 2017



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ENGINEERING

From HOD's Desk

It is with immense pleasure and pride that I am writing this message to the students. Foremost, my wishes to the team that worked on this newsletter. The department has yet again added multiple feathers to its cap during this mid- year.



The summer has gone so useful for our students. Many of the students have got meritorious internships to do their summer project and get trained in research and industrial aspects as well. The prestigious SRFP fellowships were awarded to four of our students. Also, our students have interned in US and Japan. Groups of students have polished their knowledge in various renowned industries like Dow Chemicals, Technip, CPCL, CETEX Petrochemicals and SPIC. I wish them best in their career growth.

Our faculty had always taken steps to the pinnacle of success. Dr.P. Senthil Kumar has submitted 5 book chapters to the Springer Publications and they have been accepted in the book, 'Waste Bioremediation'. He has also been nominated as editorial board member for three international journals. I wish him the best in all his endeavours. Dr. B. Ambedkar and Dr. J. Dhanalakshmi submitted a project proposal DST-SERB under Extramural Research Funding (Individual Centric) Scheme (Total Project Cost - 28.31 Lakhs). I wish them the best under this regard.

I urge all the students and faculty of this department to work towards the future for '*the future is won only by efforts of the present*'.



EDITORIAL *Sailing the icy oceans...*

This new edition of “Spark” is another evolution of the department. Students of our department make us sail through icy oceans. We always have bothered about their comforts and they never bothered about sailing through the icy oceans to take the department on to the shores of sunny lands.

In order to give a detailed insight into the modern era of science and its advancements multiple scientific articles have been included. This edition contains an article which gives a detailed insight on molecular simulation in chemical engineering, application of cavitation based treatment methods for industrial effluents. We have explored the truth behind certain myths on “Climate Change”. Also, we have referred the news about closure of few industries by Green Tribunal for violating environmental laws. In the alumni corner, Mr. Ayyappan, addresses the topic and details on ‘the craft of the question’.

In the non-technical section, N.Shruthi, pens her thoughts in the verses of a poem. We have added a detailed Tamil essay on Climate Change.

We have also mentioned the achievements of our students and faculty. We strongly anticipate your support and feedback to improve the edition in the future.

Editorial Board

Chief Editor	Dr.R.Parthiban, Prof.& Head
Editor	Dr.K.P.Gopinath, Associate Professor
Student Editors	Ms.B.Madhumeetha & Ms.Neela Saraswathi
Students	Mr.Prithivinath P.Kamath (3 rd year) N.Shruthi (3 rd year), Goutham.R (4 th year), R.Badri Narayan (4 th year) Samynaathan.V (3 rd year)

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**Indian Academy of Sciences (IAS) – Indian National Science Academy (INSA) –
National Academy of Sciences, India (NASI) Summer Research Fellowship
Program (SRFP)**

	<p>Hema. P Institute of Chemical Technology Matunga, Mumbai</p>
	<p>R.Badri Narayan Institute of Chemical Technology Matunga, Mumbai</p>
	<p>R.Goutham University of Petroleum and Energy Studies Dehradun</p>
	<p>Sangeetha R Iyer Indian Institute of Science Bengaluru</p>

STUDENTS INTERSHIPS

Final Year

S.No.	Name	Institution/ Organization
1	Abhaiguru R	Internship under Tiju Thomas, Dept. of Metallurgical and Materials Engg. IIT- Madras
2	Arun Krishna B	Internship at Tube Investment Diamond Chain, India
3	Pavithra N	Internship under Dr. S. Swarnalatha, Scientist, Environmental Technology Division, CSIR-CLRI, Chennai
4	Goutham R	Internship under Dr.S.M.Tauseef, Dept. of Chemical Engg., UPES, Dehradun
5	Neeraja B	Internship under Dr. R.Ravikrishna, Department of Chemical Engineering, IIT Madras
6	Shiv Rekhi	CHEMFAB Alkalis Ltd, Pondicherry
7.	Amruth Varshinee M	Internship under Dr. M.S. Ramachandra Rao, Material Science Research Center, Department of Physics, IIT Madras
8	Sakthi Prasanth A	Technip India Ltd., Chennai
9	Kasi M	SPIC, Tuticorin.
10	Badri Narayan R	Internship under Dr Parag R Gogate, ICT, Mumbai
11	Avinash U	Internship at Dept of Metallurgical and Materials Engg., IIT - Madras
12	Shanmukapriya J	Technip India Limited, Chennai
13	Lavanya K	
14	Akshay Thiagarajan	Internship Under Dr Morgan Stefik, University of South Carolina, USA
15	Solai Natarajan	Dow Chemical International Pvt. Limited, Chennai
16	Dikshita Sakthivel	
17	Vaibhav kn	Ernst and Young, India
18	Shyamala B	Dr S Venugopal, Dept. of Chemical Engineering, IISC, Bangalore

19	Srikanth B	Dr K.Haribabu, Dept. of Chemical Engineering, NIT Calicut
20	Ram Prasath A	
21	Shriya Kumar	Inplant at Indian Institute of Food Processing Technology, Thanjavur
22	Manohar N T	SPIC, Tuticorin.
23	Mohamed Ismail Salman M	
24	Ganesh Raj	
25	Srinath R	
26	Vidyasagar A	
27	Naveen Krishna D	Internship at The Kerala Minerals and Metals Ltd., Chavara
28	Vishal Vaid	Internship at Integrated Coastal and Marine area Management, Ministry of Earth Sciences, GoI
29	Surya Prakash K	PETROFAC, Chennai

Third Year

1	P.L. Sriram, G	In-plant training at CETEX Petrochemicals
2	G. Rakshana	
3	G. Siddharth,	
4	G. Shanmugapriya,	
5	M. Joselyn Monica	
6	V. Felix Vargees	
7	P. Varshini,	In-plant training at NIPPON Paints
8	V. Priyadarshini	
9	M. Danish John Paul	In-plant training at Jayasakthi Chemicals Pvt. Ltd
10	R. Ajay krishna	In-plant training at CPCL Ltd
11	Anshuman. K	
12	Saravanan	In-plant training at Hi-Tech Carbon (Aditya Birla)

STUDENTS Beyond GRADES

GRADE?



A. Adithya Joseph

GRE – 326/340

Nivetha Thyagarajan

Internship

**Hiyoshi Corporation, Omihachiman,
Shiga prefecture, Japan**



Sangeetha R Iyer

Summer Research Fellowship

IISC Bangalore



R. Racchana

Internship

CSIR



Harish.C

Internship

**DRDO High Energy
Materials Research Lab,
Pune**



Samynaathan. V

IIT Kanpur

Internship







Projects, Awards & Achievements





Dr.P.Senthil Kumar, Associate Professor received **“Outstanding Researcher & Scholar Icon 2017”** under the research area of “Chemical Engineering” in recognition for the meritorious achievements rendered through research. This award was received from Jupiter Scholar Awards for Excellence in Research Powered by Jupiter Publications Consortium & Ingenious Cyberonics Private Ltd held at Liberty Park Hotel, Chennai

Publication list (April- July-2017)

	<p>Dr. R. Parthiban, Professor & Head accepted a research article titled "Potential application of redox mediators and metabolic uncouplers in Environmental Research-A-Review" in an International Journal titled "ChemBioEng Reviews"</p>
	<p>Dr. K. Jagannathan, Associate Professor, along with three other coauthors abroad, had published an article titled "Effect of Catalyst Loading on Photocatalytic Degradation of Phenol by Using N, S Co-doped TiO₂" in the IOP Conf. Series: Materials Science and Engineering 206 (2017) doi:10.1088/1757-899X/206/1/012092.</p>
	<p>Dr. K. Jagannathan, Associate Professor, along with Dr. V. Jaikumar, Associate Professor, had published a research paper titled "Investigations on nanostructured LiMnPO₄ particles for cathodic material in Li-ion battery applications", in the international journal, <i>Res. J. Pharm. Biol. Chem. Sci.</i>, vol 8(3S), pp. 1-7.</p> <p>Dr. K. Jagannathan, Associate Professor, along with Dr. V. Jaikumar, Associate Professor, had published a research paper titled "Nitrogen and Sulphur Doped TiO₂ for Photodegradation of Phenol under visible light", in the international journal, <i>Res. J. Pharm. Biol. Chem. Sci.</i>, vol 8(3S), pp. 360-364.</p> <p>Dr. K. Jagannathan, Associate Professor, along with Dr. V. Jaikumar, Associate Professor, had published a research</p>

	<p>paper titled "Biodegradation Kinetics of Azo Dye Mixture: Substrate Inhibition Modeling", in the international journal, Res. J. Pharm. Biol. Chem. Sci., vol 8(3S), pp. 365-375.</p> <p>Dr. K. Jagannathan, Associate Professor, along with Dr. V. Jaikumar, Associate Professor, had published a research paper titled "Pulasan Peel for the Removal of Reactive Orange 16", in the international journal, Res. J. Pharm. Biol. Chem. Sci., vol 8(3S), pp. 376-387</p>
	<p>Dr.P.Senthil Kumar, Associate Professor in collaboration with King Saud University, Saudi Arabia published a research article titled "Fabrication and characterization of a nanocomposite hydrogel for combined photocatalytic degradation of a mixture of malachite green and fast green dye" in an International Journal titled "Nanotechnology for Environmental Engineering", Vol. 2 (4), pp.1-7, 2017, Springer.</p> <p>Dr.P.Senthil Kumar, Associate Professor along with our passed out M.Tech Environmental Science and Technology student Mr.M.Yashwanthraj published a research paper titled "Modelling and analysis of packed bed column for the effective removal of zinc from aqueous solution using dual surface modified biomass" for an International Journal titled "Particulate Science and Technology", DOI: 10.1080/02726351.2017.1329243, 2017 (IF: 0.707).</p> <p>Dr.P.Senthil Kumar, Associate Professor in collaboration with Amrita University, Coimbatore published a research paper titled "An insight into the Prediction of Biosorption Mechanism, and Isotherm, Kinetic and Thermodynamic Studies for Ni(II) ions Removal from Aqueous Solution using Acid Treated Bio-sorbent: the <i>Lantana camara</i> fruit" for an</p>

	<p>International Journal titled "Desalination and Water Treatment"(IF:1.272).</p> <p>Dr.P.Senthil Kumar, Associate Professor published the following research papers in the International Journal titled "IET Nanobiotechnology",</p> <p>“Construction Of Active Bio-Nanocomposite By Inseminated Metal Nanoparticles Onto Activated Carbon: Probing To Antimicrobial Activity” - DOI:10.1049/iet-nbt.2016.0234, 2017 (IF: 1.50).</p> <p>"Green synthesis of metal nanoparticles loaded ultrasonic assisted <i>Spirulina platensis</i> using algal extract and their antimicrobial activity - DOI: 10.1049/iet-nbt.2016.0223, 2017 (IF: 1.50).</p> <p>Dr.P.Senthil Kumar, Associate Professor in collaboration with Amrita University, Coimbatore published a research paper titled "Functional group assisted green synthesized superparamagnetic nanoparticles for the rapid removal of hexavalent chromium from aqueous solution" for an International Journal titled "IET Nanobiotechnology" (IF: 1.50).</p> <p>Dr.P.Senthil Kumar, Associate Professor published a research paper titled "Efficient Techniques for the Removal of Toxic Heavy Metals from Aquatic Environment: A Review" for an International Journal titled "Journal of Environmental Chemical Engineering", DOI:10.1016/j.jece.2017.05.029, 2017, Elsevier (IF: 1.428).</p>
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	<p>Dr. P. Senthil Kumar, Associate Professor published a research article titled "Adsorption isotherm, kinetics and thermodynamic analysis of Cu (II) ions onto the dried algal biomass (<i>Spirulina platensis</i>)" in an International Journal titled "Journal of Industrial & Engineering Chemistry", Elsevier (IF:4.421)</p> <p>Dr. P. Senthil Kumar, Associate Professor along with our M.Tech Environmental Science and Technology students Ms. K. Grace Pavithra and Ms. C. Femina Carolin published a research article titled "Removal of toxic Cr(VI) ions from industrial tannery wastewater using a novel three-phase three-dimensional electrode reactor" in an International Journal titled "Journal of Physics and Chemistry of Solids", Vol. 110, pp. 379-385, 2017, Elsevier (IF: 2.059)</p>
 	<p>B. Ambedkar^{a*} and Dr. J. Dhanalakshmi along with B.Tech final year students A. Joseph Wilson, M. S. Ken Saroven, and D. Murugesh, published a paper titled "Beneficiation of Indian Coals: Process Intensification by Power Ultrasound", <i>International Journal of Emerging Research in Management and Technology</i> - Accepted. (Impact Factor - 1.49)</p> <p>Dr. B. Ambedkar[*] and Dr. J. Dhanalakshmi along with M.Tech Passed out student Josephin Alex, published a paper titled "Enhancement of Mechanical Properties and Durability of the Cement Concrete by RHA as Cement Replacement: Experiments and Modeling", <i>Construction & Building Materials</i>, 148 (2017) 167 - 175. (Impact Factor = 2.88)</p> <p>Dr. B. Ambedkar, Dr. J. Dhanalakshmi, and Dr. R. Anantharaj and along with passed out M.Tech student Josephin Alex</p>

	<p>published a paper titled "Addition of Rice Husk Ash as Supplementary Cementitious Material (SCM) in Concrete for Sustainable Development", <i>Research Journal of Pharmaceutical, Biological and Chemical Sciences</i>, ISSN: 0975-8585, May-June 2017, 325-334.</p> <p>Dr. B. Ambedkar, Dr. R. Anantharaj, and Dr. J. Dhanalakshmi, along with passed out M.Tech student Judith Emlliah Christy S S published a paper titled "Treatment of Synthetic Turbid Water using Tamarind seeds at atmospheric conditions", <i>Research Journal of Pharmaceutical, Biological and Chemical Sciences</i>, ISSN: 0975-8585, May-June 2017, 352-359.</p> <p>Dr. J. Dhanalakshmi and Dr. B. Ambedkar along with passed out B.Tech final year students Deepak Kumar B, Aravind S, Ayyappan S, published a paper titled "Prediction of salting coefficient for Acetone-Methanol-Salt System using Scaled Particle Theory", <i>Research Journal of Pharmaceutical, Biological and Chemical Sciences</i>, ISSN: 0975-8585, May-June 2017, 335-341.</p>
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Faculty Interaction Details

April – July-2017

08.07.2017	Dr. R. Parthiban , Professor & Head newly elected as Joint Honorary secretary IChE-Chennai Regional Centre during the period of 2017-2019.
29.07.2017	Dr. R. Parthiban , Professor & Head inaugurated the association activities and delivered a guest lecture at Global Institute of Technology (GIT), Vellore.
11.04.2017	<p>Dr.P.Senthil Kumar, Associate Professor submitted a project proposal titled "An environmental remediation of chlorinated hydrocarbon fluids in the ground water by nano-zero valent iron / activated carbon composite" to DST, New Delhi under the scheme of "Water Technology Initiative (WTI)"</p> <p>Dr.P.Senthil Kumar, Associate Professor had a first technical discussion with the AQUA BASE CONSULTANTS people to install a 400 KLD Sewage Treatment Plant in our SSN Campus.</p>
01.05.2017	<p>Dr. P. Senthil Kumar, Associate Professor has submitted the following book chapters to Springer Publications and it has been accepted to include in the book titled "Waste Bioremediation"</p> <ol style="list-style-type: none"> 1. "Biomining for recovery of resources" 2. "Evaluation of Next-Generation Sequencing Technologies for Environmental Monitoring in Waste Water Abatement" 3. "Bioremediation of heavy metals" 4. "Pesticides bioremediation" 5. "Biosorption strategies in the remediation of toxic pollutants from contaminated water bodies" <p>He has also reviewed the research manuscript titled "TDWT-2017-0484 - Adsorption of direct yellow 12 dye from aqueous solutions by Fe₃O₄-gelatin adsorbent; Kinetics, isotherm and mechanism analysis" for an International Journal titled "Desalination and Water Treatment".</p>
02.05.2017	Dr.P.Senthil Kumar , Associate Professor has been nominated as an Editorial Board Member for an International Journal titled " Nanotechnology for Environmental Engineering ".

04.05.2017	Dr.P.Senthil Kumar , Associate Professor has been nominated as an Editorial Board Member for an International Journal titled " Journal of Chemical Engineering ".
05.05.2017	Dr.P.Senthil Kumar , Associate Professor has been nominated as an Editorial Board Member for an International Journal titled " Asian Journal of Chemical Sciences ".
12.05.2017	<p>Dr. P. Senthil Kumar, Associate Professor has submitted the following book chapter for the book titled "Life-cycle Assessment of Wastewater Treatment" to be published by CRC Press Taylor & Francis Group and it has been accepted to include in the book.</p> <ul style="list-style-type: none"> • Environmental and health effects due to the usage of wastewater • A biological approach for the removal of pharmaceutical pollutants from wastewater • Technologies for the treatment of heavy metal contaminated groundwater
15.05.2017	Dr. P. Senthil Kumar , Associate Professor has nominated to submit the book chapter titled " IPR & Biosafety – Chapter 31 - Patent filing and infringement " for the book titled " Essentials of Biotechnology Part 1 " for the M.Sc. (Biotechnology) students, University of Mumbai.
23.05.2017	Dr. P. Senthil Kumar , Associate Professor published a book chapter titled " Progress from Composite Materials to Biocomposite Materials and Their Applications: A Review " for the book titled " Modified Biopolymers Challenges and Opportunities " for the book series " Polymer Science and Technology ", published by NOVA Science Publishers, New York, ISBN: 978-1-53612-116-2, pp. 163-188, 2017.
08.06.2017	Dr. P. Senthil Kumar , Associate Professor has received an appreciation based on his previous chapter titled " Chapter 31 Patent Filing and Infringement " submission and also further he has nominated to submit one more book chapter titled " Bioprocess Technology, Chapter 25 Concepts of basic mode of fermentation processes " for the book titled " Essentials of Biotechnology Part 1 " for the M.Sc. (Biotechnology) students, University of Mumbai.
17.06.2017	Dr. P. Senthil Kumar , Associate Professor submitted the following three abstracts as a book chapters titled

	<p>i) "Global macrorends in pharmaceutical industry"</p> <p>ii) "Order and shipping improvement in pharmaceutical industry"</p> <p>for the book "Global Supply Chains in the Pharmaceutical Industry" published by IGI Global Publishers, Pennsylvania (USA) and it has been accepted to include in the book.</p>
18.06.2017	Dr. P. Senthil Kumar, Associate Professor has submitted the book chapter titled "Production strategies in pharmaceutical industry" for the book titled "Global Supply Chains in the Pharmaceutical Industry" to be published by IGI Global Publishers, Pennsylvania (USA) and it has been accepted to include in the book.
19.05.2017	Dr.P.Senthil Kumar, Associate Professor has been nominated as an Editorial Board Member for an International Journal titled "Current Green Chemistry".
20.06.2017	Dr. P. Senthil Kumar, Associate Professor has submitted the book chapter titled "Innovative Catalysis In Petroleum Refinery" for the book titled "Advanced Catalysis Processes in Petrochemicals and Petroleum Refining" to be published by IGI Global Publishers, Pennsylvania (USA) and it has been accepted to include in the book.
23.06.2017	Dr. P. Senthil Kumar, Associate Professor has convened the Ph.D. public Viva Voce Examination for his Part Time research scholar Mrs. R. Jothirani.
04.07.2017	Dr. P. Senthil Kumar, Associate Professor has submitted the book chapter titled "Diffusion of multiwall carbon nanotubes into industrial polymers" for the book titled "Recent Advances in Diffusion and Transport Phenomena of Composite Materials" to be published by Trans Tech Publications Ltd., Switzerland and it has been accepted to include in the book.
21.07.2017	Dr.P.Senthil Kumar, Dr. K.P. Gopinath and Dr. D. Balaji Co-Conveners and Dr. R. Parthiban, have organized the one day National Workshop on "Writing Scientific Research Paper - Phase IV".
27.07.2017	Dr.P.Senthil Kumar, Associate Professor has submitted the project proposal titled "Decentralized energy supply through willpower energy system for capturing-

	converting CO ₂ into bio-energy from residential building" to the DST, New Delhi with the project worth of Rs. 21.5 Lakhs.
05.05.2017	Dr. M. Subramanian , Associate Professor attended a one day workshop titled "Challenges and Opportunities in Modeling/Developing Industrial Processes" organized by Department of Chemical Engineering, Indian Institute of Science Bangalore, on 5 th May 2017
28.07.2017	Dr. B. Ambedkar arranged an Industrial Visit to Grundfos Pumps India Pvt. Ltd. 118, Rajiv Gandhi Salai, Chennai - 97, for 3 rd year B.Tech Chemical Engg. students. Dr. V. Jaikumar and Dr. B. Ambedkar accompanied the students during the Industrial visit.
20.07.2017	Dr. B. Ambedkar (PI) and Dr. J. Dhanalakshmi (Co-PI) , submitted a project proposal titled "Microwave Assisted Carbon Rich Solvent Vacuum Regeneration in Post Combustion CO ₂ Capture Process for Sustainable Energy and Environment: Continuous Process" to DST-SERB under Extramural Research Funding (Individual Centric) Scheme (Total Project Cost - 28.31 Lakhs). Dr. B. Ambedkar submitted a preliminary PATENT application to InnovationCenter at SSN.
02.05.2017	Mr.Kilaru Harsha Vardhan conducted ISO Internal Audit in ECE Department
08.05.2017	Mr.Kilaru Harsha Vardhan , Asst Professor conducted ISO Internal Audit in Sports Complex



Catalysing commercialisation :

A “cool” energy storage technique to preserve milk in rural areas.

Goutham. R, R. Badri Narayan
(4th year)

Electricity shortages stunt the economic growth of many emerging economies. In India, more than \$10 billion worth of fresh produce is wasted each year due to poor grid infrastructure. Without a reliable source of power, food processors in agricultural areas cannot operate refrigeration equipment economically. Their only option is to use backup diesel generators to fill the power gap. This not only doubles the capital cost of refrigeration equipment, it also triples the operating costs. In addition, diesel generators are a major source of noise and environmental pollution.

But help is on the way. Promethean Power Systems, a Somerville, MA-based small business with grants from the National Science Foundation, has developed a thermal battery-based refrigeration system to address the challenges of unreliable electricity supply in rural areas. Its patent-pending thermal battery pack can store and release large amounts of thermal energy to

cool agricultural products and preserve their freshness during transport from farms to markets.

The initial application for this technology is a milk chiller that cools raw milk to 4°C in seconds to arrest bacterial growth and preserve its freshness after milking. To date, Promethean has installed more than 80 milk-chiller systems in areas throughout rural India, with a total thermal energy storage capacity of over 2 MWh. The company is also conducting field trials for a similar refrigeration system for the U.S. microbrewery market, and for chilling fruits and vegetables on farms.

The Promethean thermal battery consists of a phase-change material (PCM) submerged in a heat-transfer fluid (HTF) that is encapsulated in densely packed plastic tubes. Ethylene and propylene glycols, mixed with water, are used as the HTF because of their wide availability and low cost. The PCM consists of

water containing 12–14% of a nucleating agent, such as monopotassium phosphate, to achieve target temperatures necessary for food preservation (0–5°C).

This proprietary combination of HTF and encapsulated PCM is a novel modular design approach to thermal storage that enables compact, low-cost energy storage systems with predictable performance and high heat-transfer rates.

During charging, the PCM freezes as it absorbs energy from the HTF. The PCM expands during freezing, and the tubes allow for this expansion to occur without bursting.

During discharge, the PCM releases energy as it melts. The HTF remains in liquid form during charging and discharging.

To charge the battery, a refrigeration compressor cools the HTF and freezes the PCM. The compressor needs about 5 hr of grid electricity to fully charge a battery with a standard storage capacity of about 28 kWh. An automated control system consisting of a combination of

software and reconfigurable hardware from U.S. suppliers starts the charging process if and when electricity is available and stops it when the battery is charged. Once the battery is fully charged, it can chill up to 700 L of milk without any additional power.

In India's hot climate, farmers can sometimes lose as much as 30% of their milk due to spoilage. For the world's largest producer of milk, the amount of milk lost annually in India could equal the total milk production of China. While the technology addresses a significant commercial opportunity, more importantly the rapid milk chillers have the potential to change the lives of millions of people.

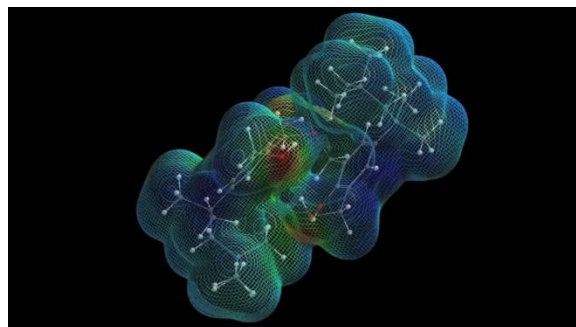
"It's a win for the dairy processors because they can collect more quality milk, it's a win for the farmers because they make more money for their milk, and it's a win for the consumers because it's healthier milk," says director Sam White, who co-founded Promethean Power Systems in 2007 in Boston with Sorin Grama, the company's chief technology officer.

Molecular Simulation in Chemical Engineering

Samynaathan V, 3rd Year

Molecular simulation involves designing, executing and analysing a model of a physical system.

The major aim of molecular simulation is to analyse the molecular interactions and shaping the structure and thermodynamic properties of the molecules. Computer simulations generate information at the microscopic level and statistical mechanics converts its information at microscopic level into macroscopic quantities. However, not all properties can be directly measured by computer simulations. Molecular simulation employs two general types of algorithms, Monte Carlo and Molecular dynamic simulation to solve the equations of statistical mechanics. Both the algorithms provide us information about the macroscopic properties of the system. Molecular dynamic simulation is a technique to study the physical movements of particles and to compute macroscopic properties of the system by integrating newton's laws of motion whereas Monte Carlo simulation relies on the probability distribution of certain system parameters. Generally, Monte Carlo method is used for examining thermos-physical and structural properties at equilibrium.



Chemical engineers apply molecular simulation to study challenging problems in the synthesis, design and characterisation of advanced materials,

Molecular simulation has evolved dramatically in the last three decades. This progress in Molecular simulation is because of the major advances in the speed of computational hardware and also due to the development of new computational algorithms.

Chemical engineers should focus on developing advanced computational strategies for overcoming length and timescale limitations. Chemical engineers should collaborate with physicists and chemists to make significant Contribution in other areas of molecular simulation. Development of efficient code and algorithms is one of the major areas. Graphical processing units allow simulations to be readily parallelized which accelerate the calculations and help to overcome potential length and timescale limitations. GPU has enabled researchers to gain access to superior

computational resources because of their relatively high performance-to-cost ratio. Chemical engineers have developed new approaches to identify promising materials for carbon capture and natural gas storage. They have also made great strides in quantum chemistry, by developing and applying methods to improve catalyst design and enhance the performance of

materials in a variety of energy-related and environmental applications. The insights obtained from combining computational and experimental investigations will help us to develop new technologies aimed at addressing many problems faced by humanity.

Application of cavitation based treatment methods for industrial effluent

R. Badrinarayan, 4th year

Across the world, there continues to be a large volume of wastewater that is generated daily from different industries. Industrial wastewater usually contains pathogens, persistent contaminants, pesticides and heavy metals. If the industrial effluent and wastewater is not properly treated before being discharged directly into rivers, water bodies, environment, human health and different organisms can be negatively affected. Water pollution caused by industrial wastewater leads to oxygen depletion in water bodies and contamination of drinking water. Cavitation is one of the methods to treat such wastewaters. Cavitation is defined as the formation, growth, and subsequent collapse of the cavities occurring in an extremely small

interval of time (milliseconds), releasing large magnitudes of energy. Under such extreme conditions water molecules are dissociated into $\text{OH}\bullet$ and $\text{H}\bullet$ radicals. These radicals then diffuse into the bulk liquid medium where they react with organic pollutants and oxidize them. Based on the process of generation of cavities, Cavitation is classified into four types based on the method of production of cavities, namely,

- Acoustic
- Hydrodynamic
- Optic
- Particle

Cavitation generated by use of ultrasound has been referred to as acoustic cavitation. Environmental remediation by ultrasound involves pollutant destruction either directly

via activating thermal decomposition reactions, or indirectly by the production of oxidative species such as hydroxyl radicals. Ultrasonically induced cavitation has been used with great success for degradation of various pollutants on a laboratory scale of operation. In order to enhance its

efficiency for scale up purpose it is coupled with Advanced Oxidation Processes (AOPs) like hydrogen peroxide addition, ozone and Fenton's reagent.

The Future of Science

Science is just not something we "learn", we are surrounded by it. Each and every thing what we see around us, reminds us about its purpose. Right from the early morning coffee that you need, till the alarm that you set up at night, we are engulfed by science, in various avatars.

Science is something which is ingrained into human consciousness right from the dawn of time. The curiosity that we have, right from childhood, plays a vital role, in unravelling the mysteries of the world around us. How can we forget, Sir Isaac Newton, for his discovery of the gravitational force, by wondering incessantly the cause of the fall of the apple? Of course, listening to the story from a starry eyed Physics teacher, on a mundane Monday Morning, makes many wish that perhaps a watermelon had fallen on his head! Nevertheless, right from the ability to make fire, Humanity has progressed leaps and

bounds, by venturing into uncharted territories with a passion. The universe is like a boundless box, full of endless things. Humanity has taken upon itself to dig deep into the box

I am not here to talk about the future inventions that we might encounter. Full of endless possibilities, that is quite a cumbersome task to list out the possibilities. Rather I am here, to talk about the future of science. As we keep on discovering new things, or making impossible things come into reality, the veracity of the progress of the human race, is in no way, doubted. Yet one might feel that with this rate of finding out things, by simply at the fingertips, due to the ever ubiquitous "invasion" of electrical gadgets, one can fear that the innate curiosity that helped humans to propel themselves to such astounding heights, might vanish from human consciousness!

This is not to say that I am against, the usage of these gadgets. The lack of a

proper development of the scientific consciousness, among the young of this generation, results, in a generation, Google fed. After all, why take the effort to experiment, when you see the results on Google scholar! Many well intentioned projects, given as assignments simply get finished by checking out the Net. The education system, as it demands a high standard of marks, fails to check whether the objective has been achieved or not.

This is just the tip of the invisible iceberg that we face. We are conditioned, right from the start that the world around us works on a well-defined formula. There are no deviants, and we are taught that the application of the concept yields us the desired results. But have people

ever questioned the rationale behind the concept? Have we, stepped out of our comfort zone? We might get our lives progressively eased by the various inventions that are bound to follow, but do we find out the logic behind them? After all, one might end up fearing, that eventually, we might lose the need to question things, and the capacity to finding out things, all by ourselves

If we go down the path, where we don't do a thing properly, and rather rely on an external source to get easy answers, perhaps, the joy of working towards something, and finding out the ultimate gold, beneath the end of the rainbow, will just be a Midsummer's night dream.

Climate Change: Myth Vs. Fact

With American President Trump set to dismantle much of his predecessor's climate change legislation, many are wondering what the impacts of climate change will be and which sources to believe. The facts and fiction on the issue of global warming:

1. If global warming is real, then why are we still experiencing record-cold winters? Isn't the planet supposed to be getting hotter?

It is true that we have observed colder temperatures in some areas. The winter of 2009 to 2010 in particular was unusually cold in Europe, and overall sea ice around Antarctica has even increased somewhat.

But it would be wrong to use this as evidence against global warming. Many different factors influence the Earth's climate, alongside human activity.

The El Niño phenomenon is the main culprit of these bizarre weather patterns. Every four years or so during the winter season in the Northern Hemisphere, warmer-than-usual sea surface temperatures appear along the South American west coast, which affects trade winds around the world and can feed into large winter storms in areas like Europe.

Although ice cover in the Antarctic has increased in recent years, the exact opposite is occurring in the Arctic Circle, where there is currently less ice than any winter in recorded history. The Antarctic is lucky in the sense that it is surrounded by strong winds and

ocean currents, which protects it from outside climate influences to some extent.

But the reality is that an increase in average temperatures on Earth has been observed since systemic measurements begin back in 1880.

The year 2016 was the warmest on record, with 2015 and 2014 taking second and third place, respectively. According to the Intergovernmental Panel on Climate Change (IPCC), the average global temperature has increased 0.85 degrees Celsius (about 1.5 degrees Fahrenheit) from 1880 to 2012. So although there will always be outlying cold weather events, there is really no disputing that the temperature is in fact increasing around the world.

2. The Earth has heated and cooled throughout its history - climate change is a natural phenomenon. Humans have had nothing to do with it in the past, this current warming is just a natural fluctuation.

Yes, the Earth's climate has changed many times over the course of millions of years as part of natural environmental processes.

But the scary thing is that this particular warming phase, over the last 50 to 150 years, has occurred much faster than any other time in history.

Climate change skeptics often argue that CO₂ emissions from human activity alone could not influence the Earth's climate to such an extent. They point to the fact that CO₂ emissions also come from other sources such as volcanoes, and that high levels are naturally controlled by plants and the permafrost cycle.

The problem is that our greenhouse gas emissions disrupt the existing balance, whereby the planet is unable to absorb and release the CO₂ as it normally would. This problem is made even worse due to increased deforestation.

The IPCC considers it "highly probable" that human influence has been the primary cause of global warming since the mid-20th century. Since 1750, the concentration of CO₂ has increased by 40 percent, and methane by 150 percent.

Although skeptics also often try and highlight the 3 percent of scientists who are not certain that human activity is driving climate change, these researchers are frequently from conservative think tanks such as the Cato Institute, which is funded by companies such as Volkswagen and other groups that rely on the continued use of fossil fuels.

3. We can't even accurately predict tomorrow's weather forecast. How can we be sure of what our climate will look like 100 years from now?

It's a common enough scenario: you check the weather forecast and are excited to see sunshine predicted for the weekend. But instead, you are disappointed by grey skies and rain.

It's important to know that the weather forecast and climate models are essentially two different things. The weather is short-term, often unpredictable, and is influenced by a variety of factors.

The climate, on the other hand, is long-term, and unpredictable weather events get balanced statistically. It is much easier to observe an increase in global temperatures over several decades, as opposed to predicting changes in weather on an hour-by-hour basis.

According to the IPCC, the reliability of climate forecasts has improved significantly in recent years, so we can be confident in their predictions - and hopefully act accordingly.

4. So what if the temperature increases by a couple degrees? The Earth is resilient; it will pull through like it has before.

At face value, increase of 2 or 3 degrees doesn't seem like much at all. But on a global level, even a minor

change in temperature can have extreme consequences.

This translates into an increase in extreme weather events such as droughts and storms - even wildfire. Sea levels are rising due to melting glaciers, and many highly populated areas increasingly find themselves underwater.

And if we don't start implementing ambitious climate protection goals

soon, the IPCC says the average global temperature could rise by 5.4 degrees by the end of the 21st century.

The Earth's climate is unpredictable by nature, and its inhabitants have had to adapt themselves many times in the past. But natural adaptation has its limits - and we are running out of time to mitigate the more severe consequences of manmade climate change.



Silver Rain, Scarlet Stream

N.Shruthi, III year.

Torn apart from glistening eye
Rolls down a pact of silver thread.
Then and there the pact does die
Scarlet, bleeds the heart instead.

“See not much, best I shall pain”,
Bleeding heart begs its part.
“Pain not much, best I shall wail”,
Beady eyes soon retort.
Even as the pact comes to be,
The soul does too much see,

And before it could hide and flee,
The tender heart does start to bleed.

Silver rain softly slides down,
Scarlet stream spills unbound,
Looking out for remains of love.
Instead, finds blood stained, snowy dove.

As voices do, once again raise
Loneliness, a faithful friend to embrace
Trying to stiffen up and face the world
Building a wall to sift through all grace.
Age old ruse, never to cease,

Pain too much even to bear a breeze.
Yet caught in a desert, a wild storm, silver rain,
Scarlet stream flows on!
Wild rumbling clouds make too much sense,
Flew right over all innocence.
Soon, like a blinding light in a distant dream,
Silver rain flows out into a scarlet stream.
Yet even beneath the bitter winter snow
Therein lies a lone seed of previous sow,
That one day, by a caressing tendril of Sun's ray
Becomes a tender scarlet, it may.....



Craft of the Question Mark

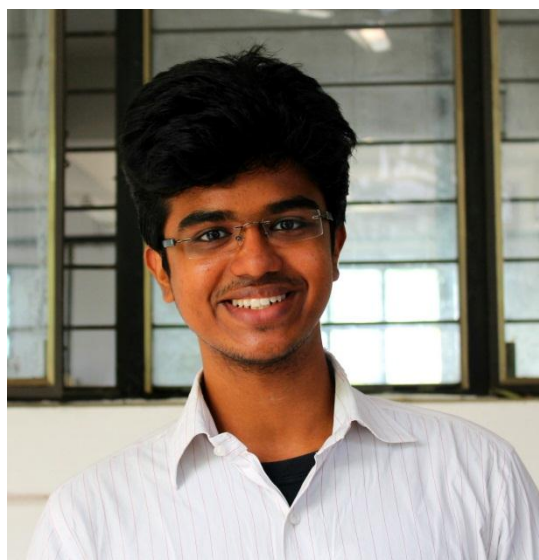
Ayyappan.R, 2012-16 Batch

As an alumnus writing in this space, I realise these words will meet eyes and minds unknown to me. In that regard, I am thankful to this platform for holding us different threads, strange to one another, together in a gentle bundle.

After I was asked to write in this space my mind wandered in the wild in search of a subject. Finally, I decided evoking nostalgia would be a cliché, and that if I could share one of my own personal lessons, this attempt could be more valuable and self-satisfying.

At the start of professional life were many changes, some externally thrust upon and some internally expected. One of the biggest lessons, however, was changing my (typical) mindset to stop telling / answering and switch to questioning. Listening and questioning.

At work, I was eager to answer, both for myself and for others in unasked interventions. It was perhaps to prove a point, and at other times, to show off. And then through the natural course, I learnt questioning is the higher form, a tougher craft; that if you could ask the right question, both



to yourself, and when needed, to others, it lifts the situation, making the cause productive.

There are a lot of factors involved in questioning. First, we mustn't question for the sake of it. The practice is to listen to the speaker, try to assimilate what (s)he is putting forth (because always what is coming out of the speaker is what the point has meant to him or how he has understood it, and not the point itself), and then when we find ourselves in ambiguity, raise an appropriate question to have it resolved. Often, we listen to the speaker and when we stumble upon ambiguity we tend to assume the inference most natural to us. When

you do this, when you *assume*, you are making an *ass* out of *you* and *me*.

And as it goes, assumption is at the root of every miscommunication. You can't afford to miscommunicate at workplace.

Another to be kept in mind is the element of curiosity that is a part of questions. When you ask a question, you exhibit curiosity; you want to fill a gap, showing that you are interested in the other person's ideas, while at the same time making yourself interesting to the person. In any conversation, the person who answers feels that he is in control of the situation, so when you pose your question, you grant the other party a sense of power, making things more favourable and less antagonistic.

There is a lot of psychology involved; try experimenting in your relationship.

In classroom too, asking questions is the best way to truly understand the concepts. While professors of other institutions may waylay your questions, or simply ignore them, ours is a place where they are most welcome. So I urge you to fully use this facility and demand, dig and delve deeper to make definite your understanding of the subject.

(I regret I didn't participate at this level while in college. Often you realise outside of where it would benefit you.)

No wonder questioning is also the right strategy in sales. When we are selling something, be it an idea, an object, or our service, all that we tend to do is to endlessly talk about its benefits, advantages and features, to the point where the could-have-been buyer has become bored and departed. But if we question his needs, to understand them and maybe even to make them clearer to himself in his process of answering, we stand a better chance of selling. While I have said in simplest terms the power of questioning in sales, it demands strategy to ask the right *kind of* question at the right moment. If interested, read SPIN Selling.

While the words are here and you are reading them, they remain just that. They become profound only once you internalise the idea and come to a realisation in your own experiences. I would be very happy to hear your thoughts around this.

Mail me at
ayyappan.sriram@gmail.com

National Green Tribunal orders closure of 13 industries violating pollution norms

(Source: "Business Standard" News article)

The National Green Tribunal today ordered closure of 13 industries in Uttar Pradesh, including Amroha-based drug firm Jubilant Life Sciences, after inspections found them violating pollution norms.

A bench headed by NGT Chairperson Justice Swatanter Kumar passed the order after noting the findings of a special inspection team which informed that effluents discharged in the Bagad river were beyond the prescribed limits.

Bagad, which spans a distance of 200 kms, contained heavy industrial pollutants from Gajraula and Bhagrula industrial clusters as there was no common effluent treatment plant on this river.

The tribunal had noted that though Bagad does not meet Ganga, the effluents would meet the river when there is a heavy flow.

"We hardly find any substance in the submissions made by the industry. We grant them time to put on record to show that they are compliant. These industries have failed to discharge their onus...We hereby direct 13 industries to shut down forthwith," the bench said while noting that these

units were extracting ground water without permission from Central Ground Water Authority.

The tribunal also directed UP government and the state pollution control board to immediately disconnect their electricity and water supply. It also asked these industries to file their response on the findings of the committee within a week.

The industrial units to be closed are Jubilant Life sciences Ltd (distillery unit), Jubilant Industries Ltd (Polymer unit), Jubilant life sciences ltd (chemical unit -1), Jubilant life sciences ltd (chemical unit -2), Jubilant Agri & Consumer Products, Jain Distillery Pvt Ltd, Teva API India Ltd, Insilco Ltd, Umang Dairies Limited, Dairy India Private Limited, Coral Newsprints Limited, Kamakshi Paper Mill and Mohit Petrochemicals Private Limited.

On April 24, the NGT had constituted an inspection team comprising Member Secretary of Central Pollution Control Board, Director (Tech), National Mission for Clean Ganga, Director, Ministry of Environment and Forests and Member Secretary of Uttar Pradesh Pollution Control Board.

They were directed to inspect 12 industries in the catchment area of Bagad River at Gajraula in Amroha district of Uttar Pradesh and report about the source of water used by them.

The tribunal had earlier said that excessive extraction of water between Haridwar and Unnao in Ganga floodplains is a serious issue and should be immediately stopped.

It had said that the water which was being diverted into the various canals should be regulated so as to help maintain a minimum flow of the river.

In a detailed report covering various aspects of contamination in the river, CPCB had informed the NGT that the Ganga, spanning a distance of 543 km

between Haridwar and Kanpur, was affected by 1,072 seriously polluting industries which were releasing heavy metals and pesticides.

At present, 823.1 million litres per day of untreated sewage and 212.42 MLD of industrial effluents flow into the river, while three of the four monitored Sewage Treatment Plants were non-compliant with the set standards, it said.

The green panel has divided the work of cleaning the river in different segments - Gomukh to Haridwar (Phase-I), Haridwar to Unnao (termed as segment B of Phase-I), Unnao to border of Uttar Pradesh, border of Uttar Pradesh to border of Jharkhand and border of Jharkhand to Bay of Bengal.

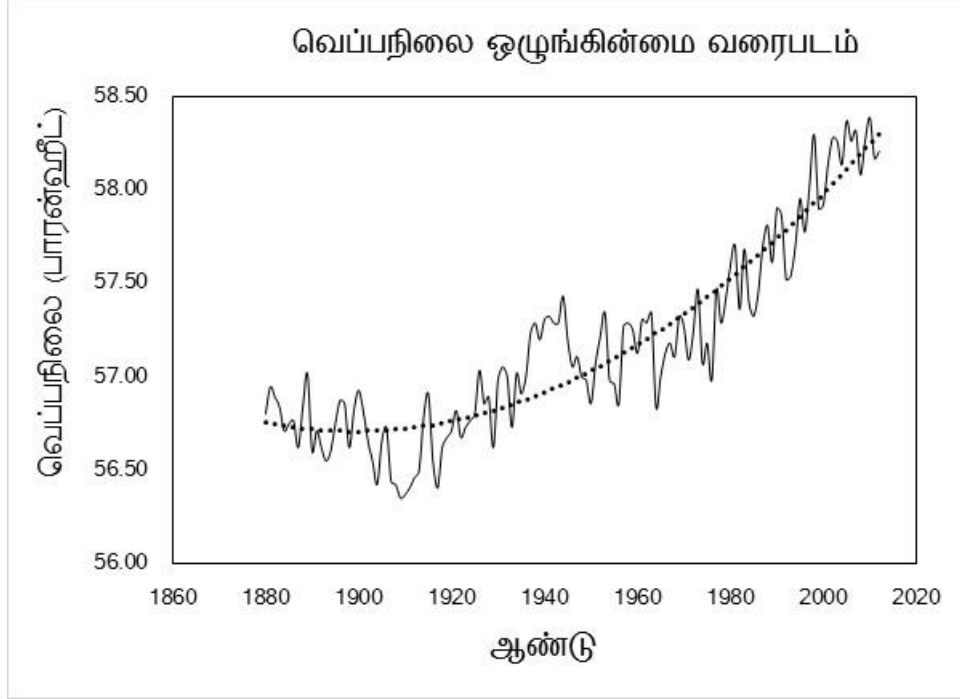
காத்திருக்கும் பேரழிவு

பேரழிவு அல்லது பேரூழி பற்றிய கருதுகோள்கள் நீண்ட நெடுங்காலமாக மக்களிடையே நிலவி வருகின்றன. இந்த ஞாலம் தோற்றுவிக்கப்பட்ட காலம் முதலாய், எவ்வளவோ அழிவுகளைச் சந்தித்துள்ளது. பல இழப்புகளைக் கண்டுள்ளது. ஆனால் அவை எல்லாம் இயற்கையாக நிகழ்ந்தவை. விண்கற்கள் வந்து மோதி டைனோசர்கள் அழிக்கப்பட்ட நிகழ்வுதான் நாமறிந்த நிகழ்வுகளிலேயே மிகப் பெரியதும், பேரழிவுக்குரியதுமாகும். 75 விழுக்காடு உயிரினங்கள் அழிந்து போனதோடு பல நூறு ஆண்டுகள் இப்புவியின் தட்பவெப்ப நிலைகளில் பெருமளவு மாற்றங்கள் நிகழ்ந்ததும் அப்போது தான். அதன் பிறகு, அது போன்றதொரு பேரழிவுக்காக நாம் காத்துக் கொண்டிருக்கிறோம். ஆனால், இம்முறை அப்பேரழிவு இயற்கையானதாக இருக்காது. மனித இனத்தின் முறையற்ற செயல்களின் வெளிப்பாடாகவே இருக்கும்.

புவி வெப்பமடைதல் குறித்து பெருமளவு ஆய்வுகள் மேற்கொள்ளப்பட்டாலும், இன்னமும் அந்த கருத்து பொய்யானது எனக் கூறும் ஒரு சாரார் உள்ளனர். தற்போதைய அமெரிக்கக் குடியரசுத் தலைவர் திரு.டோனால்ட் ட்ரம்ப் அவர்களும் கூட அப்படிப்பட்ட நம்பிக்கைக் கொண்டவர் தான். அவர் பதவியேற்றவுடன், அமெரிக்க பல்கலைக் கழகங்களில் நடத்திவரப் பெற்ற புவி வெப்பமடைதல் குறித்த ஆய்வுகளுக்கான நிதியுதவியை அவர் நிறுத்தி ஆணையிட்டதுடன், அது குறித்து ஆய்வில் ஈடுபட்ட பல நூறு அறிவியலாளர்களின் பதவியிழப்பிற்கும் காரணமானார். ஆயினும், மிகப் பரந்துபட்ட அறிவியல் கருதுகோள்களைப் பற்றியெல்லாம் குழப்பிக்கொள்ளாமல், காணக்கிடைக்கும், மிக இயல்பான, எளிய, ஆகச்சிறந்த காரணிகளை உற்று நோக்கினால், ஒரு எளிய மனிதனால் கூட புவி வெப்பமடைதல் எவ்வளவு உண்மையான நிகழ்வு என அறிந்து கொள்ள இயலும்.

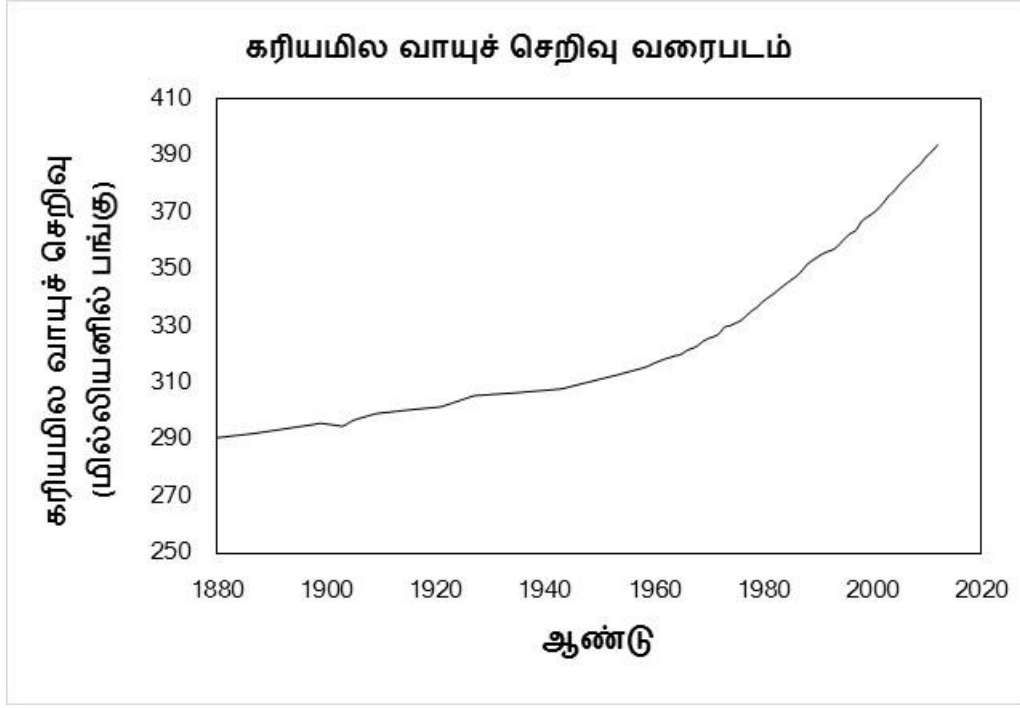
அமெரிக்க விண்வெளி ஆய்வுக் கழகமும் இன்ன பிற ஐரோப்பிய விண்வெளி ஆய்வுக்கழகங்களும், இப்புவியின் வெப்பநிலையைக் கண்காணிக்க பல செயற்கைக் கோள்களை ஏவியுள்ளன. இந்தச் செயற்கைக் கோள்களில் இருந்து பெறப்பட்ட அளவீடுகள் மூலமும், வரலாற்றின் பதிவுகளின் மூலமும், புவியின் சராசரி வெப்பநிலையானது அனைவரது பார்வைக்கும் காணக்கிடைக்கின்றது இந்த

அளவீடுகளின் தரவுகள் குறித்த எந்த ஐயமும் எழாத வண்ணம், ஏறக்குறைய எல்லா நாடுகளின் வானிலை மற்றும் விண்வெளி ஆய்வுக் கழகங்களும் இதை உறுதி செய்துள்ளன. இவற்றின் சுருக்க முடிவுகளை படம்.1ல் காணலாம்.



படம்.1 ஆண்டு வாரியான வெப்பநிலை ஒழுங்கின்மை வரைபடம் (புள்ளியிடப்பட்ட கோடு சராசரி போக்கினைக் குறிக்கிறது)

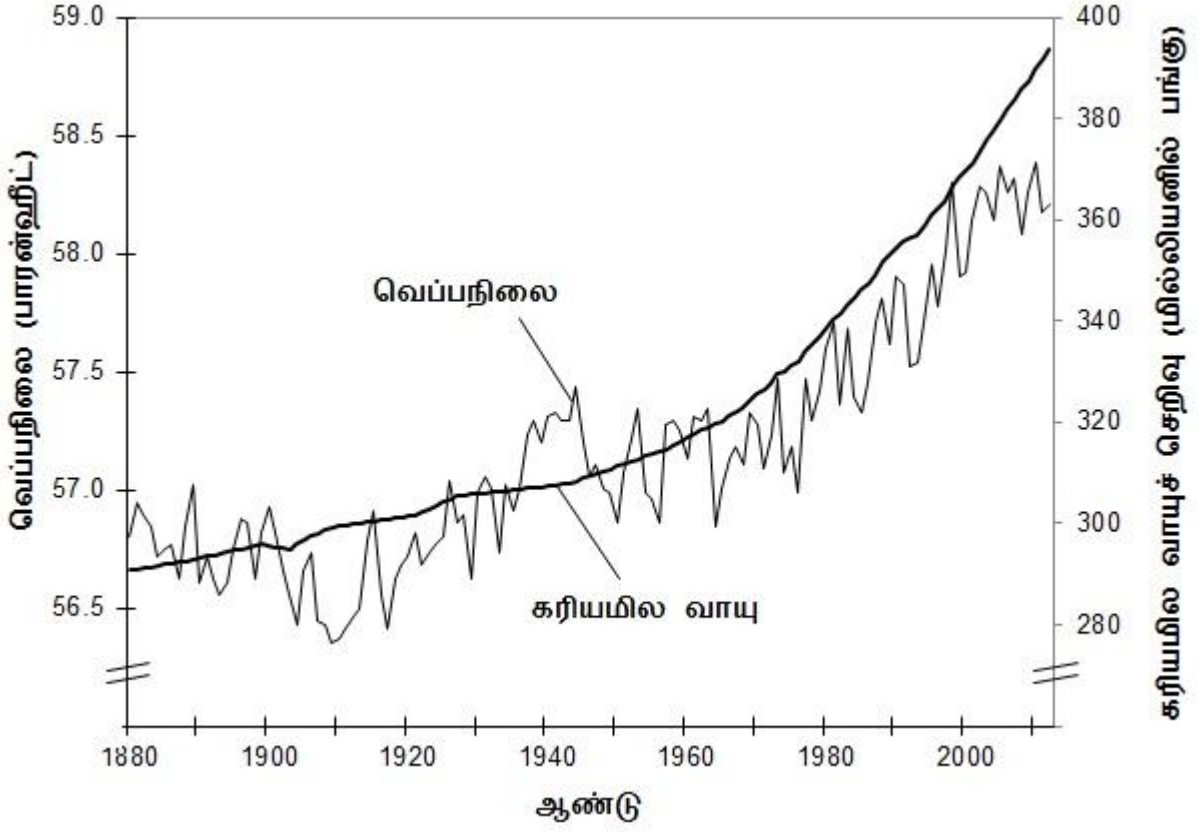
படம்.1 சொல்லும் செய்தி மிகத் தெளிவானது. புவி மிக விரைவாக வெப்பமடைந்து வருகிறது. இந்த விரைவு, புவியால் கையாள இயலாத அளவிற்கு உள்ளது. இவ்வளவு விரைவாக புவியை வெப்பமடையச் செய்வது எது? விடையில்லா கேள்வியல்ல இது. இதற்கான விடையை மனிதன் தெரிந்தே வைத்துள்ளான். கதிரவனிடம் இருந்து வரும் வெப்பக் கதிர்களை, புவி திருப்பி அனுப்புகிறது. அவ்வாறு திருப்பப்படும் கதிர்களை, புவியைச் சூழ்ந்துள்ள வளிமண்டலம் தடுப்பதில்லை. ஆயினும், வளிமண்டலத்தில் ஏற்பட்டுள்ள ஒரு தடித்த வாயு அடுக்கு, அக்கதிர்களை தடுப்பதுடன், மீண்டும் புவிக்கே திருப்புகிறது. அந்த தடித்த வாயு அடுக்கில் பெரும்பான்மையாக கரியமில வாயுவே உள்ளது. அந்தக் கரியமில வாயுவின் அளவு தொடர்ந்து உயர்ந்த வண்ணமாய் உள்ளது. படம்.2 ல் புவியின் சராசரி கரியமில வாயு செறிவு காட்டப்பட்டுள்ளது.



படம்.2 ஆண்டு வாரியான வளிமண்டல சராசரி கரியமில் வாயுச் செறிவு

படம்.2 லிருந்து கரியமில் வாயுவின் செறிவு ஏறுமுகமாக இருப்பதைக் காணலாம். அதிலும் கூட தொழிற்சாலைகளின் பெரும் வளர்ச்சி துவங்கிய 70-களிலிருந்து கரியமில் வாயுவின் செறிவு மிக விரைவாக ஏறுவதைக் காணலாம். தொழிற்சாலைகளின் வளர்ச்சியால் ஏற்பட்ட சுற்றுச்சூழல் சீர்கேடே இதற்குக் காரணம். மேலும் போக்குவரத்துத் துறையின் வளர்ச்சியும், படிம எரிபொருள் கொண்டு செலுத்தப்படும் வண்டிகளின் புகை வெளியேற்றமும் இதற்கு பெரும் பங்காற்றுகிறது. மேலும், வளிமண்டலத்தினால் தாங்கக் கூடிய கரியமில் வாயுவின் செறிவு சுமார் 450-500 பங்கு ஒரு மில்லியன் வளியில். இப்போதோ நாம் 402 என்ற அளவில் இருக்கிறோம். இதன் ஏற்ற வீதம் ஆண்டுக்கு சுமார் 2 பங்கு என்ற மிகையளவில் இருக்கிறது. மேலும் அந்த ஏற்ற வீதம் இப்போது 3 பங்கு என்ற அளவிற்கு சென்றுவிட்டது. இன்னும் பத்து முதல் பதினைந்து ஆண்டுகளில் தாங்கவொண்ணா நிலையை வளிமண்டலம் எய்தும் போது அதன் விளைவு பேரழிவு.

கரியமில் வாயுவும், புவி வெப்பமடைதலும், ஒன்றுக்கொன்று தொடர்புடையதா என்ற ஐயம் பலருக்கும் ஏற்பட்டிருக்கும். இப்போது, படம்.1 மற்றும் படம்.2 இரண்டையும் இணைத்துப் பார்த்தால் அது விளங்கும். படம்.3 லிருந்து இந்தத் தெளிவை நாம் பெறலாம்.



படம்.3 ஆண்டு சராசரி அளவு வெப்பநிலை மற்றும் கரியமில்வாயுச் செறிவு குறித்த ஒப்பீட்டு வரைபடம்

புவியின் சராசரி வெப்பநிலை ஏற்றம் கரியமில் வாயுவின் செறிவின் ஏற்றத்தோடு ஒத்துப் போவதை நம்மால் காணமுடியும். காற்று மாசுறுதலின் மிக மோசமான விளைவு புவி வெப்பமடைதல். இனிவரும் புவியின் பேரழிவு, ஐயம் திரிபற மனிதனின் சுயநலமான செயல்பாடுகளின் விளைவாகவே அமையும் என்பது திண்ணம். இதற்குத் தீர்வு என்று ஒன்று இருந்தது. ஆனால், அதற்கும் தகுந்த காலம் அமைந்திருந்த நிலை போய், நாம் அதையும் கடந்து வந்துவிட்டதாகவே தோன்றுகிறது. இந்த நொடியில் நாம் தீர்வைத் தேடி செயல்படுத்தத் துவங்கினாலும் கூட, சில ஆண்டுகளாவது, பாதிப்பை உணர்ந்த பின்னரே பழைய நிலைக்குத் திரும்ப வாய்ப்புள்ளது. ஆனால், நாம் இன்னமும் துவங்கவில்லை. பேரழிவிற்காக நாம் ஒவ்வொரு நொடியும் காத்திருக்கிறோம்.