Sri Venkateswara College of Engineering

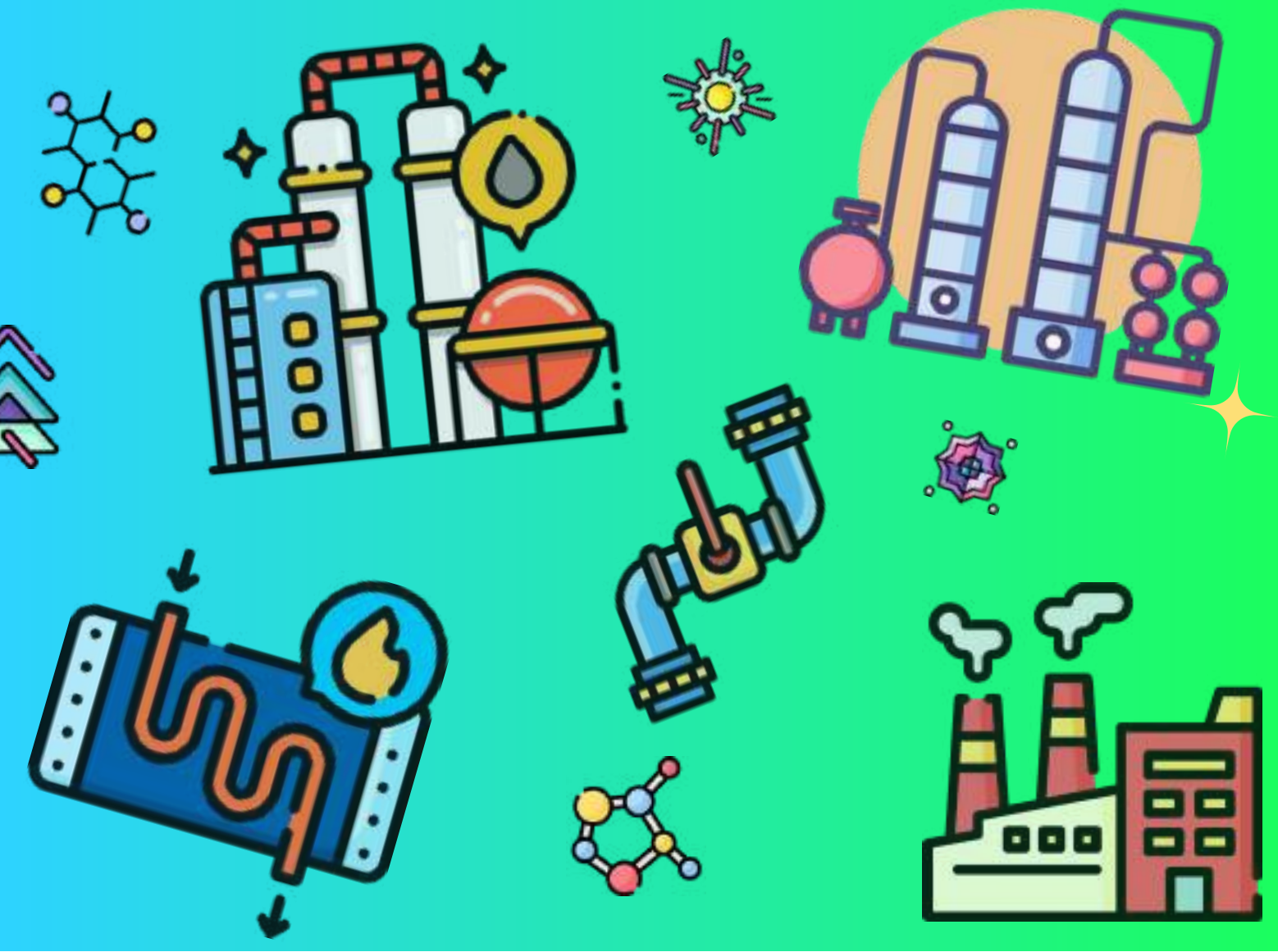
CHEMEVO

DEPARTMENT OF CHEMICAL ENGINEERING

2021 - 2022

SRI VENKATESWARA COLLEGE OF ENGINEERING

AUTONOMOUS - AFFILIATED TO ANNA UNIVERSITY



VISION

To be a leader in Higher Technical Education and Research by providing state-of-the-art facilities to transform the learners into global contributors and achievers.

MISSION

To develop SVCE as a "CENTRE OF EXCELLENCE", offering Engineering Education to men and women at Undergraduate and Postgraduate degree levels, bringing out their total personality, emphasising ethical values and preparing them to meet the growing challenges of the industry and diverse societal needs of our nation.

DEPARTMENT OF CHEMICAL ENGINEERING

VISION

To be a leader in Chemical Engineering Education and Research by providing balanced learning and fostering research to enable the learners to meet the challenges of process industries and societal needs.

MISSION

1. To produce graduates practicing Chemical Engineering professionally and ethically.
2. To produce Chemical Engineering graduates contributing to the betterment of society in the competitive global environment.
3. To focus on the development of Chemical Engineers to foster innovation through proficiency and effective communication.

ABOUT THE DEPARTMENT

The Department of Chemical Engineering was started in the year 1994. The Department currently offers a 4-year B.Tech and 2-year M.Tech programmes in Chemical Engineering. The Department has been recognized as a Research Centre for Ph.D. Programmes by Anna University from 2011. The Undergraduate programme is approved by AICTE and accredited by National Board Accreditation (NBA), AICTE, New Delhi. The Department has taken several Strategic Initiatives to fulfill the ever-growing local and global demands in allied Chemical Engineering streams. All the laboratories contain state-of-the-art infrastructure facilities for academic and research needs and are fully equipped with the latest equipment and advanced software packages like ANSYS FLUENT, ASPEN-HYSYS, PROSIM and MATLAB. In addition, the Department has a CTS-sponsored Process Modeling and Simulation Laboratory and an exclusive, industrial-grade “Distributed Control System” (DCS) in the Process Control Laboratory. The Department has qualified & experienced faculty and staff members, who possess a deep commitment to nurturing the next generation's education and consistently pursue excellence in all areas of their expertise. The Department is also engaged in research activities in the wide areas of Chemical Engineering, Environmental Engineering, Fuel Cell Chemistry, Process Control and other related areas. The Department organizes a National Level Technical Symposium “PANSOPHY” every year and also organizes STTP/FDP/Seminars/ Workshops periodically.

MESSAGE FROM THE SECRETARY

Dr. M. Sivanandham
SECRETARY

Chemical Engineering is a field that has continuously contributed to the betterment of society and industries through innovations and advancements. In today's world, where sustainability and environmental consciousness are paramount, the role of Chemical Engineers becomes even more critical. These professionals play a crucial role in developing processes and technologies that are both efficient and eco-friendly. As the Secretary of SVEHT, I am delighted to announce that the Department of Chemical Engineering is launching a e-magazine dedicated to this dynamic field. This magazine will serve as a platform to showcase the ground-breaking research, projects, and achievements of our esteemed faculty members and talented students. It will provide insights into the latest developments in Chemical Engineering, including cutting-edge technologies, sustainable practices, and their applications in various industries. I am confident that this e-magazine will not only disseminate valuable knowledge but also ignite a passion for research and innovation among our readers. I extend my heartfelt appreciation to the editor and the entire editorial team for their efforts in bringing this initiative. Their dedication and hard work will undoubtedly make this e-magazine a tremendous success.

Secretary

MESSAGE FROM THE PRINCIPAL

Dr. S. Ganesh Vaidyanathan
PRINCIPAL

In the realm of scientific and technological progress, Chemical Engineering stands tall as a discipline that has revolutionized numerous industries, touching every aspect of modern life. It is with immense pride and enthusiasm that I extend my heartfelt congratulations to the Department of Chemical Engineering on the launch of their much-awaited magazine. This magazine comes at a time when the world is seeking innovative solutions to address global challenges, and the Department of Chemical Engineering has consistently been at the forefront of such endeavours. The magazine promises to be a valuable resource, providing valuable insights into the latest research, developments, and breakthroughs in the field of Chemical Engineering. It will be a testament to the relentless pursuit of excellence by our faculty and students. My heartfelt appreciation goes to the faculty members and students for their dedication and hard work in bringing this magazine. May this magazine illuminate minds, spark innovation, and reaffirm the vital role of Chemical Engineering in shaping a sustainable and prosperous future for all.

Principal

MESSAGE FROM HEAD OF THE DEPARTMENT

Dr. N. Meyyappan

HEAD OF THE DEPARTMENT

The Department of Chemical Engineering at SVCE has been a pioneer in providing exemplary education and fostering a research-driven environment since its inception. As the Head of the Department, it fills me with immense pride to introduce our exclusive magazine dedicated to showcasing the exceptional work and accomplishments of our students and faculty members. Chemical Engineering is a domain that constantly evolves to address the ever-changing needs of society. Our department has been committed to staying at the forefront of these developments, equipping our students with not only theoretical knowledge but also practical skills and problem-solving capabilities. This magazine serves as a testament to our commitment to academic excellence and innovation. Through this magazine, we aim to offer readers a glimpse into the diverse research areas explored by our students and faculty. It will feature cutting-edge projects, sustainable solutions, and novel technologies that have the potential to impact industries and improve lives. "CHEMEVO" will not only inspire researchers and professionals but also engage a broader audience, raising awareness about the significance of Chemical Engineering in addressing global challenges. I would like to extend my heartfelt gratitude to the entire editorial team for their tireless efforts in making this magazine a reality.

Head of the Department

FROM THE EDITOR

R. V. Kamalakanth

"To know that we know what we know, and to know that we do not know what we do not know, that is true knowledge."
—Nicolaus Copernicus.

Warm greetings to my dear readers,

In a world where industries strive to meet global demands while preserving our precious environment, chemical engineers stand as the guardians of sustainability. As the gears of industrialization turn, energy consumption, waste generation, and emissions have soared, threatening the balance of our ecosystem. Now, we are fostered with CHEMEVO which is here, as a treasure of knowledge, showcasing cutting-edge research and technologies that address the world's most pressing issues. As the editor of this remarkable magazine, I am humbled by the tireless efforts of the Chemical Engineering department's members, thinkers, and writers who have poured their hearts and minds into creating this treasure trove of wisdom. Together, we can navigate the challenges ahead, ensuring a harmonious co-existence with our planet. We invite you, dear readers, to join us in this journey of discovery and innovation. Share your ideas, your thoughts, and your passions with us. Let us embrace the power of knowledge, and together, we shall unleash the potential of chemical engineering to create a world where industry and ecology thrive hand in hand!

FACULTY IN-CHARGE

Dr. N. P. Kavitha

ASSISTANT PROFESSOR / CHE

SREE HAREEHARA SUDHAN EDUCATIONAL TRUST AWARD WINNER

Mr. R. V. Kamalakanth

2021 - 2022

DUBASI BALAKRISHNA DORA AWARD WINNER

Mr. N. Sanjay

2021 - 2022

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EDITORIAL TEAM

2021 - 2022

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M. A. Thahir

A. Vijayan

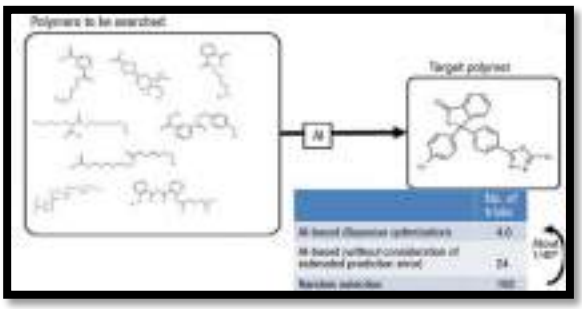
RECENT ADVANCES IN CHEMICAL ENGINEERING

INTRODUCTION

Recent achievements in engineering industry have been aggressive and aligns with the emerging innovations in Information Technology, Artificial intelligence and robotics. The three wings of Chemical engineering applications sectors like Research and Development, Technology development and design engineering, Chemical Plant operations have significantly changed leveraging the best computational techniques of IT industry and other engineering sector advancements

Chemical Engineering - Research and Development

In today's R&D world, we are seeing everyday advancements in new products evolution and application advancements, material science. This swift evolution is becoming seemingly possible leveraging the best from the Artificial Intelligence and Niche statistical techniques, mathematical modeling and simulations. AI and mathematical modeling techniques help in even determining the chemistry and molecular design of new chemical products matching the application field. With the advancement in computational techniques, it is even possible to develop the necessary molecular structure of a chemical suiting the required applications viz, medicine, silicon sector, polymer applications, paints and coatings, adhesives, etc.



Using AI-assisted polymer design, the number of trials required to target a particular material property is drastically reduced

These advancements of product design and application is a boom for the development of related industry.

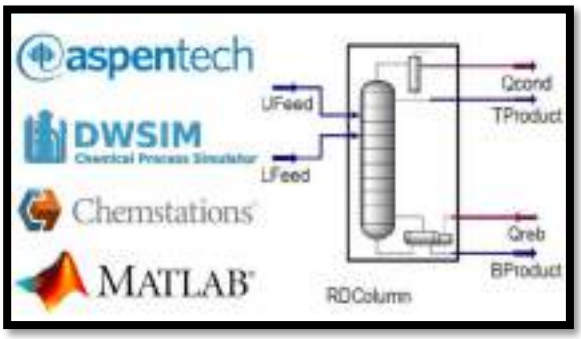
There are several improvements and achievements in nuclear defense and aerospace sector and chemical engineering material science improvements has been serving as a Phillip support for all these developments.

Chemical Engineering – Technology and Plant design

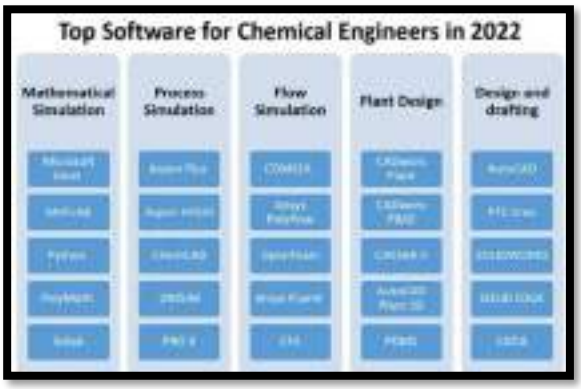
In the Technology development and Plant design segment of chemical industry we also see the usage of new software that are being used solving complex design problems. This software is highly useful in reducing the time multifold and helps in speed execution of projects.

New AI modules can consider the necessary process changes required to a system's current state to target a specific polymer property

Many improvements in the conventional system approach have supported in optimizing the efforts and improving efficiency in practice. For example, Technological advancements in engineering sector has been helpful in effective Oil and Gas exploration and drilling management saving and optimizing time and capital cost. Usage of process design and simulation software like Aspen Plus, Hysys are becoming intimate and handy for engineers' day by day which minimizes the efforts and time spend at work. Also, various software for piping and equipment design like HTRI for heat exchangers, Flow Master, Pipe net for piping design, etc.



Project management and Management Information Systems, Project control have also changed significantly and more professional to meet the needs of competitive market requirements.



Chemical Engineering – Plant Operations

The traditional way of Plant operations to recent practices have seen a significant 360 change in plant operating lifestyle. Today's Robotics, AI and Machine Language advancements have been excessively

implemented in plant machinery operations. This is highly helpful in automation of industrial plant and machinery operation. High level of reliability, safety and quality is possible in such advancements. Also, plant operating control system developments are highly helpful to program complex process control in automatic mode. Drone technology, X-Ray scanner, etc are helpful in equipment monitoring and maintenance prediction to improve operational integrity.

The recent advancements in chemical engineering field are highly supportive to the pollution abatement and environmental hygiene. In the recent past lot of technology have been developed in the energy sector. Nuclear energy, Solar energy, Ocean thermal, Wind energy and increasingly becoming in use replacing the fossil fuel sources. This is possible with the growing advancement of energy storage batteries.

Various areas of Artificial Intelligence support in Chemical Manufacturing Industry

The clean fuel technology application has become a reality thanks to the advancement in all engineering fields. Moe and more efforts are being done to protect and control the acid gas emissions. Thermal application and getting converted to clean electric application. For example, thermal furnace and getting converted to electric furnace, etc.

Pollution Control and Clean Technology advancements

Flue gas treatment, Usage of Hydrogen as clean fuel, etc. significantly help in minimizing the CO2 emissions to atmosphere. Hydrogen manufacturing using environmentally sustainable and clean technology are focused thanks to the advances in Electrochemical and electrical energy-source equipment and machinery. And thanks to information technology growth in today's world Plant process control and monitoring is even possible using handy mobile phone.

Technical training and knowledge sharing is being done through remote virtual meetings thanks to the advancements like Virtual Reality, Augmented reality. More and more virtual mode discussion and information sharing helps in quick decision making getting the support of eminent people availably globally anywhere and

anytime. Also, adaption to Wi-Fi, online monitoring, Robotic vigilance of plant operations have significantly changed the life style of the world. Right from Ceramic industry to Silicon chip industry, aerospace the recent advances in chemical engineering have greatly contributed to the innovative and effective growth of industrial sector and global economy.

All sectors like Agriculture and farming, Oil and Gas and petrochemicals, Specialty Chemicals and Drugs, Cement, Ore processing and metals, Material science, Drugs and Pharmaceuticals have benefited and still constantly getting more improvement with advances in chemical engineering right from R&D till implementation and manufacturing.

Conclusion

Using the best synergy across various engineering discipline developments more and more improvements are possible. This will require up-to-date information and knowledge in different fields. Social economic responsibility and commitment have driven the industries to optimize resources and improve quality besides minimizing the environmental impact.

Chemical engineering field being the applied engineering sector of chemical science have footage over allover the industrial applications and this pushes Chemical engineers to stay focused on global advancements in engineering and technology to match the emerging trends. Chemical industry is well connected with human life and quality of life day to day from drinking water, travel, apparel, food, and housing till lifesaving medicine.

Arvind S

2nd Year

A Breakthrough in Paint Technology: Cu^{+1} Paint that Kills COVID-19

In these challenging times, finding innovative solutions to combat the spread of COVID-19 is crucial. One such breakthrough comes from Corning Inc., a leading materials science company, with their revolutionary Cu^{+1} paint technology. This paint, formulated with Corning Guardiant, has been shown to kill more than 99.9% of SARS-CoV-2, the virus responsible for COVID-19.

The Power of Cu+1: Corning Guardiant

Corning Guardiant is a glass-ceramic technology that incorporates copper, a naturally occurring element known for its antimicrobial properties. By leveraging copper ion technology, Corning Guardiant keeps the most effective form of copper readily available for reducing harmful germs. This unique paint additive has been developed using Corning's expertise in materials science, aimed at creating products that make the world a better and safer place.

Unmatched Antimicrobial Efficacy

The efficacy of Cu^{+1} paint, containing Corning Guardiant, against SARS-CoV-2 has been rigorously tested and approved by the U.S. Environmental Protection Agency (EPA). Under EPA-approved test methods, coatings with Corning Guardiant have demonstrated highly durable antimicrobial activity, remaining active even after simulated scrubbing for six years. These tests were designed to mimic real-life conditions, accounting for the cleaning that surfaces may undergo over time.

Dr. Luisa Ikner, in Professor Charles Gerba's lab at the University of Arizona, conducted the SARS-CoV-2 testing on coatings containing Corning Guardiant. The results showed that this paint additive effectively kills the virus within two hours of contact with the painted surface. Moreover, Corning Guardiant has also exhibited superior efficacy in killing other bacteria and viruses, including gram-positive and gram-negative bacteria, as well as non-enveloped viruses.

Collaboration with PPG: Introducing Copper Armor™

Corning is partnering with PPG, a leading global paints and coatings manufacturer, to bring Cu^{+1} paint to the market. PPG is currently seeking EPA registration for their paint product formulated with Corning Guardiant, which will be available under the name Copper Armor™. This collaboration aims to provide customers with an additional safeguard against COVID-19 and other harmful microorganisms in areas that pose a higher health risk.

Michael H. McGarry, Chairman and CEO of PPG, expressed pride in partnering with Corning and emphasized the importance of

multiple layers of protection during the COVID-19 pandemic. Once registered with the EPA, Copper Armor™ will be launched in the coming months, offering customers peace of mind in various settings such as hospitals, schools, senior living facilities, hospitality segments, multi-family properties, and residential spaces.

The Advantages of Copper

Corning's choice to work with copper as the key ingredient in their antimicrobial paint is backed by five key benefits. First, copper has been proven to kill a broad spectrum of bacteria and viruses, including the COVID-19 virus. Second, Cu^{+1} paint works continuously with high potency, killing more than 99.9% of bacteria and viruses within two hours of contact. Third, copper has not shown evidence of contributing to microbial resistance, ensuring long-term effectiveness. Fourth, Cu^{+1} paint provides a mold and mildew-resistant coating, adding value to the protection it offers. Lastly, Cu^{+1} paint from Corning exhibits excellent durability and hide, providing long-lasting results.

Choosing the Right Antimicrobial Paint

When selecting an antimicrobial paint, it is essential to consider certain factors. Look for an EPA registration on the label, indicating that the product has undergone the necessary registration process with the US Environmental Protection Agency and is proven to actively kill bacteria. Additionally, check for claims about the longevity of the paint's antimicrobial capability, as well as its efficacy against hard-to-kill microorganisms such as non-enveloped viruses. It is also important to ensure that the paint is compatible with commonly used cleaning agents and does not contribute to microbial resistance.

Conclusion: Creating Safer Spaces with Cu^{+1} Paint

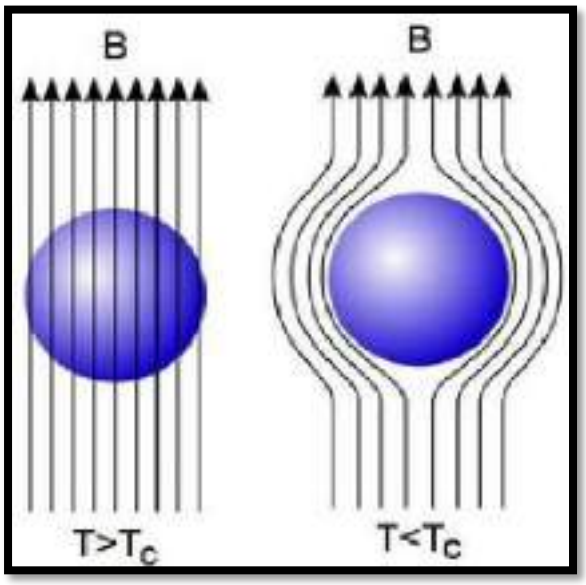
In conclusion, the introduction of Cu^{+1} paint, formulated with Corning Guardiant, represents a significant breakthrough in paint technology. By incorporating copper ion technology, this paint additive provides continuous and long-lasting antimicrobial efficacy, killing more than 99.9% of bacteria and viruses, including SARS-CoV-2, within two hours of contact. The collaboration between Corning and PPG to bring Copper Armor™ to the market further emphasizes the importance of creating safer spaces in various industries and settings. As we navigate the challenges posed by COVID-19, Cu^{+1} paint offers an additional layer of protection, giving individuals peace of mind in their homes, workplaces, and public spaces.

Keerthana Ratheesan

2nd Year

Recent Advancements in Superconductor Technology and Beyond

Conductors and semiconductors are materials which are discussed quite often and holds credits to innumerable researches that have changed the way in which scientific and modern world works.



But what are these superconductors?

Superconductors are substances that offer no resistance to the electric current or zero resistance to the applied current. The current can circulate inside the material without any dissipation of energy, but all these are possible if the material is cooled below the critical temperature which is one of the ubiquitous properties of superconductors.

One other remarkable property of it is the expulsion of magnetic field, which is known as the Meissner effect.

When cooled below the critical temperature superconductor expels magnetic field from the interior by setting up an electric current at the surface. The surface current creates a magnetic field that exactly cancels the external magnetic field.

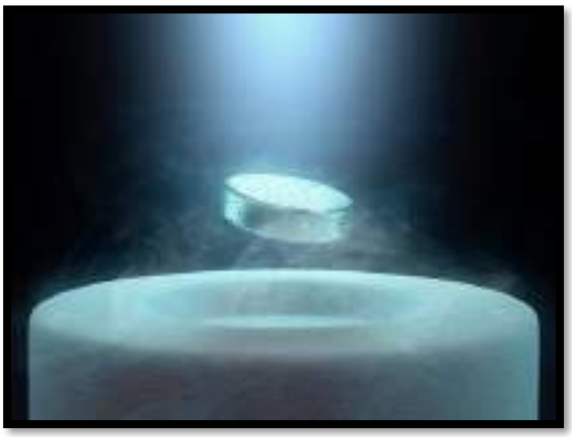
As of why to cool a substance below its critical temperature to make it a superconductor, that could be explained through the following example. when electrons flow through a standard conductive material, such as an aluminium wire, they act something like bumper cars, bouncing off atoms. All this bouncing creates resistance, reducing the electric current. But if that aluminium wire is cooled down about one kelvin above absolute zero, something bizarre happens: the rules of traffic change so that electrons join together in pairs and glide smoothly, these pairs are called cooper pairs explained by BCS theory. Does it have to be necessarily cooled below critical temperature? if so how can it be used in

daily life at ambient temperature and pressure?

The pioneer of this work was Heike Kamerlingh Onnes who discovered that mercury can act as a superconductor when cooled at 4k (-269˚ C) in the year 1911.

The first ever high-temperature superconductor is the YBCO (yttrium barium copper oxide) which is a type II superconductor, it behaved as a superconductor at 93k (-180˚C) , some researchers thought they saw hints of the compound developing superconductivity at room temperature – but those disappeared on closer inspection .

On a recent research, superconductivity has been observed at 20˚C (294K) in a nitrogen doped lutetium hydride under a pressure of 1 GPa (10kbar). The material was made and studied by Ranga Dias and colleagues at the university of Rochester. they conducted the experiment by placing a small amount of NDLH (nitrogen-doped lutetium hydride) sample in a reaction chamber with 99% hydrogen gas and 1% nitrogen gas for 2-3 days at 392˚ F. The resulting lutetium -nitrogen – hydrogen compound was initially blue in colour. but the sample turned pink and then lustrous red when compressed at very high pressure in a diamond anvil cell. it showed superconducting properties surprisingly at room temperature but at a high pressure, which is still in research to make it successful at ambient conditions.



An article which appeared on July 27th 2023 in a non-peer reviewed journal features a team of south Korean scientist who have discovered a superconductor LK-99 which works at room temperature, ambient pressure. It's a compound of lead, copper, phosphorus and oxygen at a temperature above 400 k (260 ˚ F), a material that can conduct electricity perfectly under everyday conditions.

Several scientists and researchers have expressed their opinion as “it’s too good to be true, if proven, it will be a brand-new historical event that opens a new era for humankind”. But their experiment is yet to be properly scrutinized by the scientific community. Having discussed the above possibilities, it could be understood that the importance of superconductors is immeasurable.

To make superconductors available to everyday use, factors such as ambient temperature, ambient pressure, availability of the material and its cost are vital. More such research is needed in relevant fields for an advanced world and there are several researches and scientists working, over a millennium. It's an ongoing research with immense potentiality, one which could revolutionize science and the community.

N. Prerna Unnathe

2nd Year

Liquid Solar Fuel: A Promising Path Towards Sustainable Energy

Introduction

As the energy demand in the world is increasing the search for renewable and sustainable energy sources becomes ever more critical. One promising pathway in this quest is the development of liquid solar fuels, which offer a potential solution to store and transport solar energy efficiently. While solar photovoltaic (PV) panels have made significant strides in generating electricity directly from sunlight, their intermittent nature and inability to store energy efficiently remain challenges. Liquid solar fuels offer an alternative approach, allowing solar energy to be captured, stored, and transported in a more flexible and convenient manner. This article explores the concept of liquid solar fuel, its advantages, challenges, and the current state of research in this cutting-edge field.

What is Liquid Solar Fuel?

Liquid solar fuel is a type of synthetic fuel that directly harnesses solar energy and stores it in a liquid form. It is produced through a process which mimics the natural photosynthetic process in the plants, which is known as SOLAR FUEL SYNTHESIS. This technology allows for the conversion of sunlight into chemical energy, with liquid fuels such as hydrogen, methanol, or even synthetic hydrocarbons being the end products.

Current Research and Development

The development of liquid solar fuels is still in its early stages, but researchers and scientists worldwide are actively exploring various approaches to achieve efficient and cost-effective production. Some of the key research areas include:

Artificial Photosynthesis: Scientists are working on developing artificial photosynthesis systems that mimic the natural process by using specialized catalysts to convert water and carbon dioxide into solar fuels like hydrogen or methanol.

Carbon Capture and Utilization: The direct capture of carbon dioxide from the atmosphere or industrial sources to produce synthetic hydrocarbons and other liquid solar fuels.

Photovoltaic-Electrolysis Systems*:* This approach involves using photovoltaic cells to generate electricity from sunlight, which then powers an electrolysis process that splits water molecules into hydrogen and oxygen. The hydrogen can be stored as a liquid solar fuel.

Advantages of Liquid Solar Fuel

Solar Energy Storage: The liquid solar fuel's Intermittent nature makes it a challenge to handle. Liquid solar fuels provide a practical solution by offering a way to store solar energy in a dense and transportable form. Unlike traditional solar panels, which generate electricity when the sun is shining but cannot store excess energy, liquid solar fuels allow energy to be stored for later use.

Energy Transportability*:* Liquid solar fuels can be easily transported through existing fuel distribution networks, making them compatible with the current infrastructure. This characteristic is a significant advantage over other renewable energy sources like wind and solar, which require specific transmission systems.

Greenhouse Gas Emission Reduction*:* Liquid solar fuels have the potential to significantly reduce greenhouse gas emissions compared to traditional fossil fuels. When combusted, these fuels release only the CO2 that was initially extracted from the atmosphere during their production, effectively closing the carbon loop.

Grid Integration*:* Integrating liquid solar fuels into existing energy infrastructure becomes more straightforward due to their compatibility with existing liquid fuel distribution systems. This means that liquid solar fuels could complement conventional fuels seamlessly, gradually reducing carbon emissions from transportation, aviation, and industrial sectors.

High Energy Density*:* Liquid solar fuels typically have a higher energy density than current battery technologies, making them a potential solution for applications that require high energy requirements, such as long-haul transportation and heavy machinery.

Challenges and Future Outlook

Despite the promising potential of liquid solar fuels, several challenges must be overcome before they can be widely adopted:

Efficiency: The efficiency of the conversion process is an important factor in making the solar liquid cells viable. Current technologies still face limitations in achieving high efficiency levels, and further research is required to improve this aspect.

Cost-Effectiveness: The initial costs of implementing liquid solar fuel production system is generally high due to emerging technologies. For widespread adoption, it is crucial to make these processes more economically competitive with traditional fossil fuels.

Scalability: To make a significant impact on the global energy landscape, liquid solar fuel production must be scalable to meet large-scale energy demands.

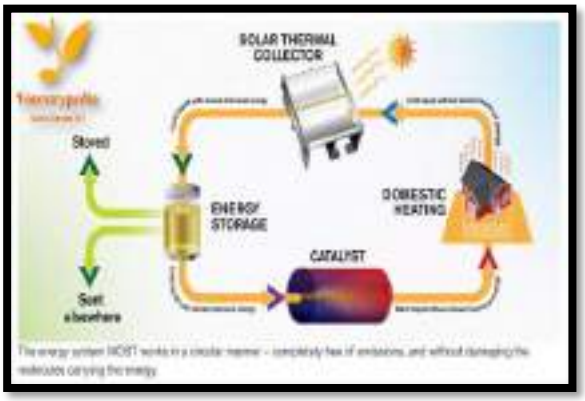
Competition with Battery Technologies: Battery technology has seen considerable advancements in recent years, and the competition between liquid solar fuels and battery storage remains a challenge to navigate.

Key Components and Mechanism

Photo-electro chemical Cells (PECs): Central to the liquid solar fuel process are photoelectron chemical cells. These specialized devices consist of semiconductors that absorb sunlight and convert it into electricity. The electrons generated during this process are used to drive chemical reactions that produce the desired liquid fuel.

Catalysis: Efficient catalysts play a crucial role in the conversion process, as they accelerate the reaction rates. These catalysts can be in the form of nanoparticles or other materials that promote the conversion of water and CO2 into fuels like hydrogen or hydrocarbons.

Electrolysis: In some liquid solar fuel technologies, water is split into oxygen and protons through electrolysis. The protons are then combined with CO2 to create liquid hydrocarbon fuels through a process called CO2 reduction.



The Solar-to-Liquid (STL) Process

The production of liquid solar fuels primarily relies on a two-step process: solar-driven electrolysis and the Fischer-Tropsch (FT) synthesis. In the first step, solar energy is harnessed to split water into hydrogen (H2) and oxygen (O2) through a process known as solar-driven electrolysis. The H2 obtained serves as the main building block for the subsequent synthesis of liquid hydrocarbons.

In the second step, carbon dioxide is captured from the atmosphere or industrial sources and combined with the hydrogen produced earlier. The FT synthesis, a well-established chemical process, converts the H_2 and CO_2 into a variety of liquid hydrocarbons, depending on the desired end product. The resulting fuels can directly replace conventional petroleum-based fuels and can be used in existing engines and infrastructure, making them a viable transitional solution towards a sustainable future.

Conclusion

Liquid Solar Fuel will definitely play a major role as a renewable and sustainable resource. By converting solar energy into a liquid form, we can address the intermittency issue of solar power and reduce greenhouse gas emissions. While challenges remain, ongoing research and development in this field provide hope for a future where liquid solar fuels play a significant role in our transition to a cleaner and more sustainable energy system. With the continued research in this field with the help of government private sector, researchers would develop a full fledged liquid solar fuel which would be eco friendly and will definitely play an ultimate role in making a sustainable and pollution free environment

Jaya Vardhini M

2nd Year

Sustainable Scent Solutions: BASF's Fermentation-based Breakthrough Reshaping the Fragrance Industry

Sandalwood oil, cherished for its rich herbal scent, has long been a sought-after fragrance ingredient. However, the sandalwood trees that produce this precious oil are facing a critical threat, as they are being pushed towards endangerment due to unsustainable cultivation practices and illegal harvesting. The demand for this natural essence has outpaced the growth of sandalwood trees, leading to a volatile and limited supply chain, a challenge that demands an innovative solution.

Recognizing the urgent need for sustainable alternatives, chemical giant BASF has embarked on a groundbreaking journey, venturing into fermentation-based production. In 2019, BASF acquired Isobionics, a pioneering Dutch biotech firm specializing in flavors and fragrances, with the aim to revolutionize the fragrance industry.

The result of this collaboration is the recent launch of "Isobionics Santalol," a microbially derived sandalwood oil replacement that offers a ray of hope for the endangered sandalwood trees. The process revolves around fermenting cornstarch-derived sugars using the versatile microorganism, Rhodobacter sphaeroides. This novel approach ensures a reliable, year-round supply of sandalwood oil without dependence on the natural growth and maturity of sandalwood trees, effectively eliminating the environmental strain caused by traditional harvesting methods.

The use of fermentation as a sustainable production method for fragrance and flavour molecules is gaining momentum, thanks to its consistency, reliability, and environmental appeal. By utilizing this biotechnological breakthrough, BASF can offer a product that aligns seamlessly with the fragrance and flavour industry's stringent requirements, catering to consumers preferences for eco-conscious choices.

One of the main challenges faced by traditional sandalwood oil lies in its varying chemical composition, resulting in fluctuations in flavor and aroma profiles. However, BASF's fermentation process precisely yields α- and β-santalol, the primary aromatic compounds found in sandalwood oil, in a ratio similar to that of natural sandalwood. This remarkable achievement makes "Isobionics Santalol" an exceptional substitute for authentic oil, guaranteeing consumers a predictable and consistent sensory experience.

Beyond its technical advantages, fermentation-based production brings a host of environmental benefits. By eliminating the need to stress and harvest sandalwood trees, this new approach champions the conservation of these invaluable trees and the ecosystems they sustain. Additionally, sourcing raw materials from various sugar sources presents an opportunity to establish local production facilities, minimizing shipping and logistical complexities and reducing the carbon footprint.

For consumers who prioritize sustainability and responsible sourcing, the appeal of fermentation-based ingredients is undeniable. Not only does BASF's innovative process provide a steady and economically viable source of sandalwood oil, but it also holds a compelling marketing advantage. Regulations across most regions permit fermentation-produced ingredients to carry the coveted "natural" label, giving these products a competitive edge in an ever-evolving market driven by conscious consumer choices.

BASF's foray into fermentation-based sandalwood oil production marks a significant step towards meeting the escalating demand for natural ingredients without compromising the well-being of our planet. As more companies follow in BASF's footsteps, the once-threatened allure of sandalwood oil can flourish once again, spreading its delightful aroma far and wide. Through biotechnological innovation, the fragrance and flavor industry is embracing a sustainable and prosperous future, where conscious choices and responsible practices harmonize to preserve the beauty and essence of nature's finest creations.

Jana R

2nd Year

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