A CHEMICAL ENGINEERING DEPARTMENT INITIATIVE

# Absorb.

## Your Window to Chemical Engineering

NATIONAL INSTITUTE OF TECHNOLOGY
ANDHRA PRADESH

FEBRUARY 2021

REACH OUT TO US AT : **absorb.nitandhra@gmail.com**

Chemical Engineering Association
National Institute of Technology
Andhra Pradesh

" Chemical engineering more than any other, may be called the engineering of the future. It is the result of an evolution in which most of the other branches have played a part... The chemical engineer stands today on the threshold of a vast virgin realm; in it lie the secrets of life and prosperity for mankind in the future of the world. "

- JOHN HAYS HAMMOND

# ELEMENTS



## Technical Articles



## Current Affairs

# Director's Message!

FROM THE DESK OF THE DIRECTOR OF
NATIONAL INSTITUTE OF TECHNOLOGY-ANDHRA PRADESH.

Hi,
From the desk of your beloved Director.
It gives me immense pleasure about knowing and writing this message to the readers of the magazine being unveiled by the Department of Chemical Engineering of the National Institute of Technology, Andhra Pradesh.

The department started along with the inception of the institute in August 2015 with a meagre sanction strength of 30 per year. I am very happy to know that the driving force behind such efforts was not the number of students but the very intent of good students in the department, striving hard to be high in academics as well as in co-curricular and extracurricular activities. The success of students was very much dependent upon the motivation rendered by their faculty to take up challenging work and showcasing their talent as time demands.

At this juncture, I would like to congratulate the team of students bringing out topics related to chemical engineering, which are essential to the community. At this point, we are facing an energy crisis and we should note that chemical engineering being a fraternity involved in fuels, fertilizers and other allied fields plays a vital role in safeguarding our future.

The association also has arranged expert talks from academia of international fame and industrial exposure to give a blend of knowledge in the area of energy. I understand that these talks have greatly motivated the students to tune their future scope of works.

I once again congratulate the HoD, faculty advisor, the student coordinator, and students of the Chemical Engineering Association of the department for their great endeavors and paving the way for the juniors to follow and keeping the flag of the alma mater high.
Wishing you all success.

**Prof. C.S.P Rao**
Director
National Institute of Technology, Andhra Pradesh

# Registrar Says

FROM THE DESK OF OUR BELOVED REGISTRAR

Hello Readers,
It gives me immense pleasure to announce the first edition of the Chemical Engineering Student's Magazine, "Absorb". The students who have been involved in the development of the magazine have worked passionately over the course of the past few months to gather resources, creating and exploring new ideas, capture the reader's attention, and bring a new perspective into the field of chemical engineering. I wish the magazine stands up to its name and gives its readers an ocean of knowledge to absorb.

Chemical Engineering is a branch of engineering that emerged upon the development of unit operations, that uses the principles of physics, chemistry, and mathematics, to create and sustain chemical reactions and produce essentials we use in our day-to-day life at an industrial scale. The study of chemical engineering first emerged as a direct consequence of the industrial revolution. Chemical engineering since then has been one of the prominent streams of engineering.

The Department of Chemical Engineering, National Institute of Technology, Andhra Pradesh was established on 20th August 2015 at our temporary campus in Tadepalligudem. With an intake of 30 students every year, the department has been one of the pivotal parts of the institute through the years. Currently, the institute has shifted to a permanent campus with excellent infrastructure & well-established laboratories.

I wish all the students and readers, a great future ahead and that they use their skills to work for the development of our nation.

**Dr. Dinesh P Sankar Reddy**
Registrar
National Institute of Technology-Andhra Pradesh

# Department Head Writes

FROM THE DESK OF OUR BELOVED HOD

Dear Readers,
Greetings!
I hope you are doing good and staying safe amidst the unprecedented COVID-19 crisis across the globe.

First and foremost, I would like to congratulate my dear students for their great initiation on publishing a Department's Magazine named, Absorb, under the guidance of Dr. P. Dinesh Sankar Reddy, an immediate past Head of the Chemical Engineering Department at the National Institute of Technology, Andhra Pradesh. I believe that this magazine Absorb will motivate the students and teachers to share their creativity and new ideas with the world and facilitate their overall development, as well as enlighten and account for the various activities and achievements of the students and staff members, and events organized by the department.

The Department of Chemical Engineering was set up in the National Institute of Technology Andhra Pradesh at the time of the inception of the institute in 2015. With time the department has grown in every sphere. The students of the department are highly encouraged to get hands-on experience with the industry and acquainted with state-of-the-art technology. Chemical engineering is a very diverse branch of engineering that embodies in itself a wide array of subjects. Right from the morning when you take a wave-like glob of your toothpaste to when you switch off the lights in the evening, chemical engineering is omnipresent. With this wide range of subjects to choose from, our student editors have diligently narrowed it down to a few.

Having said this, I leave the floor to my dear students. I am very proud to say that the students of the department have worked hard to assemble this Departmental Magazine. I am sure that all the readers of this magazine are impressed by their efforts. I wish the students luck for their future and pray for them to bring glory to themselves, to the institute, and the country. Also, I invite the readers of Absorb for their contribution and suggestions to the forthcoming issues.

**Dr. Vinoth Kumar Raja**
Head, Department of Chemical Engineering
National Institute of Technology-Andhra Pradesh

# From the Editorial Board.

Hope you all are safe and sound in these tough times of the pandemic. We at ABSORB wish the world to soon free itself from the icy cold clutches of the virus, tide over the grief and disruption, and for us to stray back to our normal lives.

ABSORB is a subsidiary of the Chemical Engineering Association of the prestigious National Institute of Technology, Andhra Pradesh. Under the able guidance of our Faculty Advisor, HoD, and the Director of the Institute, we bring to you the very first edition of our Departmental Magazine.

ABSORB literally means to take in or soak up. The word ABSORB was one of the first suggestions by the team for the magazine's name and as we see it stuck by. With this magazine, we aim to help the readers get acquainted with the advancements, prospects, and functioning of a chemical engineering industry.

We aim to provide as much exposure as we can, to help the readers assimilate in themselves and the information. Chemical engineering is ought not to be one of the first choices in career planning as it is less celebrated and we intend to change that.

We based this edition on a Heterogenous theme, with a vision to be able to indulge with all aspects of the industry. Since the chemical industry envisages in itself a wide variety of platforms and varied independent streams, the theme helped us bring out the best in each.

How might we be able to strike a chord with the audience? What topics would resonate with the target audience? These are some of the many questions that Team ABSORB asked itself while gathering and curating the magazine.

We at ABSORB wish you all a good read.
Cheers!!

THE EDITORIAL BOARD.

# CHEMICAL ENGINEERING AT A GLIMPSE

**By Deepthi Devan Pisharady**
**Second Year Chemical Engineering student**

Chemical Engineering is all about converting basic raw materials into a variety of useful products such as clothes, food, and energy. Historically, the chemical engineer has been primarily concerned with process engineering, which can be generally divided into two complementary areas: Chemical Reaction Engineering & Separation Processes. Chemical engineers deal with the design and operation of chemical plants and equipment. Chemical engineers are sometimes called "Universal Engineers" because it is such a broad discipline.

**Origins:**

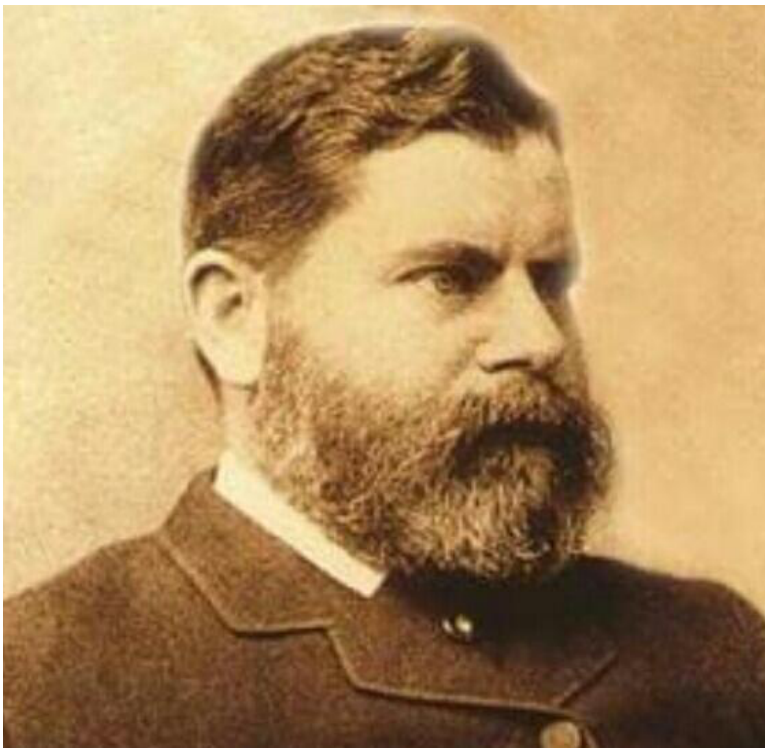
The Chemical Engineering profession evolved from the industrial applications of chemistry and separation science, primarily in the refining and chemical process industries. But like all other Engineering disciplines, chemical engineering also got recognized as a core field in the 19th century. The first high-volume chemical process was implemented in 1823 in England for the production of Soda Ash, which was used for the production of glass and soap. During the same time, advances in organic chemistry led to the development of chemical processes for producing synthetic dyes from coal for textiles in the 1850s.

The industrial revolution led to an unprecedented augmentation in demand for bulk chemicals such as Soda Ash, both concerning quantity and quality. This made the enhanced requirement for engineers who could design chemical reactors and plants. It led to the rapid growth of chemical industries. Until then, the chemical industry had to rely mainly on mechanical engineers and chemists. But the design of plants and equipment of chemical process industries was beyond the scope of both.

In this view, there emerged a new engineering discipline in 1888 – THE CHEMICAL ENGINEERING by the professors of Massachusetts Institute of Technology (MIT) as "Course X". Chemical Engineering is more to do with designing the equipment/chemical process. Chemical Technology is the study of different processes in the chemical industry.

**History:**

A landmark in the development of Chemical Engineering was the publication of the first textbook on the subject, by George E Davis, a British chemical consultant in 1901. Also In 1880, he made the first attempt to form a society named "Society of Chemical Engineers" in London. He was the moving spirit behind the formation of the "Society of Chemical Industry" in 1881. In 1887 Davis gave a series of 12 lectures at the Manchester School of Technology, which formed the basis of his two-volume "Handbook of Chemical Engineering (1901; revised 1904)", the first of its kind. Davis was unique in organizing his text by the basic operations common to many industries. As a consequence, George E Davis is regarded as the "world's first chemical engineer". In 1905 a publication called "The Chemical Engineer" was founded in the US, and 1908 the "American Institute of Chemical Engineers (AIChE)" was founded, and the UK "Institution of Chemical Engineers (IChemE)" in 1924. The Founding Father of Chemical Engineering education and research in India was Dr. H L Roy. He fulfilled one of his life-long dreams of establishing the Indian Institute of Chemical Engineers in 1947 at Calcutta. Now India's first Central Institute of Chemical Engineering & Technology (CICET) will be set up in Gujarat to give a boost to the chemical industry.



George E Davis – The Father of Chemical Engineering

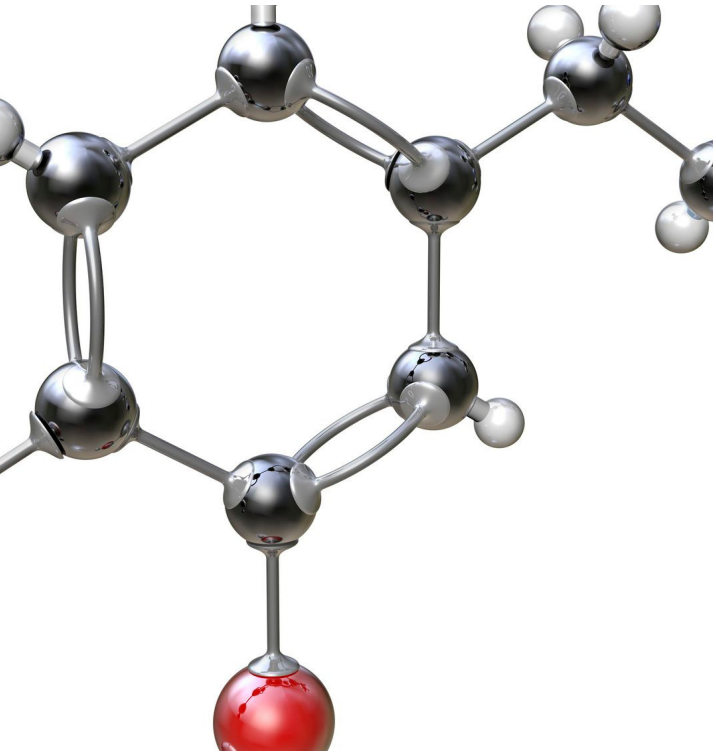
**Significance:**

Chemical Engineers are employed in the design and development of both processes and plant items. Plant operations and control are increasing the sphere of the chemical engineer rather than chemists. Chemical engineering provides an ideal background for the economic evaluation of new projects and, in the plant construction sector, for marketing. They focus on production by improving existing processes or creating new ones. Chemical Engineers aim for the most economic process. This means the entire production chain must be planned and controlled for costs. The modern discipline of chemical engineering encompasses much more than just Process Engineering. Chemical engineers are now engaged in the development and production of a diverse range of products, as well as in commodity and specialty chemicals. These products include high-performance materials needed for aerospace, automotive, and space, and military applications. Additionally, chemical engineering is often intertwined with Biology and Biological Engineering. The three biggest disciplines of chemical engineering are pharmaceuticals, environment, and petroleum. Nowadays, these blooming industries enhance the significance of chemical engineers more than before.

Dr. H L Roy - Founder of IICHE

# MOLECULE DEVELOPED TO STORE ENERGY

**By Yaswanth**
**Second year Chemical Engineering student**



Life as we know it, isn't possible in this world without the sun. We are in a situation where every renewable source of energy is essential, and one of the major contributors to this renewable source is Solar Energy.

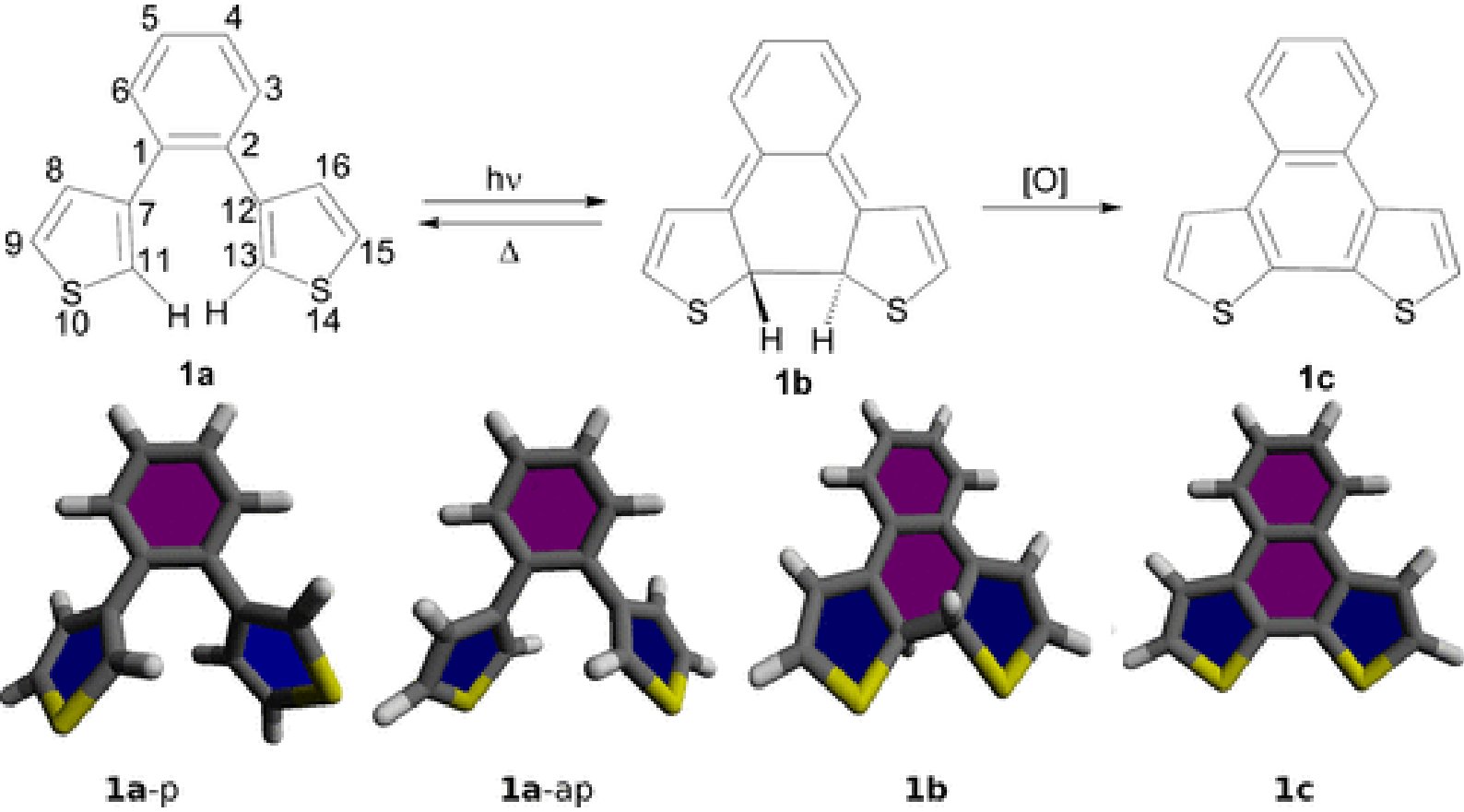
We use solar panels as a commercial product but the catch is that they don't store solar energy. But now, with the advent of technology, storage of that energy has become a reality.

Researchers and scientists are trying their utmost to harness this powerful energy source. They have developed a molecule that absorbs energy from sunlight and stores it in chemical bonds. The Earth continuously receives more energy from the sun than we humans have been able to harness.

This energy is absorbed by solar power facilities, but one of the challenges of solar power is to store it efficiently, in such a way that the energy is available when the sunlight is not sufficient enough to produce continuous energy, like cases during night times, or during cloudy weather, or even long winters.

This molecule can take on two different forms: a parent that can absorb energy from sunlight, and an alternate form, and during the absorption, the structure of the parent form changes and becomes far more energy-rich, while remaining stable. The molecule belongs to a group referred to as "molecular photo switches". These are always available in two different forms, isomers, that differ in their chemical structures.

**This molecule can absorb energy from sunlight and store it in chemical bonds.**




Picture: Chemical structures of the Dithienylbenzene Switch studied during this work, and their conformations

**Most chemical reactions start in a condition where a molecule has high energy and subsequently passes to one with a low energy. However the opposite happens here—a molecule that has low energy becomes one with high energy.**

.The chemical structures of all photo switches are influenced by light energy. This suggests that the structure, and thus the properties, of a photo switch are often changed by illuminating it.

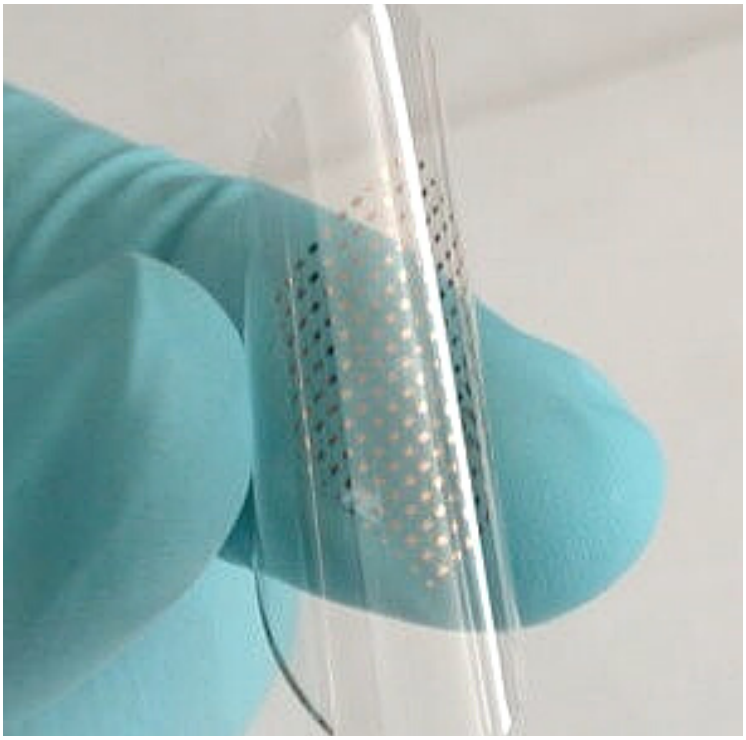
Bo Durbeej and his team carried out work in theoretical chemistry, and conducted calculations and simulations of chemical reactions. This involved advanced computer simulations.

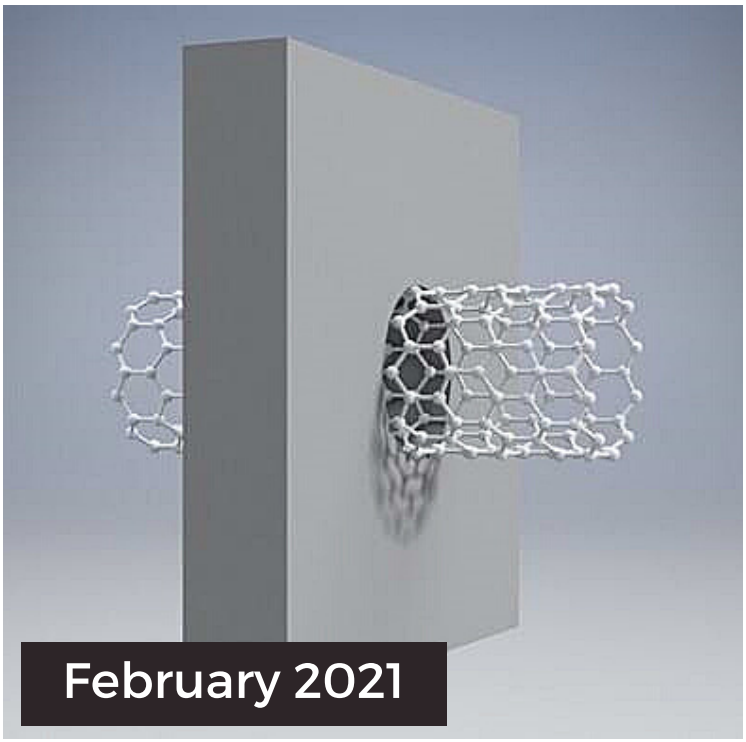
The calculations showed that the molecule the researchers had developed would undergo the chemical reaction they required, and also might happen extremely fast (within 200 femtoseconds). In order to store large amounts of solar power within the molecule, the researchers attempted to form an energy difference as large as possible between the two isomers.

The parent form of their molecule is extremely stable, a property that within organic chemistry is denoted by saying that the molecule is "aromatic". The essential molecule consists of three rings, each of which is aromatic.

The researchers showed in their study, published in the Journal of the American Chemical Society, that the concept of switching between aromatic and non-aromatic states of a molecule have a major potential in the field of molecular photo switches.

A possible long-term use of the molecule is to capture solar energy efficiently and store it for later consumption.





Technical Article

# CARBON NANOTUBES AND THE QUEST OF RENEWABLE ENERGY

**By Abhishek**
**Fourth year Chemical Engineering student**

A breakthrough in the manufacturing of carbon nanotube membranes that can help large-scale production has been made. These "molecular factories" have the potential to get rid of carbon dioxide from the atmosphere and convert it to fuel.

Conventional membranes designed for filtering small molecules and dissolved salts from water suffer from limitations concerning their permeability and chemical resistance. The membranes of the new Carbon Nano-Tube (CNT) don't suffer from these limitations. They showcase high permeability, but unfortunately are very difficult and dear to supply and have thus are forced to remain as prototypes in laboratories.

The carbon nanotube is embedded in a flexible polymer sheet and may be programmed to manipulate molecules in certain ways, making it a programmable molecular gateway. Nanotubes act as conveyor belts that perform varied processes on molecules that pass in turn through it in a file. These processes might be catalysis, desalination, drug delivery, or purification of pharmaceutical compounds, thereby essentially transforming the nanotubes into molecular factories.

A catalyst gate is often created by affixing a catalyst to the opening of the tube so that all molecules passing through must interact with the catalyst. Each polymer sheet is embedded with around 250 turn gateways per square meter. A series of gateways are often manufactured to possess different functions, thereby creating chemical synthesis factories that will be as small as a shoebox.

The aim is to make it possible to mix different types of our CNT membranes thereby doing what molecular factories have long been predicted to do; forming anything we'd like from basic molecular building blocks. To sum it up it's like printing matter from the air. Imagine having one among these devices with you. You could print food, fuel, building materials, and medicines from the atmosphere and soil or recycled parts.

This technology will give us a level of control over this fabric world that we never have had before. We would be able to choose which molecules could permeate our membranes and what happened to them once they do. For instance, to get rid of carbon dioxide from the air and convert it to fuels; which would be a dream come true. This has already been done using conventional technology, but it has proven to be too expensive for it to be practical.

Using CNT, we will be ready to produce carbon-zero gasoline, diesel, and jet fuels that are cheaper than fossil fuels.

This invention, if made to be practical in monetary terms would usher us into a new era and set a golden note in the history of science. This invention is a potential lifesaver wherein it would help us reduce our carbon footprint, salvage us from this global warming crisis and make our world a better place to live in.

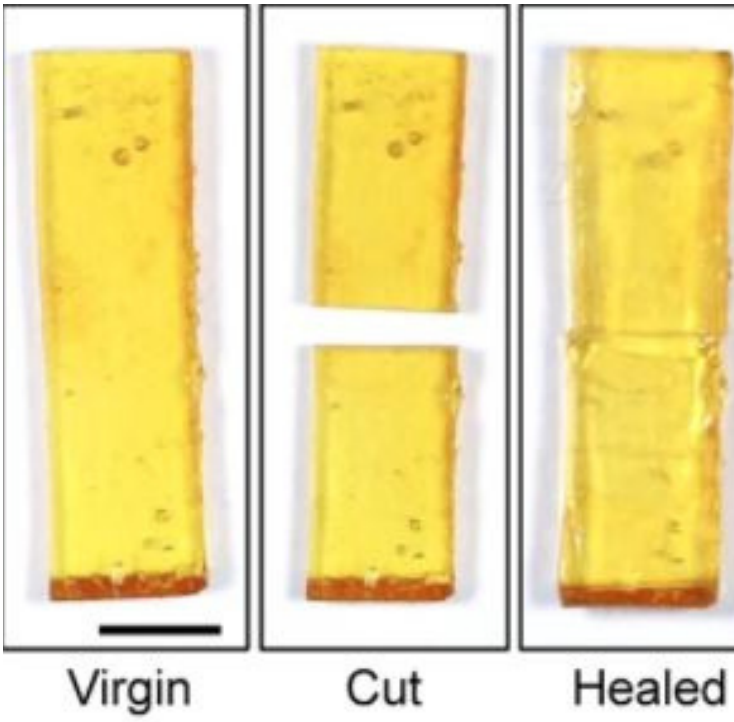
# THE SELF HEALING MATERIAL

**By Yaswanth**
**Second year Chemical Engineering student**


Airplanes are behemoths of the sky. At 500 mph (804.67 km/h), however, these behemoths aren't impervious to impact, even from the seemingly innocuous goose. Such damage can result in a range of issues, from fluctuations in air pressure and altitude.

USC researchers have developed a replacement material that would fix such impact damage within the air, as soon as it occurs. The team, led by Qiming Wang, Stephen Schrank Early Career Chair and assistant professor in the Sonny Astani Department of Civil and Environmental Engineering, created 3-D lattice structures - that will autonomously get over impact damage, first restoring the structure's original shape then healing the fatal fractures or breaks within the material.

Traditionally, lattice structures, while lightweight, have low damage tolerance, meaning if there's impact, it'll easily spread, eventually compromising the structure. This new material created has high damage tolerance. The new material is characterized by high strength and stiffness. Unlike traditional self-healing materials, no manual intervention is required. 3-D lattice structures are not easy to fabricate.




To create this, the researchers built on a prior innovation, a more rubber-like self-healing material featuring dynamic bonds (disulfide bonds) that trigger self-healing. To incorporate the properties necessary to satisfy their goals, the researchers added crystalline domains—polymers with high rigidity and responsiveness to heat. The material is strong like Teflon.

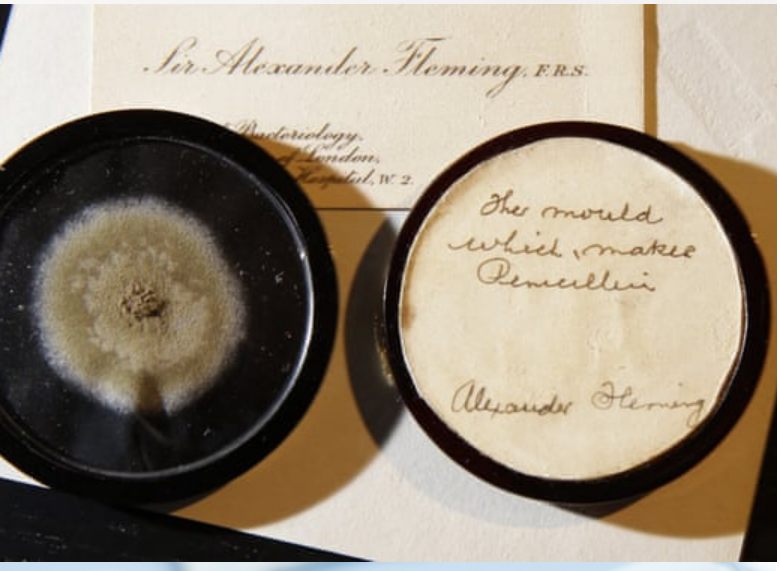
Researchers also added another key property: shape memory, meaning the polymers memorize the structure's original shape. They also incorporated an acrylate chemical group (often used in adhesives), which made the material photocurable, or reactive when the material is exposed to light.

In this case, the researchers created a lateral wing and smashed a weight into it. The original shape of the wing was restored within two minutes. Under continuous heat, the fractured pieces begin to reform bonds and heal. After six hours, the fabric returned to its original strength and structure.

In this study, the researchers completed ten cycles of damage and healing with an equivalent structure. Even after the tenth cycle, the structure maintained the same level of mechanical integrity as the original.

These new lattice structures could be used to reinforce any number of vehicles, from airplane to automobile, offering long usage periods and better damage tolerance.

# A BRIEF HISTORY OF MEDICINES THAT CHANGED THE WORLD.






**By Rahul N**
**Third year Chemical Engineering student**

The entire world as we all know it's in the midst of a pandemic called "COVID-19". Doctors are trying to battle this situation by treating the ill and prevent them from spreading the disease to others. Scientists are working to create new formulas for vaccines and drugs which counteract the effects of the virus on humans. So in light of this situation, let us travel down human history, and take a look at the discoveries of various revolutionary formulas for medicines and vaccines, the process and methods in which they were manufactured, and the impact that they created on a global scale.

## Penicillin:

Penicillin, which remains a crucial part of our antimicrobial armamentarium, had an impact on the last half of the 12th century. Deep-fermentation methods - Fermentation is the technique used for the commercial production of penicillin. Mini-harvest protocols are usually employed in penicillin fermentation. They involve the removal of 20-40% of the fermenter contents and its replacement with a fresh sterile medium. This procedure will be repeated several times during this process without yielding reduction, it can enhance the entire penicillin yield per fermenter. The pH should be between 6.4 and 6.8 during the active production phase.

## Insulin:

Insulin may be a relatively low-priced drug, however, the chronic nature of diabetes means the value of insulin treatment is high. Two major pathways for large-scale production of recombinant human insulin are currently used. One route uses e-coli as an expression host, where the overexpressed insulin precursor (IP) forms inclusion bodies requiring solubilization and oxidative refolding. The second route uses yeast-based expression systems (mainly Saccharomyces cerevisiae) where the IP is directly secreted within the culture supernatant in its correctly folded conformation.

## Morphine:

Morphine may be a pain medication of the opiate family that's found naturally in numerous plants and animals, including humans. It acts directly on the Central Nervous System (CNS) to decrease the sensation of pain. It may be taken for both acute pain and chronic pain. Morphine was first isolated between 1803 and 1805 by German pharmacist Friedrich Sertürner.

The method is to extract morphium from the crushed plant with diluted sulfuric acid, which is a stronger acid than meconic acid, but not so strong to react with alkaloid molecules. The extraction is performed in many steps (one amount of crushed plant is extracted at least six to ten times, so practically every alkaloid goes into the solution). From the solution obtained at the last extraction step, the alkaloids are precipitated by either ammonium hydroxide or sodium carbonate. The last step is purifying and separating morphine from other opium alkaloids.



## Smallpox Vaccine:

The history of smallpox holds a unique place in medicine. It had been one of the deadliest diseases known to humans, and so far (2016) the sole human disease to be eradicated by vaccination. The smallpox vaccine, introduced by Edward Jenner in 1796, was the primary successful vaccine to be developed.

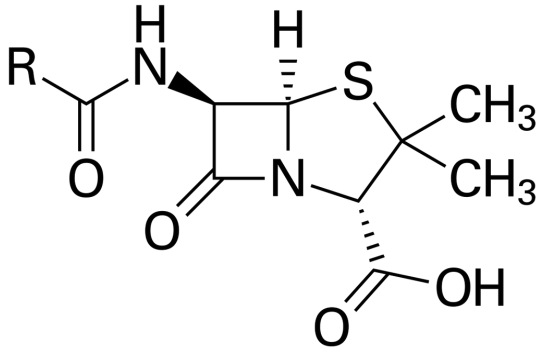
In the late 1940s and early 1950s, Leslie Collier, an English microbiologist working at the Lister Institute of Preventive Medicine, developed a method for producing a heat-stable freeze-dried vaccine in powdered form. Collier added 0.5% phenol to the vaccine to reduce the number of bacterial contaminants bit the key stage was to add 5% peptone to the liquid vaccine before it was dispensed into ampoules.

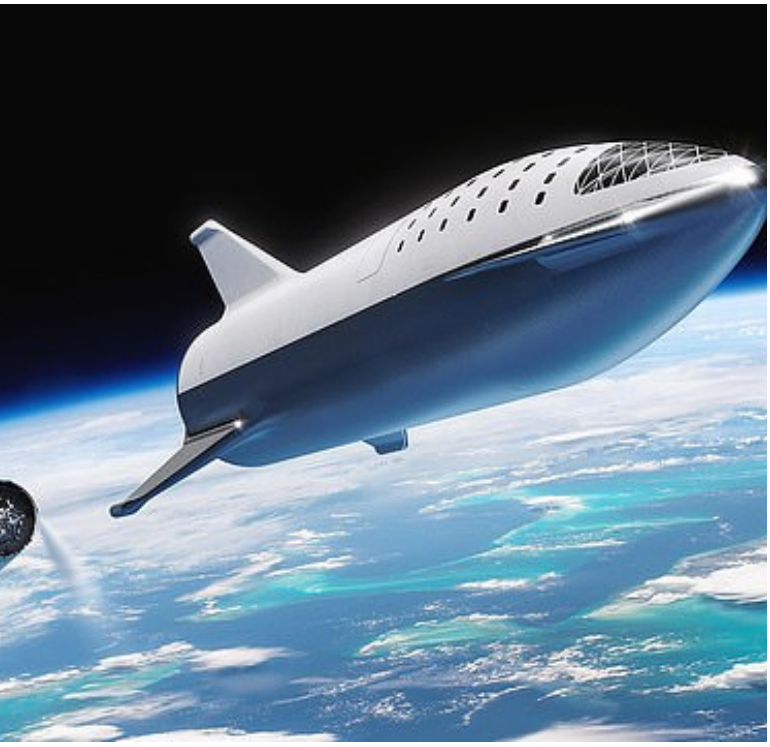
This protected the virus during the freeze-drying process. After drying the ampoules were sealed under nitrogen. Like other vaccines, once reconstituted it became ineffective after 1–2 days at ambient temperatures. However, the dried vaccine was 100% effective when reconstituted after 6 months storage at 37 °C (99 °F) allowing it to be transported to, and stored in, remote tropical areas.

Collier39s method was increasingly used and, with minor modifications, became the standard for vaccine production adopted by the WHO Smallpox Eradication Unit when it initiated its global smallpox eradication campaign in 1967, at which time 23 of 59 manufacturers were using the Lister strain.

## Aspirin:

Aspirin also referred to as Acetyl Salicylic Acid (ASA), is a medication used to reduce pain, fever, or inflammation. Specific inflammatory conditions that aspirin is used to treat include Kawasaki disease, pericarditis, and rheumatic fever. Aspirin is also used long-term to help prevent further heart attacks, ischaemic strokes, and blood clots in people at high risk. It may also decrease the risk of certain types of cancer, particularly colorectal cancer. Aspirin is the most widely sold over-the-counter drug. The production process involves the reaction of Salicylic acid and acetic anhydride in glass-lined vessels. The liquid produced is pumped to a crystallizer, where it is cooled down to start the crystallization to Aspirin which is then filtered to remove the acetic acid and solvent, which are recovered and possibly recycled. The crystals are then washed and filtered again. The crystals are sent to sifting, granulation, and tableting after drying.



Technical Article.

# THE AMAZING COMPLEXITY AND ENGINEERING OF SPACEX'S NEW RAPTOR ENGINE.

**By Rahul N**
**Third year Chemical Engineering student**

Space Exploration Technologies Corp also fondly referred to as SpaceX by the world, is an American aerospace manufacturer and space transportation services company headquartered in Hawthorne, California. It was founded in 2002 by Elon Musk, who is a real visionary of our time. He created a corporation intending to reduce space transportation costs and also aims to enable the colonization of Mars in the long run.

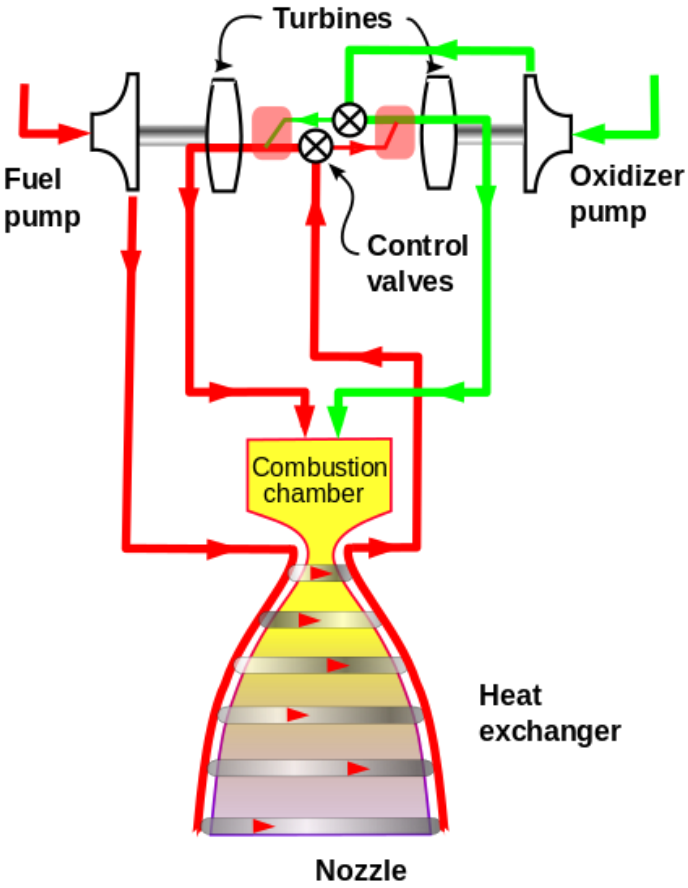
The strength of SpaceX lies in its core working 'mantra'. Their team has the right mindset to solve complex problems, but in any case, they are unable to, they iterate right back to the beginning and start working the problem all over again.

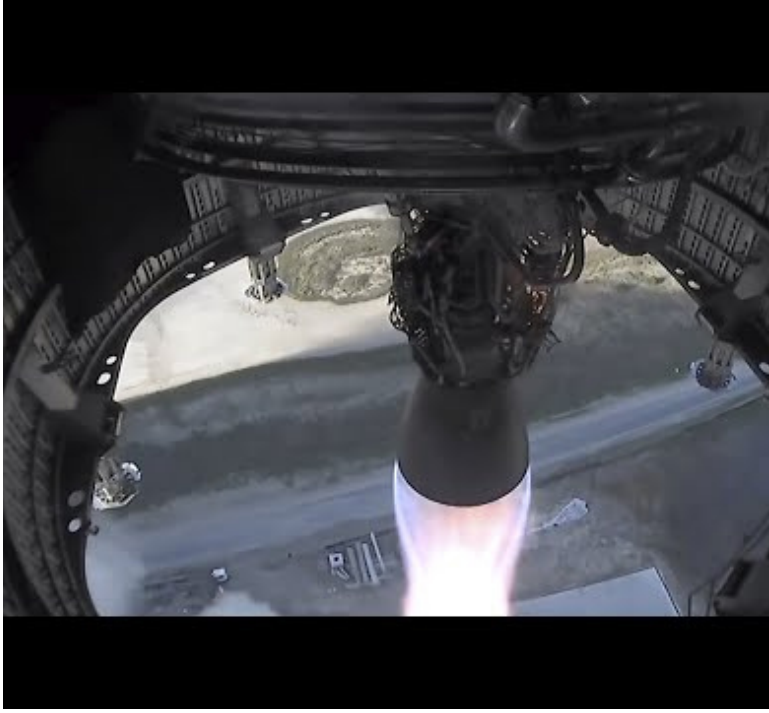
Let us look at one such complex problem, which they solved as a team, and ultimately led to the creation of the SpaceX Raptor engine, which the USSR had tried to solve previously during the advent of the space race but failed and therefore was regarded as a waste of time and resources by many.

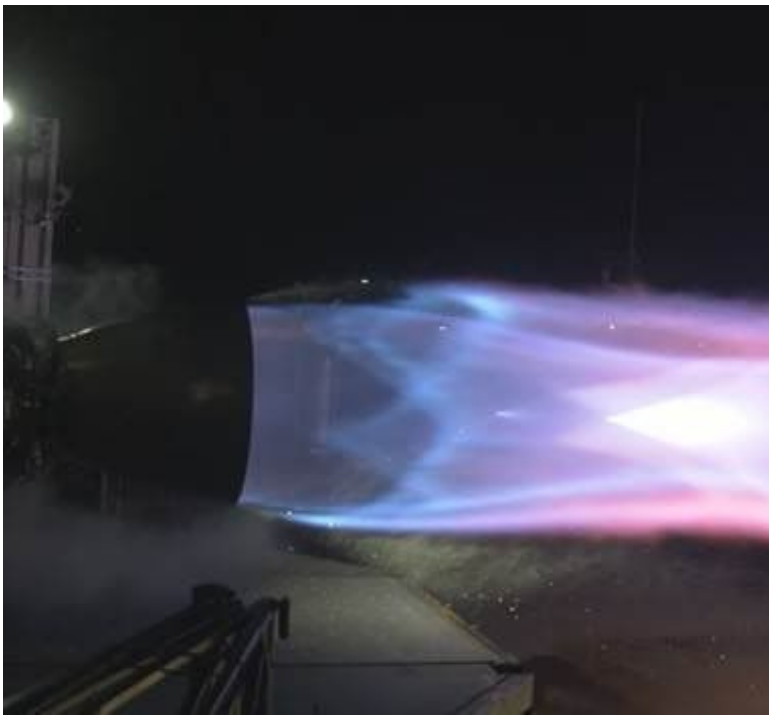
## What is a Staged Combustion Cycle?

The staged combustion cycle (sometimes referred to as topping cycle or pre burner cycle) may be a power cycle of a bipropellant engine. In the staged combustion cycle, propellant flows through multiple combustion chambers and is thus combusted in stages. The most advantage relative to other engine power cycles is high fuel efficiency, measured through specific impulse, while its main disadvantage is engineering complexity.

Typically, propellant flows through two sorts of combustion chambers; the primary is called a pre-burner and the second is called the main combustion chamber. In the pre-burner, a little portion of propellant is combusted, and therefore, increasing volume flow is employed to drive the turbo-pumps that feed the engine with propellant. Within the main combustion chamber, the propellants are combusted completely to supply thrust.





## What is a Full-Flow Staged Combustion?

Full-flow staged combustion (FFSC) is a twin-shaft staged combustion cycle that uses both oxidizer-rich and fuel-rich pre-burners. The cycle allows the full flow of both propellants through the turbines. The fuel turbopump is driven by the fuel-rich pre-burner, and therefore, the oxidizer turbopump is driven by the oxidizer-rich pre-burner.

Benefits of the full-flow staged combustion cycle include turbines that run cooler and at lower pressure, due to increased mass flow, resulting in extended engine life and better reliability. As an example, up to 25 flights were anticipated for engine design studied by the DLR (German Aerospace Center) in the frame of the SpaceLliner project, up to 1000 flights are expected for Raptor from SpaceX. Further, the full-flow cycle eliminates the necessity for an inter-propellant turbine seal normally required to separate oxidizer-rich gas from the fuel turbopump or fuel-rich gas from the oxidizer turbopump, thus improving reliability.

## Where does the SpaceX Raptor stand now, the advantages and disadvantages of FSSC?

Since the use of both fuel and oxidizer pre burners results in full gasification of each propellant before entering the combustion chamber, FFSC engines belong to a broader class of rocket engines called gas-gas engines. Full gasification of components leads to faster chemical reactions in the combustion chamber, allowing a smaller combustion chamber. This in turn makes it possible to increase the chamber pressure, which increases efficiency.

The potential disadvantages of the full-flow staged combustion cycle include increased engineering complexity of two pre burners, relative to a single-shaft staged combustion cycle, as well as an increased parts, count.

# ANTI MALARIAL PLANT'S CHLOROPHYLL CATALYZES DRUG SYNTHESIS

**By Mani Kumar**
**Fourth year chemical engineering student**

The new 'green' method makes malaria-fighting artemisinin's synthesis faster and cheaper with industrial production planned for 2021. A key molecule used to make antimalarial drugs can now be directly prepared from a crude plant extract without purification. The new process is powered by the plant's chlorophyll and could make antimalarial treatments cheaper and more widely available. The method is being commercialized with plans to start industrial production in 2021.

Over 200 million people are infected with malaria every annum. The foremost powerful drugs to treat this disease are based on the artemisinin-a compound which will be isolated from the sweet wormwood plants (Artemisia annua). The molecule's activity is believed to derive from an endoperoxide bridge, which selectively damages the parasites that cause the illness. But the production of artemisinin currently depends on cultivating the wormwood plant, so alternative methods are being sought. While total synthesis is just too complicated and expensive to supply enough artemisinin to satisfy global needs, semi-syntheses from precursors such as dihydroartemisinic acid (DHAA) are an honest option.

**This work represents the primary example of a natural product being produced using the readily available machinery from the plant itself.**

## 100 times more efficient

The sweet wormwood plant contains about 1% artemisinin, alongside DHAA and other materials that are typically discarded. In their two-step process, the researchers use this 'waste' to supply more artemisinin. The tactic is additionally quite simple: first, the starting material is extracted from the plant in toluene.

The resulting green solution is then mixed with trifluoroacetic acid and oxygen gas and skilled endless flows photo-reactor with no further purification or processing required – where it's irradiated with a blue or red light. The plant's chlorophyll absorbs light and transfers that energy to molecular oxygen, which is excited and may then react with DHAA.

'After quarter-hour, we produce an equivalent result because the plant achieves naturally in three weeks, 'Gilmore says 'The process is so efficient, we will convert up to 100 times the natural levels of DHAA within the plant, meaning we will add material from additional sources on directly to our feed with none modification to the system.'

# SEAWATER - THE FUTURE ENERGY!

**By Ammu Usha Manasa**
**Fourth year Chemical Engineering student**

Primary sources for energy production in today's world are renewable energy resources and fossil fuels like coal, oil, petroleum, etc., Due to the rise in population and advancements in life, utilization of energy becomes more in the mere future, to meet our needs. It's a known fact that fossil fuels are already depleting, and it's time to search for an alternative source of energy.

It is also observed that, due to global warming, seawater levels are rising at a rapid rate. So here evolves our new source of energy, which is seawater, abundant enough to meet the future energy requirements.

Research has been going on to convert seawater to hydrogen and oxygen fuels using simple electrolysis, but the problem arises where the chlorides in seawater increase the corrosion rate of electrodes, reducing the lifespan of the system. Researchers worldwide are trying to develop an electrolysis technology that will split water directly into hydrogen and oxygen without prior desalination.

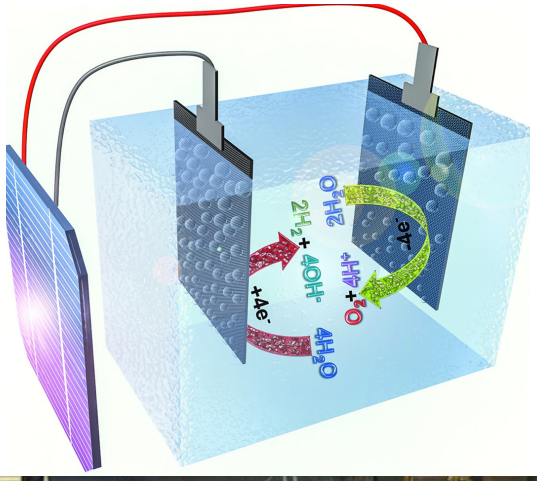
To reduce the accumulation of negative ions at the electrode, (that is to prevent excessive corrosion) researchers designed and synthesized a three-dimensional core-shell oxygen evolution reaction catalyst using transition metal-nitride, with nanoparticles made from a nickel-iron-nitride compound and nickel-molybdenum-nitride nanorods on porous nickel foam.

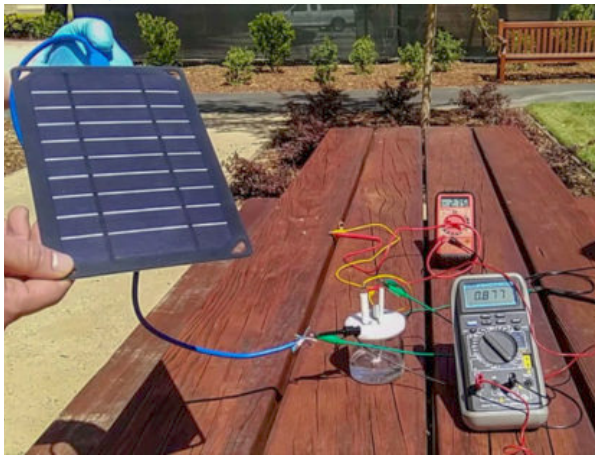
A hierarchical anode consisting of a nickel-iron hydroxide electrocatalyst layer uniformly coated on a sulfide layer formed on Ni substrate was developed, affording superior catalytic activity and corrosion resistance in seawater electrolysis.

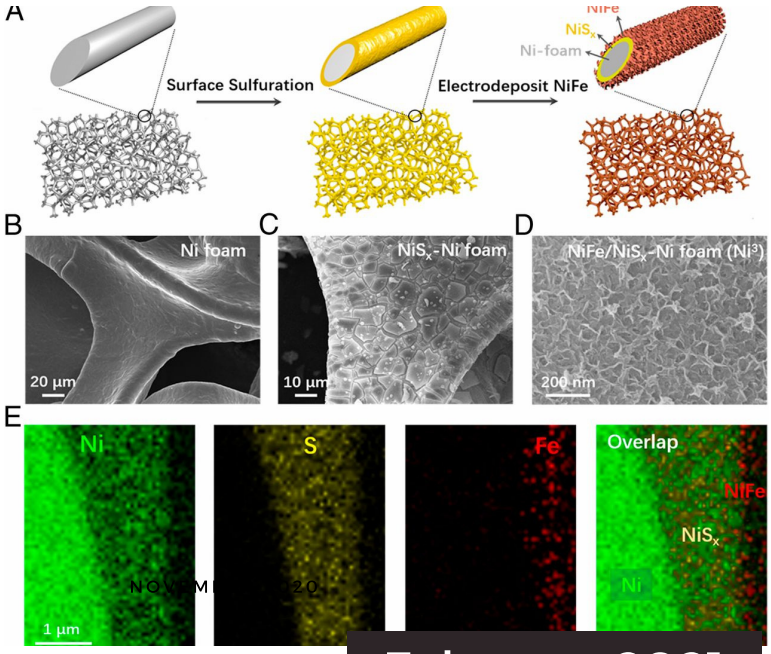
In situ-generated polyanion-rich passivating layers formed in the anode are conducted for chloride repelling, and a high corrosion resistance, resulting in new directions for designing and fabricating highly sustained seawater-splitting electrodes and providing an opportunity to use the limitless seawater on Earth as a new source of energy.

This enables us to maintain a higher life span of the system, generating enough electricity, producing sufficient hydrogen and oxygen to use as a fuel in various fields, and also providing instant oxygen for sea divers.

Thus, the vast and increasing levels of seawater can help human life in generating energy. And so "Seawater is - The next-generation raw material for energy!".

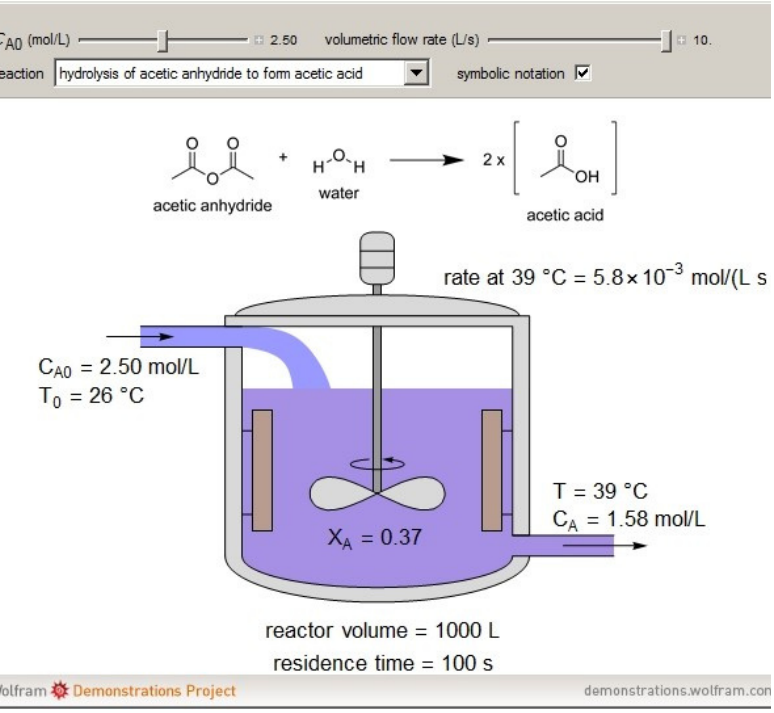


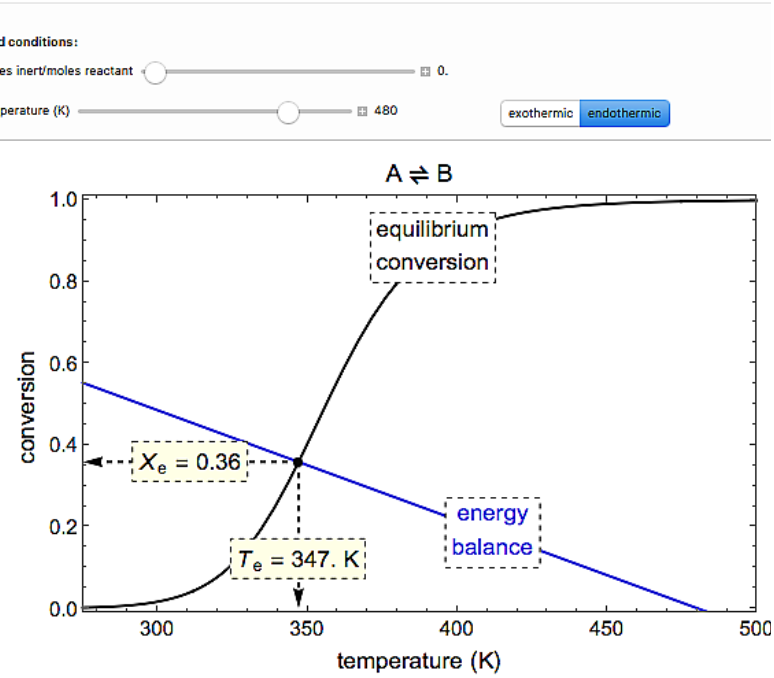



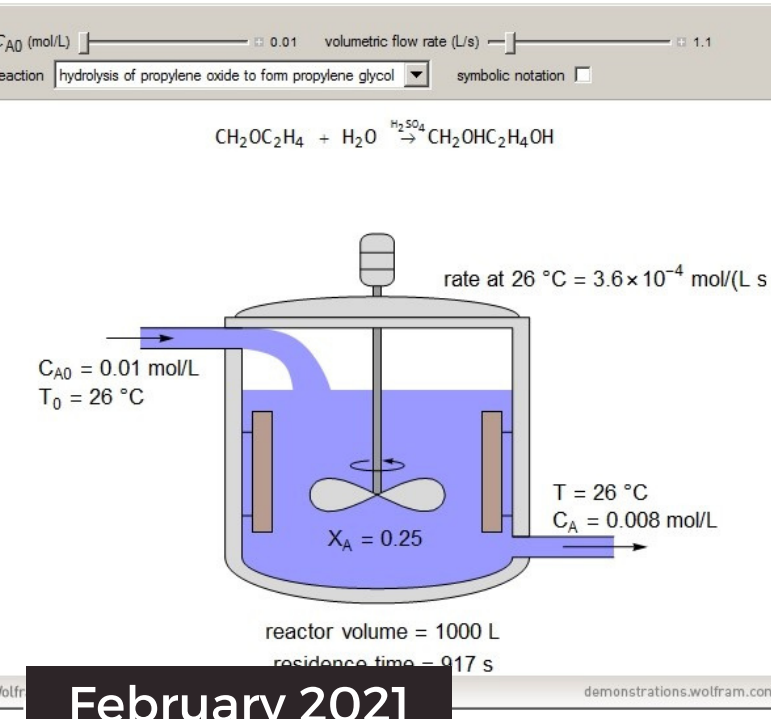


# CDF ANIMATIONS FROM WOLFRAM.

**By Abhishek**
**Fourth year Chemical Engineering student**




CDF is an abbreviation for "Computable Document Format" viewer developed by Wolfram Research. The proprietary CDF Player is released with a restricted license, which can be downloaded free of cost from Wolfram Research.

In contrast to static formats such as PDF and pre-generated interactive content provided by formats like Adobe Flash; the CDF Player contains a whole runtime library of Mathematica allowing document content to be generated in response to user interaction using many algorithms or visualizations which may be described in Mathematics. This makes it suitable for scientific, engineering, and other technical content and digital textbooks. The CDF reader support is out there for Microsoft Windows, Macintosh, Linux, and iOS but is not available for e-book readers or Android tablets. The reader supports a plugin mode for Internet Explorer, Mozilla Firefox, Google Chrome, Opera, and Safari, which allows CDF content to be embedded inline in HTML pages. But more importantly, one can look for many topics associated with not only Chemical Engineering, but also for several other topics such as Engineering, Sciences, Mathematics, and the list goes on...

In the mentioned demonstration, a mole of a binary mixture undergoes batch distillation. The first slider sets the mole fraction of the starting liquid. Once you click the "click to collect" button, the liquid evaporates and the distillate is collected in a collection flask. The quantity collected into each flask is adjusted with the help of the second slider. The gathering flask is then put aside and an empty flask is substituted. The process repeats once again when you click the "click to gather" button again until finally, 0.2 mol remains within the still. The equilibrium temperature is shown next to the thermometer. Select either the gathering flasks, an A- plot, or an A-- plot to be displayed. Click "reset" to display one of the above plots or to start over. You can choose either a perfect solution (no azeotrope), a minimum-boiling temperature azeotrope, or a maximum-temperature azeotrope from the drop-down menu. Hovering the mouse over an object reveals further information about that object. The introduction of CDF in arrears of Chemical Engineering would put away a herculean task off the engineer's shoulders. CDF would in the coming time surely prove itself as one of the trusted aides of engineers around the globe.

Vertical Roller Mill

# GUINNESS WORLD'S RECORD FOR THE LARGEST VERTICAL ROLLER MILL

**By Mani Kumar**
**Fourth year Chemical Engineering student**

The largest vertical roller cement mill is the FLSmidth OK81-6™ vertical mill with a grinding table diameter of 8.08 m (26 ft 6 in) and roller diameter of 2.64 m (8 ft 7 in), achieved by Shah Cement Industries Ltd. (Bangladesh), located in Dhaka, Bangladesh, on 6 September 2018. The vertical roller cement mill was manufactured by FLSmidth (Denmark) and commissioned by Shah Cement Industries Ltd. (Bangladesh). The cement mill contains 6 rollers and one large grinding table.

The mill is meant to supply Ordinary Portland Cement (OPC), Pozzolana Portland Cement (PPC), Portland Slag Cement (PSC), and slag cement types. It is producing PPC at a capacity of 500t/hr at 3500 Blaine with a 15% slag. Additionally, to the OK Mill, FLSmidth supplied the process and layout engineering, in conjunction with site advisory. The supporting equipment included FLSmidth Pfister weigh feeders, FLSmidth Airtech process bag filters, process fans, and auxiliary equipment from staple hopper discharge to process bag filter discharge.

**"The company is part of the Abul Khair Group, the largest business conglomerate in Bangladesh."**

# THE BAGHJAN BLAZE

**By Aditya Virkar**
**Third year Chemical Engineering student**

May 27th was the day when oil and natural gas started to gush out uncontrollably from the Baghjan oil field in Tinsukia district of Assam. Also known as a blowout in technical jargon, this leak continued to spew out inflammable substances, even as engineers were scrambled to help plug the leak. The oil field controlled by Oil India Ltd. sits less than a kilometer away from the Dibru-Saikhowa National Park. Officials of OIL worked to contain the leak as it posed an immediate threat to the ecosystem and to the people who lived nearby.

The Baghjan oil field has 17 oil fields and 5 natural gas fields, of which field no. 5 was facing problems. On the unfortunate morning of 9th June as the clearing operations were underway at when the well caught fire, giving birth to a towering inferno at the scene. The fire continued to burn vigorously for the next 48 hours.

In an effort to keep a fire from gripping the blowout, OIL had been spraying water over the area to keep temperatures down, assisted by a spate of rains as well. Three people, an OIL engineer and two firefighters had been killed in this horrific incident whereas a little over 6000 people had to be evacuated.

NDRF and SDRF teams had to be rushed in to control the blaze. An environmental damage assessment stated that around 1383 people were affected by the fire.

The incident led to a public outcry which resulted in the closure of four gas wells and eight oil wells in Baghjan and one oil well in Dakuwal leading to a cumulative loss of 3016 metric tonnes of crude oil and 10.07 million metric standard cubic meters of natural gas.

It must be noted that after 180 days the officials were not unable to completely extinguish the fire, but succeeded in limiting it to the orifice. After 90 days of this fire another fire broke out at the same well which had also been controlled by first responders.

> **"The fire continues to burn even after 180 days and all efforts to put it out are proven futile."**


# VIZAG GAS LEAK

**By Hriman Mandal**
**Third year Chemical Engineering student**

A gas leak, reminiscent of the 1984 Bhopal tragedy, has claimed 12 lives and affected thousands of residents in five villages in Visakhapatnam in Andhra Pradesh. The source of the leak was **Styrene**. The plant is owned by South Korean electronics giant LG, located at RRV Puram near Gopalapatnam, about 15 km from the coastal city.

Initial reports indicate that several people from the surrounding villages of RRV Puram, Venkatapuram, BC Colony, Padmapuram, and Kamparapalem fell unconscious on the roads. While six died due to prolonged exposure to the gas, another two died while trying to escape from the leak.

Reports said they were more than 2,500 parts per billion (ppb) on the day of the leak, while World Health Organization norms require them to be under 5 ppb.
Within hours of the leak, which began at 2.50 a.m., more than 580 were hospitalized. Over 2,000 people were evacuated between 5 a.m. and 9 a.m. from the villages surrounding the chemical plant within a radius of 1.5-3 km.

### What is styrene?

It is a flammable liquid(polymer) that is used in the manufacturing of polystyrene plastics, fiberglass, rubber, and latex. Short-term exposure to styrene can result in respiratory problems, irritation in the eyes, irritation in the mucous membrane, and gastrointestinal issues.
Long-term exposure could drastically affect the central nervous system and lead to other related serious problems like peripheral neuropathy eventually leading to death. It could also lead to cancer and depression in some cases.
It can react with oxygen in the air to mutate into styrene dioxide which is more lethal.

### What caused the leak?

The storage requirement of styrene monomer said that it should be stored strictly at a temperature below 17 °C. There was a temporary partial shutdown of the plant due to Covid-19 lockdown, excluding maintenance activities in the plant, which were being carried out as per a pre-determined schedule. The problem began as a result of styrene gas not being stored at the appropriate temperature. This caused pressure to build up in the storage chamber and led the valve to break, resulting in gas leakage.

**"A gas leak from the LG Polymers plant in Visakhapatnam, which was operating without environmental clearance for over two decades, killed 12 people and sickened hundreds on May 7"**

# Expert Answers with Dr. M. Chidambaram

**Dr. M. Chidambaram**

Educational Qualifications: B.E (Chemical) Annamalai University (1975)
M.E (Chemical) Indian Institute of Science, Bangalore (1977)
Ph.D. Indian Institute of Science, Bangalore (1984) Thesis title: 'Studies on slurry reactors'

Former faculty in IIT Bombay and IIT Madras.
Former Head of Department of Chemical Engineering, (IITM).
Former Director, NIT, Tiruchirappalli.
Presently Emeritus Professor, Department of Chemical Engineering, NIT-Warangal.

Published 190 National (59) and International Journals (131).
Listed in the world top 2% Scientist by the committee of Stanford Professors

---

**Q. Is it really important to do Master's/M.Tech after B.Tech?**
A. The placement for M.Tech is not enticing. It is suggested to accept a job after B.Tech. After a year or two, if the company where you are working gives study leave you can try for a suitable PG program or some additional courses on Environmental Assessment.

**Q. Please give us your opinion on the disasters happening worldwide in chemical industries and plants? What has to be done to reduce these risks amidst this pandemic?**
A. The Safety and Risk Analysis is to be carried out regularly to mitigate the risk.

**Q. Does a chemical engineer have good job opportunities? In which fields do we have the opportunities. Which job profile is beneficial for chemical engineering graduates?**
A. Yes. Chemical Engineering has a lot of opportunities especially in the avenues of Materials and Environmental control. Hardcore jobs - Analysis and Design type of profile is beneficial.

**Q. Is coding knowledge required for a chemical engineer along with practical knowledge on their core subjects?**
A. Coding knowledge required to use standard sub-routines to solve equations resulted from the modeling of systems.

**Q. In Master's, what are the courses that should be taken by a chemical engineer?**
A. In the master's program we have Transport Phenomena, Mathematical modeling, and simulation, Optimization techniques, Flow sheeting, advanced thermodynamics, Nanotechnology, Advanced process control, Bio-Technology, Instrumental analysis, Advanced Mass transfer, Advanced Reaction Engineering.

**Q. Is chemical engineering only about making a useful product from raw material? What would be the role of chemical engineers in industries?**
A. Chemical Engineering is the field of applied science that employs physical, chemical, and biochemical rate processes for the betterment of humanity.

**Q. To get a good score in competitive exams like GATE, in which subject should we mainly focus on?**
A. Mathematics, Process control, Thermodynamics and Kinetics, Mass Balance.

**Q. A message to young readers as they usually ignore Chemical Engineering?**
A. You Stop learning, You stop growing;
Your game is as good as your practice;
Start your work earlier (early to bed and get up earlier).

"All the very best for your career! "

**Absorb.**
Your Window to Chemical Engineering

# Behind the Pages

Dr. Vinoth Kumar Raja

Dr. Dinesh Sankar Reddy

Dr. Purushottama Rao Dasari

## FACULTY ADVISORS

## THE EDITORIAL BOARD

Shashwat Panbude
IV year

Ammu Usha Manasa
( Student Coordinator)
IV year

K Mani Kumar
IV year

Rahul N
III year

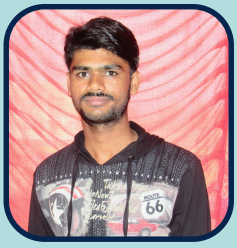
Virkar Aditya Manish
III year

Hriman Mandal
III year

# CONTRIBUTORS

Abhishek
IV year

B. V. V. Sai Kiran
IV year



B. Naveen Kumar Naik
IV year

Sudheer Kumar
IV year

Vyakhya Verma
III year

Hansitha Puli
III year

Sraavya Sree
III year

Soni P.
III year

Ch. Sahithi
III year

Deepthi Devan Pisharady
II year

Yaswanth M.
II year

Mridul Sharma
II year

Sabarinathan A
II year

**Absorb.**
Your Window to Chemical Engineering

# DEPARTMENT OF CHEMICAL ENGINEERING

Dr. Dinesh Sankar Reddy
Registrar & Asssociate Professor

Dr. Vinoth Kumar Raja
Assistant Professor & HoD

## Ad-hoc faculty

Dr. Subasis Mandal

Dr. Banavath Anil Kumar Naik

Mr. Ravi Thej Pilla

Dr. Ahammed Sherief K Y

Dr. Prince Kumar Baranwal

Dr. Purushottama Rao Dasari

**Absorb.**
Your Window to Chemical Engineering

# ACKNOWLEDGEMENTS

## SOURCES


### CHEMICAL ENGINEERING AT A GLIMPSE

- https://www.britannica.com/technology/chemical-engineering
- https://en.m.wikipedia.org/wiki/History_of_chemical_engineering
- https://www.sciencehistory.org/distillations/the-first-century-of-chemical-engineering
- https://images.app.goo.gl/fFsyqXPT3k4FsRdc6
- https://images.app.goo.gl/sMYP3HwNpddrY7kZ9
- https://images.app.goo.gl/1UmokUdhoNzEgzhz7
- https://images.app.goo.gl/BzHKYK83LWn1s3hH7
- https://images.app.goo.gl/2ij7SPSzV5Pdf9gN8

### ANTI MALARIAL PLANT'S CHLOROPHYLL CATALYZES DRUG SYNTHESIS

- https://www.chemistryworld.com/news/antimalarial-plants-chlorophyll-catalyses-drug-synthesis/3008727.article
- https://images.app.goo.gl/Wo8d6EofrbJXSAxy7

### THE AMAZING COMPLEXITY AND ENGINEERING OF SPACEX'S NEW RAPTOR ENGINE.

- https://everydayastronaut.com/raptor-engine/
- https://en.wikipedia.org/wiki/SpaceX_Raptor
- https://en.wikipedia.org/wiki/Staged_combustion_cycle
- https://en.wikipedia.org/wiki/SpaceX
- https://images.app.goo.gl/PwDWpu9WQLuNFEaz8
- https://images.app.goo.gl/9qj4M7QG4gT9EXky6
- https://images.app.goo.gl/YuicSkQuTtRco2nX9
- https://images.app.goo.gl/5hXPPDRbXGXmQQRW8
- https://images.app.goo.gl/DSutVbv6hBpesiGG9
- https://images.app.goo.gl/RuszA9nivjRBnFpG7
- https://images.app.goo.gl/zjrdo8zm5VT18FJx6

### MOLECULE DEVELOPED TO STORE ENERGY

- http://dx.doi.org/10.1021/jacs.0c06327
- https://images.app.goo.gl/hcHte1hQ4W7XV6QC8
- https://images.app.goo.gl/KmZCPWAgHpCz9SVa9
- https://images.app.goo.gl/TVF5zJG7RjWPQ2WF8
- https://images.app.goo.gl/MCbMJxxJfz6XyFZ99

### THE SELF HEALING MATERIAL

- http://dx.doi.org/10.1038/s41427-020-0208-9
- https://images.app.goo.gl/WuxJeQZi4AUAqEWL7
- https://images.app.goo.gl/nnLs5JPM48FmGShj6

### A BRIEF HISTORY OF MEDICINES THAT CHANGED THE WORLD

- https://www.news-medical.net/health/Penicillin-Production.aspx
- https://www.who.int/csr/disease/smallpox/vaccines/en/
- https://www.unodc.org/unodc/en/data-and-analysis/bulletin/bulletin_1953-01-01_3_page007.html
- https://en.wikipedia.org/wiki/Morphine
- https://www.slideshare.net/zohaibkhan404/industrial-production-of-insulin-85788813?from_action=save
- https://en.wikipedia.org/wiki/Aspirin
- http://www.kpatents.com.cn/assets/files/applications/apn-6-01-02.pdf
- https://images.app.goo.gl/pwYm7qNLSviBth198
- https://images.app.goo.gl/WxaUpVX1j6dpvGpR6
- https://images.app.goo.gl/WzYMrMKJktS4oMRE8
- https://images.app.goo.gl/DsDoxov9gAhCdHaP8
- https://images.app.goo.gl/m19gYrLTJ9meGbpn9
- https://images.app.goo.gl/C7qi8AQfWrvDDf3Z6
- https://images.app.goo.gl/gE8VRAusfT2MKFnM9


**Absorb.**

YOUR OWN CHEMICAL ENGINEERING MAGAZINE

# ACKNOWLEDGEMENTS

## SOURCES


### SEA WATER - THE FUTURE OF ENERGY

- https://www.pnas.org/content/116/14/6624
- https://fuelcellsworks.com/news/electrolysis-of-sea-water-could-provide-a-new-boost-for-hydrogen-as-an-energy-source/
- https://www.news18.com/news/auto/scientists-develop-technology-to-convert-ocean-water-to-hydrogen-fuel-2072479.html
- https://news.stanford.edu/2019/03/18/new-way-generate-hydrogen-fuel-seawater/#:~:text=Stanford%20researchers%20create%20hydrogen%20fuel,abundant%20source%20%E2%80%93%20for%20chemical%20energy.
- Hongjie Dai and his research lab at Stanford University have developed a prototype that will generate hydrogen fuel from seawater. (Image credit: Courtesy of H. Dai, Yun Kuang, Michael Kenney)
- https://doi.org/10.1073/pnas.1900556116
- https://images.app.goo.gl/9izxndtGHZm3iyK37
- https://images.app.goo.gl/h9KZhqjwu5QRSDN99
- https://images.app.goo.gl/a5txdtKEwN2DULML7
- https://images.app.goo.gl/RQnnM4wmMxUzmymn6

### CARBON NANOTUBES COULD MAKE CARBON-ZERO FUELS CHEAPER THAN FOSSIL FUELS

- https://www.thechemicalengineer.com/news/carbon-nanotubes-could-make-carbon-zero-fuels-cheaper-than-fossil-fuels/
- https://images.app.goo.gl/MyBUFqWiyZhQWBd19

### GUINNESS WORLD'S RECORD FOR THE LARGEST VERTICAL ROLLER MILL

- https://www.guinnessworldrecords.com/world-records/527561-largest-vertical-roller-cement-mill
- https://markets.businessinsider.com/news/stocks/shah-cement-inaugurates-worlds-largest-vertical-roller-mill-from-flsmidth-6955456#
- https://images.app.goo.gl/4K7qMM3NSNMF7JPn6

### THE BAGHJAN BLAZE

- https://www.ndtv.com/india-news/assam-oil-well-fire-debris-cleared-atassam-oil-blowout-site-work-on-controlling-fire-next-2263049
- https://thewire.in/environment/assam-tinsukia-baghjan-oil-field-blowoutcatches-fire
- https://www.google.com/amp/s/m.hindustantimes.com/india-news/assamnatural-gas-well-continues-to-blaze-3-months-since-blowout/storyTCFj0M9lwUsLRUCJxXGkAO_amp.html
- https://images.app.goo.gl/iztH9AnZQVeCAQwQA
- https://images.app.goo.gl/vTyrRS3GKB7zQUhS7
- https://images.app.goo.gl/7ikQPdeaCkEEFf4Q7

### VIZAG GAS LEAK

- https://indianexpress.com/article/explained/vizag-gas-leak-what-is-styrene-gas-6398020/
- https://india.mongabay.com/2020/05/years-of-neglect-led-to-vizag-gas-tragedy/
- https://www.downtoearth.org.in/dte-infographics/vizag_gas_leak/index.html
- https://www.thestatesman.com/india/6-dead-200-hospitalised-gas-leak-visakhapatnam-chemical-plant-pm-modi-ndma-meet-1502885109.html

### CDF ANIMATIONS FROM WOLFRAM.

- https://www.chemicalengineeringguy.com/the-blog/general/what-are-cdf-animations-from-wolfram/
- https://en.wikipedia.org/wiki/CDF_Player
- https://demonstrations.wolfram.com/topic.html?topic=chemical+engineering&limit=20cdf animations


**Absorb.**

YOUR OWN CHEMICAL ENGINEERING MAGAZINE

# Absorb.

Your Window to Chemical Engineering