Sri Venkateswara College of Engineering

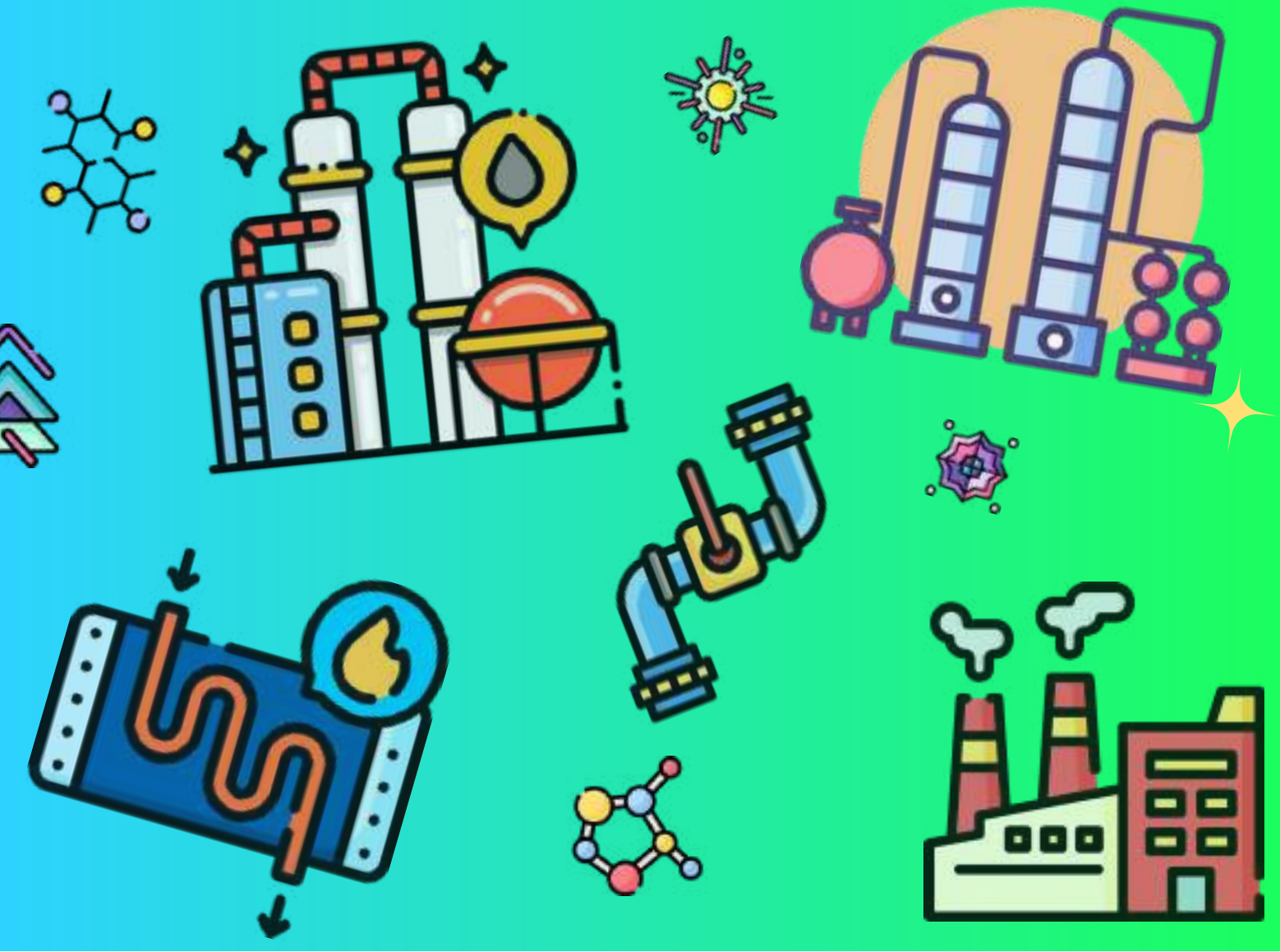
CHEMEVO

DEPARTMENT OF CHEMICAL ENGINEERING

2020 - 2021

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

N. N. Harish Kumar

""The best way to predict the future is to create it."
- Peter Drucker

Greetings Readers!

In this age of unprecedented challenges, chemical engineers are taking center stage in designing processes, materials, and technologies that minimize ecological impact. From renewable energy systems that harness the power of nature's forces to efficient waste management strategies that embrace the principles of circular economy, our field is at the forefront of sustainable development. The decisions we make in laboratories and boardrooms resonate globally, rippling through economies, ecosystems, and societies. Balancing the pursuit of economic growth with ecological harmony necessitates a holistic approach that integrates the principles of green chemistry, energy efficiency, and ethical considerations. Through thought-provoking articles penned by industry experts, research spotlights that unveil groundbreaking discoveries, and real-world case studies that showcase the tangible impact of our discipline, CHEMEVO aims to inspire and inform. We believe that by fostering a deeper understanding of the multifaceted role of chemical engineers, we can catalyze discussions, foster collaborations, and drive the transformation towards a sustainable and equitable world.

FACULTY IN-CHARGE

Dr. N. P. Kavitha

ASSISTANT PROFESSOR / CHE

DEVAKI MUTHIAH ENDOWMENT AWARD WINNER

Mr. N. N. Harish Kumar

2020 - 2021

SREE HAREEHARA SUDHAN EDUCATIONAL TRUST AWARD WINNER

Mr. N. N. Harish Kumar

2020 - 2021

DUBASI BALAKRISHNA DORA AWARD WINNER

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2020 - 2021

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2020 - 2021

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FROM LEAD TO CLEAN – THE EVOLUTION OF FUELS

Evolution of fuels

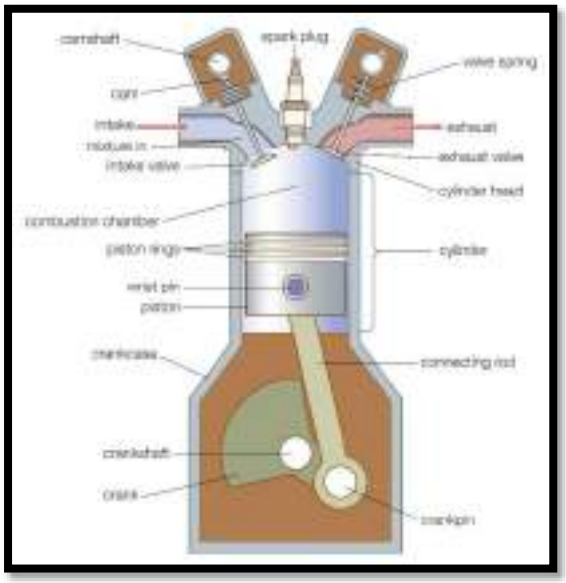
Since the early ages, humans have been looking for different forms of transportation techniques for commuting goods and themselves. The earliest modes of transports were mostly animal driven who fed on biomass available in the environment. Next up, humans even learnt to harness the power of wind to make sails for long distance travels. The first automobile took shape during the late 18th century which was run on a steam – engine. The steam engine revolutionized transportation via coal driven locomotives and steamships. The 20th century though saw a significant shift to petroleum–based fuels for transportation, driven by the rise of internal combustion engines.The discovery and development of vast oil reserves contributed to the popularity of petroleum-based fuels which is the predominant fuel used for transportation to this day. Now due to concerns regarding the ever increasing and non-steady prices of fossil fuels as well as the environmental issues caused by them, we are again undergoing a shift to biofuels, hydrogen fuel and electric vehicles.

The natural progression of fuel sources over time can be observed through a historical lens, showcasing the transition from primitive combustibles to modern energy options. This evolution is a result of various factors, including technological advancements, resource availability, and environmental considerations. As societies have developed, their fuel choices have adapted to meet changing needs and challenges, reflecting the ongoing quest for more efficient and sustainable energy solutions. This progression hasn't been without flaws or setbacks.

Lead based gasoline

Let us look onto a case of a historic error that still affects humans to this day: The addition of lead-based additives in gasoline. The need for leaded fuels arose when powerful automobiles were starting to get developed which had a severe problem of engine knocking. Engine knockingis the abnormal combustion phenomenon in internal combustion engines that occur when the air-fuel mixture ignites prematurely or spontaneously before the spark plug fires,

leading to multiple flame fronts colliding and producing a knocking sound. This not only reduced power output and lowered fuel efficiency, but also the vibrations due to knocking damaged pistons and walls of the cylinder shortening the life of the engine.



Piston of a normal internal combustion engine

One way to fix this issue was by increasing the octane number of the fuel used. Thomas Midgley Jr. who was hired by Cadillac, experimented on different substances in search of an additive that could do that. He found out adding Ethanol stopped knocking but so much of it was required; about 10% percent; which was expensive and hard to turn a profit on. Tellurium also reduced knocking but it had a terrible smell which of course we can see why, wouldn't be well received by markets. After 5 years of research, Midgley found what he thought was the perfect solution: Tetra Ethyl Lead. It was cheap to produce, was readily available, had no smell and we only need 1 part to 1000 parts fuel for it to stop knocking. Tetra Ethyl Lead (labelled as Ethyl) was well received since it could be used in existing engines, increased fuel efficiency, improved overall engine performance as well as increased engine life. The demand for leaded gasoline took off.

Discovery of Harmful Effects of lead

In the 1960s and 1970s, researchers began to uncover evidence of lead's harmful effects on human health and the environment. Studies showed that lead

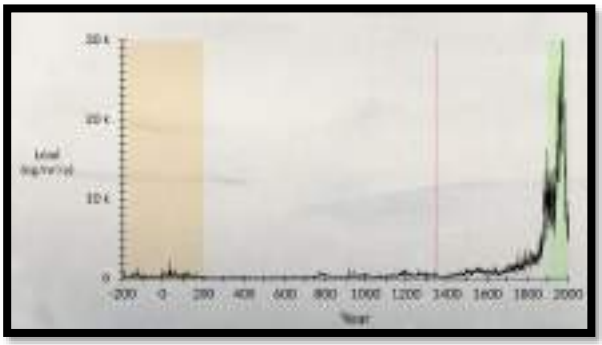
emissions from vehicles burning leaded gasoline were a significant source of environmental pollution, contaminating the air, soil, and water. People working in the petroleum industry and automobile mechanics, in particular, were at a higher risk of lead exposure. Several people who worked on the ETHYL manufacturing plants were down with lead poisoning. A lot of these were disregarded initially as the amount of lead in the fuel was relatively very low and they didn't have clear-cut information as to how much lead was considered safe.

How lead affects humans

Lead mimics Calcium in our body. It is harmful even in extremely small doses. It can be stored in the body for years. Due to this, it can continue to poison the body long after the initial exposure.The parts most affected by lead is the brain and the nervous system. It breaks down the myelin sheath around axons and prevents release of neurotransmitters. Some of the main symptoms of lead poisoning are memory loss and headaches.Lead exposure caused behavioral problems, reduced IQ, delinquency, aggressiveness and permanent brain damage. Now about 2/3rd of all unexplained learning disorders is believed to be a consequence of lead.

Another lesser-known effect of lead was the hardening of arteries which led to several cardiovascular diseases. Even now lead is believed to cause 265000 deaths per year due to cardio vascular diseases.

Social Impact caused due to lead poisoning



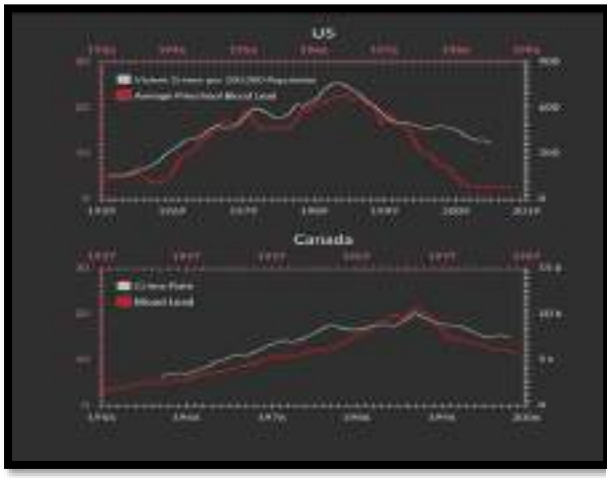
This might be a stretch to put it this way but the world is less intelligent today due to the decision to add lead in fuels. After comparing people who were deceased in

that time-line with Egyptian mummies, researches found out that modern-day people have 1000 times more lead in the body. Various studies were done it was found out that students who dropped out of high school had a higher percentage of lead in their body.

Table 7. Full-Scale and Subtest Scores of the Wechsler Intelligence Scale for Children (Revised) (WISC-R) for High and Low Lead Subjects.

WISC-R	Low Lead (Mean)	High Lead (Mean)	P Value*
Full-scale IQ	106.6	102.1	0.03
Verbal IQ	103.9	99.3	0.03
Information	10.3	9.4	0.04
Vocabulary	11.0	10.0	0.05
Digit span	10.6	9.3	0.02
Arithmetic	10.4	10.1	0.49
Comprehension	11.0	10.2	0.08
Similarities	10.8	10.3	0.36
Performance IQ	108.7	104.9	0.08
Picture completion	12.2	11.3	0.03
Picture arrangement	11.3	10.8	0.38
Block design	11.0	10.3	0.15
Object assembly	10.9	10.6	0.54
Coding	11.0	10.9	0.90
Mazes	10.6	10.1	0.37

Further children with higher levels of lead in their bones tend to show higher degrees of delinquency and aggressiveness. Another theory also shows that crime rates have also increased in a similar pattern to lead exposure levels.



Adoption of Unleaded Fuels

After the ill effects of ETHYL was discovered, manufacturers reversed back to unleaded gasoline. However, now to reduce knocking, changes were made in the engine themselves. Improvements in combustion chamber shape, piston design and ignition systems play a crucial role in minimizing the occurrence of detonation.Moreover, ethanol was also adopted to increase octane number of fuels. Ethanol had gained popularity as a renewable biofuel that can be blended with gasoline. Biodiesel blends were also used in many diesel engines which offer cleaner emissions and reduce dependence on fossil fuels.

The future of Fuels

The future of fuel is rapidly changing, as new and innovative technologies are being developed to replace traditional gasoline. One promising option is EVs, which produce zero emissions, making them a much cleaner and more sustainable alternative to gasoline.

Another potential fuel source is hydrogen, which can be used to power fuel cell vehicles. These vehicles convert Hydrogen gas into electricity, producing only water-vapour as a byproduct. While still in early

stages of development, hydrogen-powered vehicles have the potential to revolutionize the transportation industry and greatly reduce our dependence on fossil fuels.

Conclusion

Overall, the use of lead-based additives in gasoline was a historic error with far-reaching consequences for human health and the environment. While the phase-out of leaded gasoline has led to significant improvements, the enduring impact of past lead pollution serves as a poignant reminder of the importance of considering the potential long-term effects of technological innovations on human well-being and the planet.

While initially intended to improve engine performance, this practice led to severe lead pollution and its detrimental impact on human health, especially for vulnerable populations like children. Despite efforts to phase out leaded gasoline, its legacy continues to affect communities, necessitating ongoing measures to address the lingering effects of lead contamination.

Abdulla Irfan

1st year

Sodium-Ion Batteries a Possible Future

Introduction

Fossil fuels are the most widely used type of energy resource in the world but there has been growing concerns on its environmental impact, due to which there has been massive changes in the field of energy engineering to produce pollution free energy such as wind, water, solar and hydro. In order to integrate these renewable energies into an electrical gird, a large-scale energy storage system is required. Lithium-ion batteries was one such introduction into the energy market which brought massive changes in the automotive industries and electronics. Lithium is the main component in such devices, it is found on the earth's crust in an uneven manner but the increasing demand for this particular element makes it at a risk of getting depleted and its prices increasing in the future drastically due to its high demand.

This is where Sodium-ion batteries come into play, Sodium is fourth most abundant metal that is found on the Earth with around 23 billion tons of soda ash located in USA alone.

Working

Sodium-ion batteries work in a similar manner to Lithium-ion batteries. A sodium-ion battery basically contains an anode, cathode, separator, electrolyte and two current collectors. The electrolyte forms charged ions by dissolving salts in the solvent. The movement of sodium ions creates free electrons in the anode which in turn creates a charge at the positive current collector, this current flows through the battery connected in the device. While a sodium-ion battery discharges the anode releases sodium ions to the cathode, generating a flow of electrons from one side to the other. While the sodium-ion battery can use aqueous electrolyte the energy output is much lesser than that of lithium-ion battery. To get around this the same non aqueous electrolyte used in Li-ion batteries can be used or the most commonly used non-aqueous electro sodium hexafluorophosphate can be used.

Differences between Na-ion and Li-ion

The key difference between sodium-ion and lithium-ion is the large abundance of sodium and its lower costs of extraction and purification compared to lithium. The anode and cathode can also be made with Iron and Titanium which makes sodium-ion batteries more sustainable.

	Sodium-ion	Lithium-ion
Cost/kWh	40-70$	137$ avg
Volumetric energy density	250-375 W h/L	200-683 W h/L
Safety	Low risk for aqueous	High risk
Materials	Abundant and cheap	Scarce
Cycling stability	High	High
Temperature range	-20 to 60*C	-20 to 60*C (15-35*C opt)

In conclusion we can say that Sodium-ion batteries have more potential to replace

Lithium-ion batteries in the future and also being a much greener energy without harming the environment as much as Lithium-ion

M.Abhinav Subrahmanyam

1st year

The Power of Digital Marketing: Leveraging the Online Landscape for Success

INTRODUCTION:

In today's rapidly evolving world, digital marketing has emerged as a game-changer for businesses and brands. It has revolutionized the way companies connect with their target audience, enabling them to reach a wider market with unprecedented precision and efficiency. In this article, we will explore the key components of digital marketing, its significance, and how businesses can harness its potential to thrive in the digitalage.

1. Understanding Digital Marketing:

Digital marketing refers to the use of digital channels and technologies to promote products, services, or brands. These channels include websites, search engines, social media platforms, email, mobile apps, and various other online avenues. By leveraging these digital tools, businesses can engage with potential customers, drive brand awareness, generate leads, and ultimately boost sales.

2. The Importance of Digital Marketing:

In a world where people spend an increasing amount of time online, having a robust digital marketing strategy is crucial. Traditional marketing methods alone are no longer enough to stay competitive. Digital marketing offers unparalleled advantages, such as:

a. Broader Reach: With the internet's global reach, businesses can transcend geographical barriers and connect with customers worldwide.

b. Targeted Advertising: Digital marketing allows for precise audience targeting based on demographics, interests, behavior, and other factors, ensuring that marketing efforts reach the right people at the right time.

c. Cost-Effectiveness: Compared to traditional advertising, digital marketing often offers more cost-effective solutions, especially for smaller businesses and startups.

d. Real-Time Analytics: Digital marketing campaigns can be tracked and analyzed in real-time, providing valuable insights into their effectiveness. This data-driven approach allows for continuous improvement and optimization.

3. Key Components of Digital Marketing:

a. Search Engine Optimization (SEO): SEO aims to improve a website's visibility in search engine results, thereby driving organic traffic and enhancing online presence.

b. Content Marketing: High-quality and relevant content creation helps attract and engage audiences, establish authority, and nurture customer relationships.

c. Social Media Marketing: Utilizing social media platforms enables businesses to interact with their target audience directly, build brand loyalty, and increase brand awareness.

d. Email Marketing: An effective email marketing strategy can drive lead generation, customer retention, and promote brand updates and offers.

e. Pay-Per-Click (PPC) Advertising: Paid advertising models allow businesses to display their ads on various platforms and pay only when users click on their ads.

f. Influencer Marketing: Collaborating with influencers and content creators can amplify brand visibility and credibility among their followers.

4. Crafting a Successful Digital Marketing Strategy:

To make the most of digital marketing, businesses need to develop a well-rounded strategy tailored to their specific goals and target audience. A successful digital marketing strategy should include:

a. Clear Objectives: Clearly define what you want to achieve with your digital marketing efforts, whether it's brand awareness, lead generation, or sales conversion.

b. Know Your Audience: Conduct thorough market research to understand your target audience's preferences, behaviors, and pain points, enabling you to tailor your messaging effectively.

c. Consistent Branding: Maintain a consistent brand voice and identity across all digital channels to reinforce brand recognition and trust.

d. Utilize Analytics: Continuously analyze and measure the performance of your digital marketing efforts, allowing you to adjust strategies and optimize campaigns based on data-driven insights.

Conclusion:

Digital marketing has emerged as an indispensable tool for businesses of all sizes, offering unprecedented opportunities to connect with audiences, build brand loyalty, and drive revenue. By harnessing the power of various digital channels, implementing a well-thought-out strategy, and staying adaptable to market trends, businesses can navigate the digital landscape successfully and position themselves for long-term growth and success in the ever-changing digital era.

Aravind U

1st year

The Psychology of Decision Making

Consider a situation when a person must decide between an excellent course and a good college. On the one hand, he or she receives the best college, but not the subject of their choice; on the other hand, they receive the course they want, but not the college of their choice. What will the person decide, and how will s/he base that decision? Will the person choose either at random or will they weigh the advantages and disadvantages of each option? Is this decision influenced by a variety of events, is it innate, or is the person more likely to make it? Are there necessary cognitive steps that go into forming decisions?

Decision making is a fundamental aspect of human behavior, and it can have significant real-life implications.Complex interactions between cognitive, emotional, and social elements are present during decision-making. The decision-maker selects the best course of action in relation to the issue to forward the objective. Decisions are made in a process that is goal-oriented in order to achieve the goal. It has a methodical process, is participatory, and is a continuous process. It has a context and is connected to the location, circumstance, and time.According to study, instead than using a more deliberate and systematic procedure, people frequently rely on mental shortcuts or heuristics. These heuristics can occasionally result in biases and mistakes of judgment, both of which can have detrimental effects.

The Decision-Making process

The process is broken down into several stages. First, analyze the problem thoroughly. Ask yourself the following questions like “What exactly the problem is?”, “Why the problem should be solved?”,

"What are the affected parties of the problem?', "Does the problem have a specific deadline?" etc. Aftermath comes the information gathering, where you have to gather as much as information related to the factors involved in the problem. Also don't forget to always keep an alternative way. Profits and margins play a vital role during decision making and that's why brainstorming to list down all the ideas is always a best option to opt. Evaluate on the alternatives, think about the outcome, possible cause and effect and execute your decision. It is always recommended to evaluate the outcome of your decision.

There are various techniques available like Marginal analysis, financial analysis, Break-Even analysis, Ratio analysis, Operations Research techniques, Simulations etc. which can used as a effective way in the process of decision making.

Factors influencing Decision Making

Our emotions, values, and beliefs are just a few of the many things that have an impact on our decisions. For instance, if a specific option is consistent with our personal values or beliefs, we may be more likely to select it. External variables like peer pressure or social standards can also have an impact on our decisions.

Decisions can be influenced by the nature of the organization, the type of environment present, the work culture they subscribe to, and the methods they might modify to attain a goal. Personality qualities and individual variables, such as gender, age, experience, cognitive biases, and the concept of personal relevance, may also influence decision-making. The interpersonal or personal aspect is regarded to be the most difficult to manage or anticipate in the decision-making process due to the potential participation of multiple variables. Individual elements such as personality or culture are generally concerned with psychological qualities of the individual, whereas organizational factors such as amount of education are concerned with organizational aspects. A

competent decision maker is always prepared to deal with new challenges.

Decision making Strategies

Making a list of benefits and drawbacks, finding out multiple viewpoints, and taking the long view are just a few techniques that can be utilized to make better decisions. Additionally, mindfulness exercises like meditation might lessen cognitive biases and enhance judgment.

People who have cognitive biases look for evidence that supports their preexisting beliefs while ignoring that which challenges them. This can result in a limited perspective on the world and keep people from considering other viewpoints. These are deliberate errors in thinking that happen when humans take in information from their environment and interpret it. Our perception, judgment, and decision-making can be impacted by these biases. They frequently come about as a result of our brain's efforts to simplify complex information and make snap judgments based on scant data.

By becoming more conscious of these biases and aggressively challenging our presumptions and ideas, we may overcome this. To make wiser decisions, we can also look for various viewpoints and data. In addition, stepping back and giving ourselves space to think about our options might prevent us from forming snap judgments based on prejudices.

Here are some of my tips and tricks to improve the skill of decision making in various aspects of life:

Personal life

1.Make a list of your values and priorities. Knowing what is important to you will make it simpler to make decisions that will help you achieve your goals.

2.Consider how your decisions will impact the long term. Even though it could be easy to merely think about the here and now, it's

important to evaluate how your choices will impact you in the long run.

3.Allow yourself time to mull over the situation and gather information before making a decision. has negative outcomes when judgments are made in a rush.

Professional life

1.Decide on your goals and priorities. Knowing what you want to achieve can help you make decisions and make sure that they are in accordance with your professional objectives.

2.Consider the benefits and potential hazards of your decisions. Even while taking risks can lead to growth and success, it's essential to weigh all of the outcomes before making a choice.

3.Enlist the assistance and suggestions of others. A different point of view can help you make better decisions and prevent blind spots.

Interpersonal Relationships

1.Think about how your choices will affect others. It is crucial to be aware of how our decisions may impact others because they can have an impact on those close to us.

2.Be open and honest in your communication with people who are making the decisions. Making ensuring that everyone is on the same page through effective communication will help produce greater results.

3.Take into account many viewpoints and try to comprehend opposing viewpoints. Conflicts can be avoided and more original ideas may result from this.

JOW RAYMOND

1ST year

SIMULATION OF AIR POLLUTANT DISPERSION USING GAUSSIAN PLUME MODEL

INTRODUCTION:

Air Pollution is one of the major problems of today's world. In order to devise new methods for controlling air pollution, one has to understand its sources and the ways in which the pollutants disperse into the atmosphere. Air pollutant dispersion models are used by a variety of organizations, including government agencies, environmental consulting firms, and industrial companies. These models are used to assess the impact of air pollution on human health and the environment. They are also used to help design air pollution control strategies. For this purpose there are several dispersion models available namely ADMS, CALPUFF, CMAQ, FLACS etc. Air pollutant dispersion models are mathematical tools that are used to predict the concentration of air pollutants in the atmosphere. These models are based on the principles of atmospheric dispersion, which is the process by which air pollutants are transported and dispersed by the wind.

There are two main types of air pollutant dispersion models: Gaussian models and Lagrangian models. Gaussian models assume that the pollutant concentration has a Gaussian (normal) distribution, while Lagrangian models track the individual particles of pollutants as they move through the atmosphere. Gaussian models are the most common type of air pollutant dispersion model. They are relatively easy to use and can be used to predict the concentration of pollutants over a wide range of distances. However, Gaussian models are not always accurate, especially in complex terrain or in the presence of strong winds. Lagrangian models are more complex than Gaussian models, but they are more accurate in certain situations. Lagrangian models are especially useful for predicting the concentration of pollutants in complex terrain or in the presence of strong winds.

Infact, the dispersion models can be classified into four classes based on the used methodology as Box models, Gaussian models, Eulerian/Lagrangian models and Computational fluid dynamic models. Of

these, one interesting model explaining the plume concentrations at various points in the atmosphere after the pollutants have been released from a point source is the Gaussian Plume Model which has been simulated using MATLAB Version 7.10.0.499 (R2010a). The basic Advection - Diffusion Equation has been used for the derivation of this Gaussian Plume Model. The data collected from the National Thermal Power Corporation Limited (NTPC Plant), Ramagundam,Telengana has been used for the simulation of the pollutant dispersions by the Gaussian Plume Model using MATLAB

The basic assumptions made in the Gaussian Plume Air Pollutant Dispersion Model are that the pollutants are being emitted from a point source (in this case, stack(s)) at a constant rate Q (kg/s) into the atmosphere and the wind is blowing continuously in a direction 'x' and the dispersions have shapes that are "Gaussian" or "normal" in planes normal to the 'x' direction. Based on these assumptions, Gaussian plume model was devised and a function of the shape of the distribution in three dimensions is given by,

$$\frac{1}{2\pi\sigma_y\sigma_z} e^{\left(\frac{-y^2}{2\sigma_y^2}\right)} \left(e^{\left(\frac{-(z-H)^2}{2\sigma_z^2}\right)} + e^{\left(\frac{-(z+H)^2}{2\sigma_z^2}\right)}\right)$$

where, σ_y and σ_z denote the standard deviations of the gaussian distributions in the 'y' and 'z' directions.

and thus the concentration,C at any point is given by,

$$C(x,y,z) = \frac{Q}{2\pi U\sigma_y\sigma_z} e^{\left(\frac{-y^2}{2\sigma_y^2}\right)} \left(e^{\left(\frac{-(z-H)^2}{2\sigma_z^2}\right)} + e^{\left(\frac{-(z+H)^2}{2\sigma_z^2}\right)}\right)$$

CRITERIA IN CONSIDERATION:

Various parameters were defined in the code initially and conditions for the particular criterion followed it to help demonstrate the effect each criterion would have have on the pollutant dispersion from the point source i.e. the stacks. The various parameters include wind field (constant / prevailing / Fluctuating wind),the number of stacks (upto five), the stability of the atmosphere (constant stability or annual cycle), The type of aerosol in the pollutant (sodium chloride / sulphuric acid / organic acid / ammonium chloride) , the aerosol properties (dry or humidified), the mass flow rate of the pollutants (kg / s), the relative humidity,

height of the stacks and the number of days for which the model is run (maximum 365 days). The simulation can be done by adjusting the different parameters with regards to the plant under consideration and four different outputs such as Plan View, Height Slice, Surface Time and Overlay on map can be obtained for each set of values.

CHARACTERISTICS OF PLUME AND WIND NEAR NTPC:

The wind field in the area where the NTPC Plant, Telengana is located was found to be Fluctuating Wind conditions with the wind condition being moderately stable and the number of stacks under consideration was five. The stability of the atmosphere was constant near the NTPC area and the type of dry aerosol was found out to be Sodium Chloride.

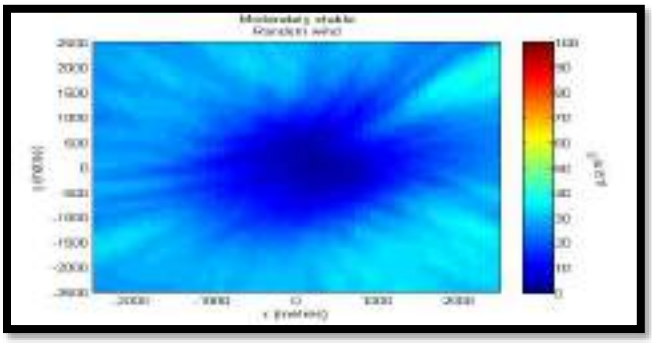
The mass flow rate from all stacks was assumed to be uniform and to be at 80 kg/sec and the height of the stacks was assumed to be 60 m. The model was assumed to run for 365 days. Based on these criteria as the varying parameters, a simulation was done and the pollution dispersion plots were obtained.

RESULTS AND DISCUSSION:

The model was simulated for the aforementioned conditions and assumptions and the results obtained are as follows:

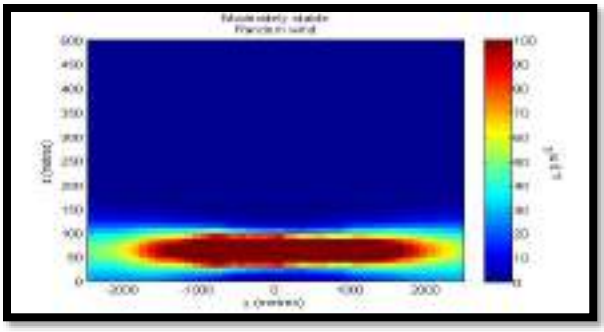
1. PLAN VIEW :

The plan view of a 3D object denotes the view as projected on a horizontal plane. In other words, it is an orthographic projection or the top view of an object. The plan view of the pollutant dispersion from the stacks was obtaind as a contour plot as follows:



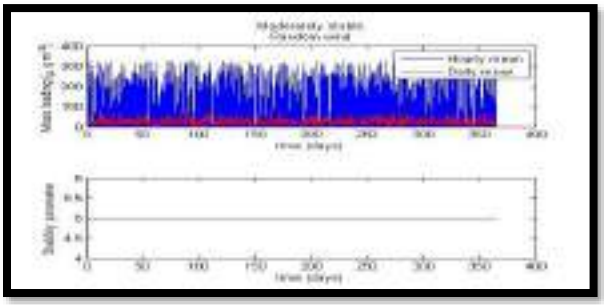
2. HEIGHT SLICE

Height Slice indicates a y-z slice which is similar to a sectional view in engineering drawing. Height slices can be taken for different values of y as ‘z’ is assumed to be at ground level. The y slice value assumed for this simulation is 10 m and the contour plot simulated is as follows:



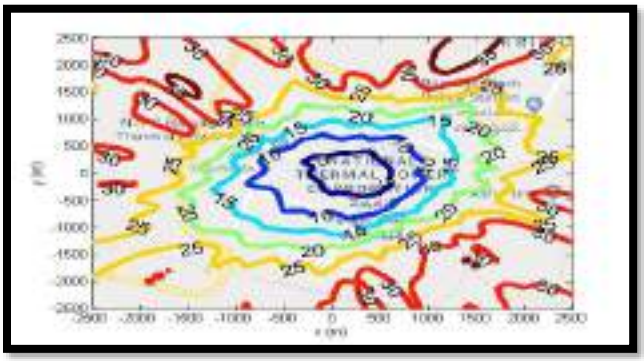
3. SURFACE TIME:

The surface time plot indicates the stability of the wind and its effect on the pollutant dispersion. The top plot indicates the rate of pollutant dispersion under various wind stability conditions and the bottom plot indicates the variations of the stability parameter over the course of time considered for the model. Here, the top plot is for moderately stable conditions and the bottom plot is a flat straight line since the stability parameter assumed was constant stability for the NTPC and not annual cycle.



4. OVERLAY ON MAP

Overlay on Map is a useful feature of MATLAB which can be used for overlaying one picture over the other and understand the pollution dispersion characteristics with respect to the geographic area under consideration so that a better contemplation of the plume concentrations at different points in the atmosphere can be accomplished. The data obtained was overlayed with an image obtained from the Google Maps and the following image was obtained as the result:



CONCLUSION:

The simulation of the plume concentration and pollutant dispersion using Gaussian Plume Model was obtained for the data from NTPC Plant, Telengana, India. The contour plota and graphs for the dispersion

of pollutants was obtained using MATLAB Version 7.10.0.499 (R2010a). The plots obtained using the simulation can be used for the better understanding of the dispersion characteristics and how it varies by altering the different parameters and this understanding can be further employed in developing better methods of pollution control caused due to emissions from the stacks of industries.

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