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THE CHEMIE NEWSLETTER

ChéA NITT

CHEMICAL ENGINEERING ASSOCIATION

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Editor's Note

Leave alone becoming an expert or the aspiration of many an engineering student-getting a core job, it is difficult to even maintain a proper conversation based on Chemical engineering with just the knowledge of 1970s edition of books that all of us look upon to help us through the grind of the examinations.

For those too lazy to learn about the principles and applications of the Chemical engineering and allied concepts, I hope our newsletter goes someway in serving them all on a platter, with plenty of salt and pepper to spice it up. I hope the newsletter serves as an appetizer for the readers to research and learn more about the interesting facets connected with our subjects.

We are currently experimenting with the idea of having an e-newsletter instead of the usual paper format, based on our personal experience that students would show more interest in anything offered on a technologically advanced platform. The time is not far off before we come up with an Android app as well. Maybe this is the way students will read their notes some 20 years from now. We can but only guess.

For now, I just hope that this newsletter will sustain your attention longer than our prescribed texts. I know that's not asking for much, but it will be a start, nevertheless.

Cheerio!

Editor

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The Physics of Snowflakes

Recently, during my Google-ing-spree that has recently taken form due to the boredom brought about by the holidays; I bumped into my childhood fascination – snowflakes! Different forms and patterns but always geometrically perfect! As common knowledge goes, it is attributed to the crystallization of water molecules. But, how exactly?

We've learnt that during nucleation, a solid surface or a group of molecules acts as a seed for the crystal. As more and more molecules bond to this nucleation site, the crystal grows. Snowflakes begin to form when water vapor condenses onto dust particles in the atmosphere and if the temperature is cold enough, the water droplets freeze and act as nucleation sites. As more and more water vapor condenses onto the ice crystal, the snowflake grows.

So that much we knew. Now what about the pattern and symmetry?

Most naturally occurring ice has a hexagonal structure. The covalent bonding in water molecules along with the molecular attraction makes water most stable in a solid when arranged in hexagonal layers. This hexagonal lattice determines the six-sided symmetry of snowflakes.

Hence, the most basic snowflake shape is a hexagonal prism. The intricate designs of more complex snowflakes form as a result of "branching." In this process, water molecules bond to the growing crystal as soon as they reach an appropriate surface, so if there is a protruding bump on the crystal—such as the corner of a basic hexagonal prism—the molecules attach to this bump rather than to other parts of the crystal. As a result, bumps can grow quickly and develop into branches, which, in turn, can develop side-branches, and so on.

Much of the shape and design of the crystal depends on the temperature and humidity at which it is formed. However, the reason why snowflakes experience such extreme variations in shape is not well understood. Scientists believe that, since ice is very sensitive to growing conditions, slight variations in atmospheric conditions change the way the crystal grows at any given moment. However, a snowflake still ends up being nearly symmetrical because each part of the snowflake experiences the same changes in conditions at the same time.

Amazingly, because every snowflake travels a different path through the atmosphere, and thus experiences unique conditions during its growth, the old saying is most likely true: no two snowflakes are exactly alike.

Anjali Menon

B.Tech., 3rd Year

In so many words

Women of today are found in all possible vocations, including the realms of engineering which was until recently a patriarchal domain. Racking into our past an amazing fact came to light.

Most Chemical engineers are made to look down upon themselves amidst their peers from the so called hot and happening circuit branches as not having high pays and other glamours of the stream. But we as chemical engineers have a reason to totally feel proud, given the piece of information a random Google search unearthed.

'The first woman engineer in history was a Jewish chemical engineer named Maria, who lived two thousand years ago during one of the most intellectually creative periods of ancient times.'

Or so quotes the website.

When the charismatic general and king named Alexander the Great (356-323 B.C.E.), after the Golden Century of Greece ended, went on to conquer the Near East and found colonies throughout his vast empire to spread the wisdom of Greek civilization and built the glorious city of Alexandria, the ancient think-tank called the Museum, where the greatest scholars and scientists of the day gathered and conducted their research, grew to pre-eminence. Many diverse groups settled in Alexandria - native Egyptians, Greeks, Romans, early Christians, and Jews - and many streams of philosophy, sciences and religion blended together in a multicultural milieu called Hellenistic civilization. With such conditions of the state 'alchemy' was born. This notion of a secret, transformative knowledge known only to the initiated, a knowledge that could change what was base into what was pure, would radically alter the direction of ancient chemistry, changing it from what it had been, a purely practical pursuit, to a mystical mission in which practitioners, following arcane formulas, attempted to transform base metals into precious ones. Indeed, some of these chemical "recipes" still survive, preserved in ancient Egyptian papyri dating to the early Roman Empire as well as in the fragmentary "lab notes" of once-famous Greco-Roman alchemists.

The chief goal of ancient alchemists was to create gold. To the ancient Egyptians, gold was the warming colour of the sun, the radiant source of all life. The flesh of the immortal gods, moreover, was believed to be of gold, the one substance the Egyptians knew does not decay. The masks and coffins of their mummies were therefore gilded or crafted of solid gold in order to signify that the souls of the departed had become immortal like the gods. By a process of cultural assimilation, even the Greco-Roman residents of Alexandrian Egypt had begun to adopt the practice of using gilded mummy cases and masks for their own funerals.

Many alchemists were not nefarious forgers, but sincerely believed in the mystical potentialities of their art. One of the most renowned was called Maria the Jewess, "the founding mother of western alchemy." Maria is one of four female chemical engineers from the Hellenistic Age whose names survive, living in Hellenistic Egypt had learned the technology of chemistry from the Egyptians. Maria's own mysticism is revealed in a cryptic utterance attributed to her in which she described the principle underlying the transmutation of matter: "One becomes two, two becomes three, and by means of the third the fourth achieves unity; thus two are but one." Known as the "Axiom of Maria,". Maria's ingenuity is demonstrated by her invention of three remarkable pieces of laboratory equipment: the *balneum Mariae* (today's double-boiler), the *kerotakis(*reflux condenser of current times), and the *tribikos(*It consisted of three parts: a vessel in which a chemical mixture was heated, a closed cooling chamber in which the vapor condensed, and three tubes through which the distilled liquid poured out into a catch-basin , **still yet to be replicated by modern science**).

Though the chemical engineers of today no longer strive to turn base metals into gold as did Maria some two thousand years ago, the quest to transmute matter has in fact been fulfilled by physicists using cyclotrons, nuclear reactors, and particle accelerators, who so far have created at least 29 synthetic elements. Significantly, it is from just such a synthetic element, plutonium 239, that the fate of today's civilized world now hangs.

This article is based on contents from the book THE GENESIS OF SCIENCE: THE STORY OF GREEK IMAGINATION by By Stephen Bertman, Ph.D

Sreeja Narayanan and Vandana Swaminathan.

B.Tech., 3rd Years

Getting candid with Dr. H.J. Prabhu

About Dr. H.J. Prabhu:
Dr.Prabhu has been a part of the Department of Chemical Engineering here at NITT for more than 29 years and has served as a professor for almost two decades. He has seen the college undergo some radical changes through the decades. Dr.Prabhu retired on the 30th of November 2011. Here is the excerpt from the candid talk that Mahesh had with Dr.Prabhu as he takes us through his journey over the years at the NITT. The ChEA team wishes Dr.Prabhu a happy retired life ahead!!

1. Please tell us something about your college life.

I am an REC - K alumni. In those days chemical engg. was a five year course. I took up petrochemical specialisation during my Btech. Then I pursued my M.Tech in AC Tech in the CRE route. Then I pursued PhD at IITM in the Biomedical engineering field in the department of Applied Mechanics with the condition that my guide should be a chemical engineer (laughs). You may hear in NIT that I am a biochemical engineer, which is not true (chuckles).

2. Can you elaborate on your field of research?

See, Biomedical engineering mainly consists of Instrumentation and Electronics engineering playing a major role. Chemical engineering comes into play only when it comes to bodily mechanisms. The CAT and MRI scans are applications of Biomedical engineering. Open heart surgery and Kidney surgery are examples of cutting edge applications. My research was more into the physiology outside the body. It was more into Biophysics and practices. In fact, I diverted completely from chemical engineering.

3. Then how did you end up here?

I was never a rich person. My father passed away when I was six months old. I had to leave my family at my uncles home in order to do a PhD with the hopes that with the job, i may get, I could take care of my mother. But, you see, getting a job for a PhD was tough in those days. Moreover, I wanted an accommodation of my own, where I could settle down for a long time to come. This was not possible in Manipal or IIT. NIT, which was under Prof. Manisundaram then, attracted me, for there were lecturer posts vacant, and it was not difficult to get a home here. So, I joined here in the chemical dept. as a lecturer. Prof. Manisundaram gave me a warm welcome and made me feel at home here.

4. Can you tell us something about the REC?

Oh. The college then was a little more political than it is now. As it was owned by the state govt., periodic changes in the govt would affect the rules in the college. However, Prof. Manisundaram was a great administrator. You might have heard of Prof. S.H Ibrahim. He was the HOD when i joined here. I agree that he was very strict and a little sensitive too. But on the overall, he was a good man. He had contacts with the faculty in the Universities in Canada and USA. But I stayed out of the mainstream politics here and concentrated on my work. Throughout my career, I have taught many courses like fertilizer technology, Unit operations in organic synthesis, CRE, MT operations for the graduate students. I became an assistant professor after 10 years of working here and a full time professor after another 19 years. Since they gave me an extension, I am still here. Since Prof. Ibrahim's time, I have been under many HODs. I have remained neutral to all and respected their decisions. To me, my work and my students are most important.

5. Can you tell us something about the research you have done while at NIT?

Haha! Here I have not done much research. It is difficult to do research here considering the teaching work, correcting answer papers, administrative responsibilities and so on. In fact, I have not contributed much to biomedical field after coming to nit.

6. Oh. Sir, Can you then suggest some ways to improve the quality of research here?

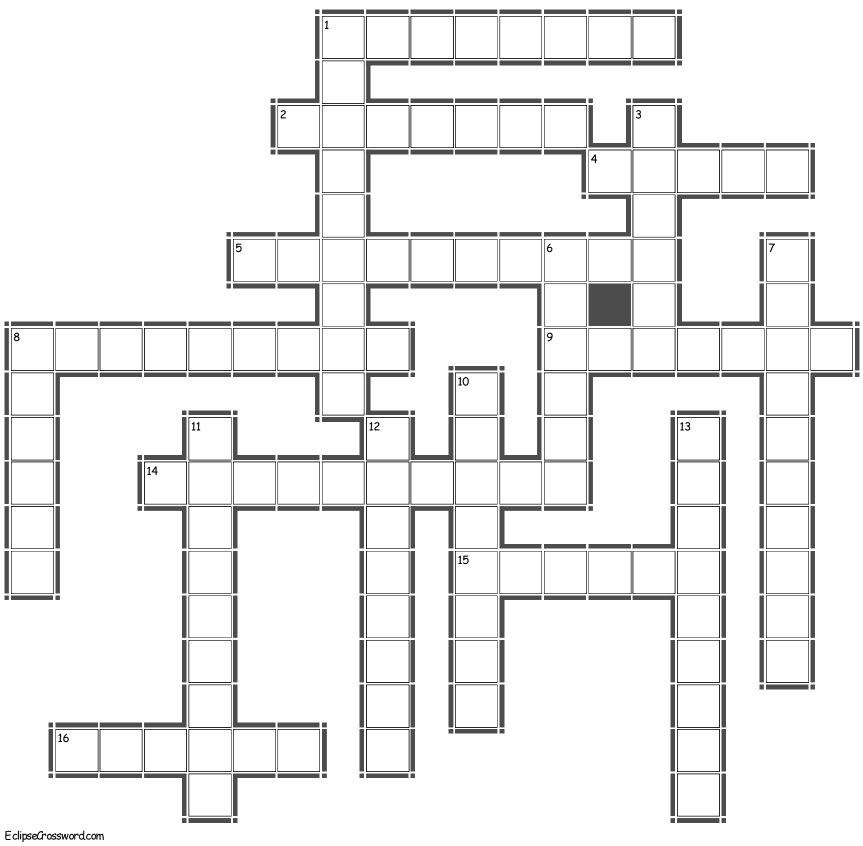
Well. Firstly, the course work on professors should be reduced and given to the instructors or lecturers. Secondly, the professors must be given projects in specific areas where they can do research and specialise in. This can be done with Tie ups with the industries or some Labs like CSIR. Thirdly, the labs here need to be expanded. The growing student population has added a lot of strain on the laboratory work. I feel that some students have been looking at labs as a mere ritual rather than grasping the maximum practical knowledge out of it. Many equipments have become old or outdated. But I am sure that in the years to come, the quality of publications from chemical dept will improve, provided we make steady progress. We should remain committed to our work.

7.What do you plan to do now, after retirement?

<chuckles> NO long term plans for now. Your director wants me to stay here for one more year, guide some students and train some new faculty to take over my position. I might as well be able to help with the research here. I have also been asked to help in making some radical changes in the undergraduate syllabus during my stay here.

Interviewed By:
Mahesh Krishna Prabhu
B.Tech Chemical Engineering
Final Year.

Crossword 1



Across

1. Dissolving salt in water is an example of which type of change ? (8)
2. This number indicates natural convection (7)
4. Which type of radiation is unaffected by magnetism ? (5)
5. ....distillation usually refers to the specific technique of adding another component to generate a new, lower-boiling substance that is heterogeneous, such as the example with the addition of benzene to water and ethanol. (10)
8. Variable area meter (9)
9. .... Rings are pieces of tube used in large numbers as a packing within columns and provide a large surface area within the volume of the column for interaction between liquid and gas or vapour. (7)
14. Fourier’s Law describes heat transfer by (10)
15. Which temperature scale is an absolute scale, where the zero point is the lowest possible temperature? (6)
16. This number is important in heat transfer in laminar tube flow (6)

Down

1. The temperature of furnace is measured by........... (9)
3. ....law is a derived equation that describes the flow of a fluid through a porous medium and is analogous to Fourier's law in the field of heat conduction, Ohm's law in the field of electrical networks, or Fick's law in diffusion theory. (6)
6. A.........triangle is versatile piece of apparatus that can be used to collect distillation fractions (6)
7. In fluid dynamics, the........... Equation is a physical law that gives the pressure drop in a fluid

flowing through a long cylindrical pipe. (10)

8. The........ Ratio is the ratio of the amount of moles returned to the column and the amount of moles of final product (6)

10. This number is important in heat conduction with a viscous heat source (8)

11. Dacron is a ……….. (9)

12. The thickness of pipe wall is indicated by…..number (8)

13. In convective heat transfer, the Churchill………….equation is used to estimate the surface averaged Nusselt number for a cylinder in cross flow at various velocities. (9)

Sreeja Narayanan and Vandana Swaminathan.

B.Tech., 3rd Years

One Litre Light

You may have noticed, thrown away plastic water bottles when you pass through roads, rails and public hubs etc. Have you ever thought of finding a solution for this menace?

How do slum dwellers, who are eking out in windowless tin shacks thrive when they can't afford electricity, candles and paraffins?

It seems that the above two facts are impertinent to each other, right! But Alfredo Moser's perception was different. He strongly believed there was more than something between the above mentioned facts. He also proved to the world that his belief is right.

Sao Paulo, Brazil 2002: Alfredo Moser was a normal mechanic in Sao Paulo, until a unique idea struck his mind. Brought up in slum environment, he longed to do something for the slum dwellers, who could not pursue the household work during daytime where daylight is not suffice even during day time. For them, getting legal electricity was a mirage.

First he tried with a soda bottle by inserting it in a roof of a house. He observed that by mere placing the bottle on the roof provided better day lighting inside the house. Then, he tried with a plastic bottle full of water by hanging it in roof and was pleased with the extra light he harnessed.

Fig: Plastic water bottles protrude through the roof of a house in the Korogocho slum of Nairobi, Kenya.
Source: http://www.thehindu.com/sci-tech/technology/article2657221.ece

Later, he disseminated his idea through internet. Moser's idea was happened to see by a Kenyan youth of Nairobi who lived in a similar ambience as that of Moser's. He dwelled in an area, where schools are windowless tin shacks and classes are often held outside because even in daytime it is too dark to see the blackboard.
Carrying this idea, the youth approached a group called Koch group. Felt amused by the idea, Koch group first tried out their hand in a primary school in that slum. Initially the idea was not appreciated by the school owner who thought the hole on the roof would let the rain water in. The group convinced the owner and implemented the idea successfully. The Successful installation of the bottle lit the minds of many and many residents started to borrow the idea. Now this idea has travelled as many as three continents South America, Africa, Asia. It is reported that this water bulb produces illumination par to a 50 or 60 Watt bulb. Since 2002, tens of thousands of people who can't afford electricity, candles, paraffins have switched on to 'Solar water bulb' or 'Water bulb' which they fondly refer.

HOW THE STUFF WORKS
Preferably, a transparent plastic water bottle is placed on the roof in such a way that the top half protrudes the roof and lower half extends into the ceiling. The bottle is filled with clear water along with a small quantity of bleach and is completely sealed. The sun rays falling on the roof passes through the water and gets refracted in all directions, thus illuminating the house. The added bleach inhibits the growth of molds inside the bottle and helps bulb to sustain up to 5 years.

CARRYING THE TORCH
Now a non-governmental organization in Philippines is attempting to use Moser's idea to lit 1

million homes by next year. They have aptly given the name of this project as ‘A litre of light’ ‘Time and again inventions have proved that they are useless unless they are affordable by a common man’.

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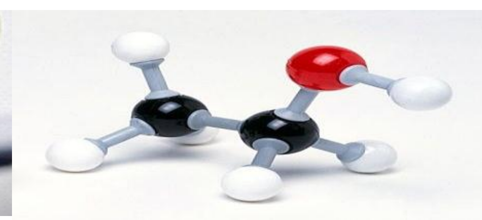
P.Prakash,
Research Scholar.

Running high on alcohol: ethanol as a fuel

‘Transport attributes to more than 25% of the global CO_2 emissions and two thirds of the global greenhouse gases. For a safe climate and sustainable mobility, conventional fuels must be replaced. What do we do???’

Long ago when a drunken scientist was considering this fact…BOOM!! He came up with the solution! ALCOHOL!

Ever wondered that the alcohol that we put in our drinks can be used to power cars and motorcycles? Yes **ethyl alcohol** or **ethanol** is by far the leading biofuel today!

Making ethanol fuel is like making beer or spirits. The process involves fermenting sugar from either sugar rich crops(sugar cane, sugar beet) or starch based crops(corn, wheat) using yeast followed by distillation to remove water from the mixture so that it is more concentrated and powerful.

THE RISE OF ETHANOL BIOFUEL

Driven by factors such as rising oil prices, need for energy security, and concern over greenhouse gas emissions, ethanol fuel gained immense scientific and public attention.

Ethanol can be used in petrol engines as a replacement for gasoline; it can be mixed with gasoline to any percentage (used as an ethanol-gasoline 'blend' ranging from 10-40% ethanol). It has a smaller energy density than does gasoline; meaning it takes more fuel (volume and mass) to produce the same amount of work. An advantage of ethanol (CH3CH2OH) is that it has a higher octane rating than ethanol-free gasoline which allows an increase of an engine's compression ratio for increased thermal efficiency. Also ethanol fuel burns 'flueless' and is relatively clean.

FOOD VS FUEL: THE CONTROVERSY

Moving away from oil-dependent transport towards an ethanol economy is possible but, like an alcoholic drink, it also comes at a cost. Producing ethanol from biofuel food crops like corn and sugarcane is not that efficient. Corn ethanol generates only about 1.5 times the energy used in its production (considering all resources needed like water, land use etc.). Moreover conversion of crop fields from food production to fuel production increases food prices for the world's poor. With rising population and more mouths to feed, a food crisis is the last thing that we would want!

Hence the ethanol boom provoked considerable criticism. Is ethanol fuel sustainable? How can we make it one?

NXG:

Innovation always helps us to find solutions doesn't it? When posed with the question of sustainability, **lingo-cellulosic** ethanol showed itself up as an answer.

Rather than using the edible parts of crops, lingo-cellulosic ethanol is made by converting lignin and cellulose of crops to sugars using enzymes (cellulobiase) and fermenting them. Most of you might say that this is still making fuel from food crops! But the crux here is that cellulosic ethanol can be made from non-food feedstock like wood chips, straw, jatropha and switchgrass.

Lingo-cellulosic ethanol could perform better in terms of energy balance, emissions and land-use. But again one of the major challenges in its production is getting the chemical reactions to occur in an efficient manner. Developing the right kind of enzyme is a major area of research.

Packing an even heavier power punch are **algae**. Algae advocates claim that while an acre of corn can produce a few hundred gallons of ethanol a year, an acre of algae could produce many thousands of gallons. Now that's some serious competition we've got there :P!

It might look like an unsightly suffocating green sludge, but trust me it's a saviour of our planet. Algae need only sunlight, wastewater and carbon dioxide to flourish. Not only do algae produce bioenergy without adding CO_2 to the atmosphere but **it can also be used to recycle CO_2 emissions from power stations**. Hence it has the potential to become one of the few truly sustainable biofuel crops!

With the alternatives in hand, all that we have to do is a little bit of research and engineering! So what are you chemicalites out there waiting for? Put on your thinking caps and start working on bioethanol fuel production: an upcoming field which really tests your knowledge and skills!

Monica Roy,
B.Tech., 2nd Year

RANDOM MUSINGS

Chemical engineering doesn't mean only Petrol and Natural gas industry. I had thought only that when I entered the department. Then my Prof told us," From food to Clothing, Pencil to Nuclear warships, everything needs Chemical engineering and engineers."

What more arenas are there in this field? Biochemical, Food industry, Polymer and plastics and even Nano technology come under this very vast ocean called Chemical industry. Let us see about an interesting discovery which threw a light on these earlier unexplored arenas.This man did both his undergrad and postgrad in Physics but finally he won the Nobel Prize for Chemistry.Venkatraman"Venki" Ramakrishnan is an Indian-born American structural biologist, who shared the 2009 Nobel Prize in

Chemistry with Thomas A. Steitz and Ada E. Yonath, "for studies of the structure and function of the ribosome".He currently works at the MRC Laboratory of Molecular Biology in Cambridge, England.

One may ask, how is ribosome anyway related to chemical? Isn't it biology? The answer is a plain no. after different chemicals mix together in right compositions, a cell is formed. Only after it gets life, it's called biology. A ribosome is a component of cells that assembles the twenty specific amino acid molecules to form the particular protein molecule determined by the nucleotide sequence of an RNA molecule.Ribosomes from bacteria, archaea and eukaryotes (the three domains of life on Earth), have significantly different structures and RNA sequences. These differences in structure allow some antibiotics to kill bacteria by inhibiting their ribosomes, while leaving human ribosomes unaffected.
We would've heard these terms in the 11th and 12th standard under 'Chemistry in everyday life'. Indeed they have much scope for research and development. It's completely new and virgin and this face provides it with loads of scope.

There is another lager fields under our engineering, Nuclear Science and technology. Thanks to our former President Dr.A.P.J.Abdul Kalam, many students have started research in this area. An atom was thought to be the smallest particle in the universe and people who researched were mocked and ridiculed for working on something small and useless. Within a few decades, tremendous amount of energy has been derived from splitting that smallest particle. The world needs alternative sources of energy and after solar and wind; nuclear energy provides us that opportunity. Though it has safety issues, research has been carried out to minimise these effects and make it a clean and comfortable form of energy. The nuclear reaction completely depends on the core physics and chemistry like kinetics, thermodynamics and heat and mass transfer.

There are various fields in Chemical Engineering like Process development, thermodynamics, Mass and heat transfer in industries, polymers, plastics, food and clothing, molecular engineering and has its influence even in Computer Science and communication technology. This article was to erase the fact from people's mind that chemical industry deals only with chemicals and completely depends on chemistry which is considered to be dry by many. Chemical engineering doesn't necessarily mean skin allergies, rashes and baldness but it has various other opportunities both in terms of jobs and research.

T.Gowtham Kumar
B.Tech., 2nd Year