NEWSLETTER

2022 - 2023

COVER STORY

Recognizing Catastrophic Hazards in Process Industries

CHEMICAL ENGINEERING ASSOCIATION
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

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Chemical engineering is a branch of science that applies together with, physical (physics and chemistry) and life sciences (microbiology and biochemistry), alongwith the principles of mathematics and economics, for transforming raw materials into products. With the incorporation of Artificial Intelligence, and Machine Learning, wide opportunities are open for all young chemical engineering graduates to build their career on. I am sure Alchemy-2022, will bring all the Chemical Engineering students closer and it will be a huge platform for interaction for all of us. This will also introduce the students towards the identification of the currently existing problems, or challenges, in chemical industries. To which they can start to ponder over, which will hone their skills even further. My best wishes to all.

Dr.Kalaichelvi P
HOD,
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CHEMICAL PROCESS SAFETY

Industrialization never ceases to advance in terms of science and technology, resulting in chemical industries dealing with various new hazardous chemicals and processes. Industries have become more complex and experimentative, increasing the risk of accidents. These accidents release tons of toxic substances into the atmosphere that can cause damage to our environment, lives, and property. Since industries are aware of the complications and damages it may cause, it has forced them to pay more attention to their safety protocols. This brings us to the importance of our theme this Alchemy 2022, Chemical Process Safety.

Chemical Process Safety mainly focuses on preventing accidents or incidents caused during the production of chemicals or errors in chemical processes. It deals with identifying and comprehending all possible risks and hazards, assessing their consequences, generating solutions, and learning from incidents when they occur. Process Safety also helps boost overall productivity and improves production quality at a lower cost. It helps to manage the growing number of people in industries and environmental regulation while enhancing economic growth.

As we have started working with more complex processes in the chemical industry, we also need more complex safety technologies. We need engineers to have a more detailed understanding of it. Since 1950, significant technological progress has been made in process safety. These specialized tools provide the necessary information for decisions concerning the plant design and operation mechanisms. The inherent approach of making essential changes to the chemical processes by substituting less hazardous materials, using passive safety devices that reduce the occurrence of accidents using the process or instrument features without actively functioning the device, application of active safety systems that are designed to detect hazard signals and take the required action or adopting administrative controls like procedural safety systems that monitor the ongoing maintenance and managing the safety systems are few strategies used to tackle process safety.

In today’s era of industrialization, process safety has become equal in importance to production. It is a discipline all engineers should be taught and highly knowledgeable of. This edition of the newsletter will focus more on this central theme.

SHREYA
CHAIRPERSON

It is a great pleasure for me to be a part of Alchemy'23 as a chairperson. It gives me great happiness to be associated with an incredible team of talented individuals. We remember our fondness to all our predecessors who contributed to the growth of ChEA and Alchemy and we look forward to put in our best efforts in translating our visions into a successful reality.

ARVINDH
VICE CHAIRPERSON

ChEA and Alchemy have always strived to enhance the passion for chemical engineering among the students by providing them with the necessary platforms to grow and showcase their skills through year-long activities. For me, they have always been an integral part of my college life. Right from being a team member, to becoming the vice-chairperson, they have provided me with ample learning opportunities and have shaped me into a person who can overcome any challenge. I'm certain that every member of the association has had a similar experience. Together, I'm confident that we, as a team, can take ChEA and Alchemy to much greater heights, this year.

VAMSI
OVERALL COORDINATOR

It's an absolute honor to be the overall coordinator for Alchemy'23. I hope we as a team will take ChEA and Alchemy to greater heights and make memories which we'll cherish for lifetime. In this contemporary world it's necessary for everyone to keep upgrading their skills to survive and so is the case for chemical engineers. Alchemy provides a perfect platform for every chemical engineer to do so with a plethora of events, workshops and guest lectures. I wish Alchemy'23 to be a grand success and hope the next junior batches continue this legacy and keep moving forward and reach greater heights.

ANUPRIYA
TREASURER

As a Treasurer for ChEA 22-23, will be taking up the obligation of budget and fund management of the symposium for smooth administering of the fest. Capital management is very crucial for any fest and must be taken care of with extreme attention to detail and genuineness. Being a Treasurer it is vital to have a decent holding with each group and it likewise helps in grasping their particular work. I want to pass on that, being a part of ChEA gives an individual a hands on experience on dealing with various instances and how to function in a group. Everybody really should chip in for their department with the goal that it makes recognition and progress and subsequently I welcome every one to come up and take the honour to make the current year's ChEA a fabulous achievement.

EX-COM & CORE


Shreya, Chairperson


Arvindh, Vice Chairperson


Vamsi, Overall Coordinator


Anupriya, Treasurer


Harshidaa


Gautham K


Jaswanth

Guest Lectures


Nivetha


Aswin


Srividya

Organizing Committee


Abey Stephen


Rohith

Marketing


Durgadevi


Gayathree


Shyam

Content


Sabitha


Jaina


Vigneswar

Design


Harsha


Venkatesh

Workshops


Nitish


Shashwat


Dhanush

Webops


Usha

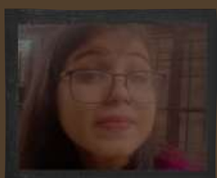

Kamal

Ambience


Manoj


Gaayathri


Karthik


Aditi Mehta

PR and Hospitality


Silambarasan


Aaisha


Sandeep

Events


Gautham


Akshay


Varshini

Publicity

Department's HISTORY

Department of Chemical Engineering at NIT Trichy is indistinguishably secure with the records of the field itself. Established in 1967, the Department of Chemical Engineering at NIT Tiruchirappalli is regarded by industries and academia as one of India's premier centers for Chemical Engineering. It also distinguishes being certainly considered one of India's seven chemical engineering divisions with a set of well-qualified faculty, staff, and motivated students. The vision of the department is to be a global centre of academic and research excellence to serve society with its first HOD Dr. Ibrahim.

The course was designed to meet the needs of students who studied in mechanical engineering and spend part of their time studying the applications of chemistry in the arts, especially the technical problems involved in the use and manufacture of chemical products.

In 1968, the Department of Chemistry granted Bachelor's degree for Chemical Engineering, the first of their kind to be bestowed anywhere. Following Dr. Ibrahim's death, the program was led by a group of eminent professors, who saw it continue to grow in popularity. The new era began in 1973, with the start of Ph.D. program in 1973 and the first MTech program in 1975. NIT Trichy was among the first institutes to grant Ph.D. degrees in Chemical Engineering in 1974. Since then, the Department of Chemical Engineering has been at the forefront in awarding graduate degrees. With over 6000 living alumni, the department's history is alive and continues to grow and well influencing research labs, corporate R&D facilities, and universities around the world.

Overview of
ALCHEMY

ALCHEMY

Overview Of ALCHEMY'22

The Chemical Engineering Association was established under the Department of Chemical Engineering at the National Institute of Technology, Tiruchirappalli, with the goal of enhancing and enriching knowledge in chemical engineering.In order to keep up with the most recent advancements, it offers a platform for individuals from other academic institutions to exchange ideas, knowledge, and technical expertise with chemical engineering students and graduates.

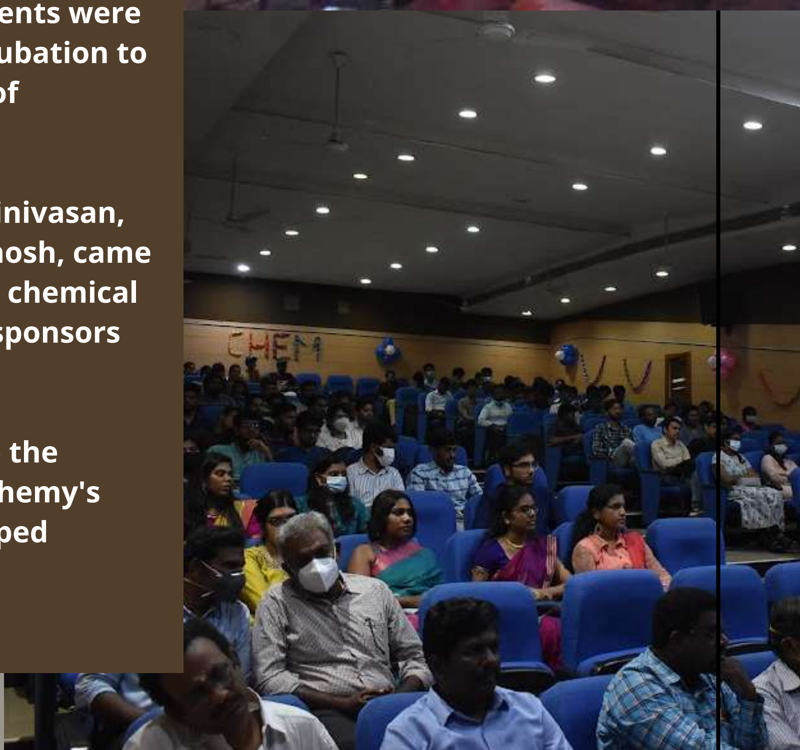
Alchemy – The technical Symposium organized by the institute is one of the best Chemical Engineering symposiums in India. This symposium includes various events, offers workshops on leading technologies and provides the platform for budding engineers to showcase their potential and talents.

Alchemy '22 was held from the 25th to the 28th of March,2022 at the National Institute of Technology, Tiruchirappalli, with the theme "Functional Materials." People from various colleges across the country attended.

Six events and two workshops were held over the course of four days. A paper presentation, poster presentation, quiz, and a few interesting events were among the events hosted. From Startup Incubation to HTRI, the workshops covered a wide range of software.

Notable guest lecturers, including Mr. V. Srinivasan, Dr. Bidhan Chendra Bag, and Dr. Anirban Ghosh, came to Alchemy '22 to motivate and educate the chemical engineering community. The Last edition’s sponsors were Conserve and AVI.

Cash prizes worth ₹35,000 were awarded to the winners in various events.In conclusion, alchemy's recent edition was a massive success. It helped students to know more about the industry.



Recognizing Catastrophic hazards in Process Industries

It goes without saying that working in an industry exposes you to a myriad of inevitable hazards. The risk factors in a process industry range from lacerations to exposure to radiation. Process materials that may be intrinsically harmful (for example, explosive or poisonous) and present under high pressure and high or low temperatures are the principal risks of the process industries. Large and unexpected escapes could result in explosions, toxic clouds, and pollution with far-reaching repercussions. Process safety events can happen for a variety of reasons in the chemical industry, including

- Incomplete operator training
- Inadequate information
- Technical issues,
- Human blunders.

The most common causes of accidents and mishaps are malfunctions, human error, and a lack of understanding of the chemistry of the process, including all its side reactions and parameters.

Applying efficient chemical process safety measures at the pilot or factory scale avoids problems and accidents. Products are typically developed under demanding timeframes, with limited resources, and in harsh environments. Chemical processes have multiplied over time, facilities have become more intricate, chemistry has become more ambitious and hazardous, and working conditions have become riskier. Because of these factors and the recurrence of catastrophic accidents, society at large and regulatory authorities have raised their awareness of safety.

A particular approach may only sometimes be necessary to reveal hazards when they are clear. This might occur, for instance, in a reactor where oxygen and hydrocarbons are combined just before the flammability interval. In some situations, risks are not immediately apparent, and uncovering the potential accidents from that place necessitates a more thorough study. It is insufficient to state that a specific facility is susceptible to an explosion or a poisonous leak. Instead, research that outlines the potential pathways or logical progression of events that could result in a specific accident is needed. This presents an opportunity to alter the course of events to lessen the likelihood of the accident or its effects.

The initiating event is the first one in the chain. Typically, a sequence of events is discovered between the beginning event and the accident that includes the responses of the system and the operators and other contemporary occurrences. The accident's effects change according to how the events, or the factors that led to it, specifically evolved. As a result, depending on how the intermediary events of propagation or mitigation are combined, the same originating event may have various negative repercussions (or none).

The process of identifying and characterizing hazards can and ought to be continued for the duration of the installation. However, the advantages anticipated for the effectiveness of risk reduction and the cost of the implemented safety measures are more significant the earlier you start. By choosing process pathways with higher inherent safety in the process itself, the materials and reagents utilized, the necessary inventory levels, etc., hazard identification during the process's defining phase could reduce these costs. Identifying hazards in a plant continues during all stages of its design and construction, as well as during startup, operation, changes, planned maintenance shutdowns, and disassembly at the end of its useful life. Each phase could call for varying levels of research, and in certain straightforward situations, formal analysis is not necessary; nonetheless, safety considerations from earlier studies should always be included.

The hazard identification methods can be divided into three categories, as shown in the table below. A record of prior accidents, design and operating codes, and safety checklists are a few examples of comparison approaches based on previously gathered experience in a given industry. Risk indices are helpful to highlight areas with a high concentration of risk, which necessitate a deeper examination or additional safety measures, even if they typically do not pinpoint specific risks. Finally, generalized procedures are flexible and extremely valuable analysis tools since they may be applied to any circumstance. The so-called expert systems, suggested as helpful instruments in the safety analysis, should also be mentioned.

Comparative Methods
Risk Indices
Generalized Methods

- Engineering codes and practices

Dow Index

- Hazard and OPerability analysis (HAZOP)

Safety checklists

Other indices: Dow-Mond, IFAL, etc.

- Failure Modes and Effects Analysis (FMEA)
- Historical Record Analysis
- Fault Tree Analysis (FTA)
- Event Tree Analysis (ETA)
- ''WHAT IF' analysis

Risk Assessment:

An organized framework for identifying and describing the sources and causes of risk is called a risk assessment.
A risk assessment's primary goal is to give decision-makers information in a way that makes it possible to compare different risk-reduction options.
Essential concerns a risk assessment helps address are:
What could go wrong and why?
How likely is it that specific situations will occur?
How severe are the impacts, and what are they?
What can we do to change it?

A risk assessment does not entirely remove risk.

Oil Spills and Risk Assessment:

Oil spills are one of the significant hazards associated with chemical process industries. A risk assessment and management is an ongoing process to decide to complement the formation of contingency plans, design of facilities, or reduction of incidents. Risk assessments can be completed before, during, or before other oil spill management programs. An improved understanding of the factors which increase the frequency of oil spills and the factors which increase the consequences of oil spills will lead to a more effective allocation of resources for improved oil spill preparedness.

The risk sources can be located using a variety of techniques. The objectives, scope, and resources at hand for the assessment will determine the method used. Event or Fault Trees, What-if Scenarios, and Hazard and Operability Analysis (HAZOP) are some analysis methods. A different strategy would be to examine the data that is already accessible and incident case histories to find trends in spill causes, sources, and sizes. It is frequently possible to collect incident records from corporate or regulatory data. Publicly accessible databases and oil industry periodicals are additional sources of information that can be used to locate potential sources.

Leakage of petroleum into water bodies became a major environmental issue with the advent of intensive petroleum exploration missions and large supertankers capable of carrying more than 500,000 metric tons of oil but, more concerningly, also capable of spilling the same amount of oil. Oil spills lead to massive irreparable economic and ecological damage.

Surface oil harms the ecosystem by affecting the amount of sunlight and dissolved oxygen available to the organisms. Some other pressing issues for animals include; oil-coated birds being affected by hypothermia as they affect the insulating properties of their fur and feathers. Moreover, ingesting this oil can be toxic to the animals, adversely affecting their life span and reproductive rate. The plant life in these ecosystems also takes a significant hit. Such oil spills also lead to a crash in the economy of the surroundings due to the adverse effects on various industries. The fishing industry in the area comes to a halt due to the risk of contamination, and tourism and power plants established due to the water in the area also suffer major setbacks. Understanding the harmful effects of such oil spills helps us better realize the need to improve the process safety standards in such industries, which can lead to major ecological damage.

Such was the case when a tragic accident in the Gulf of Mexico led to one of the world's largest oil spills.

Background Info:

The Deepwater Horizon rig was responsible for retrieving oil from The oil well located on the seabed 1,522 meters below the surface. It extended approximately 5,486 meters into the rock in the gulf of New Mexico. On the night of April 20, a surge of natural gas blasted through a concrete core recently installed to seal the well for later use. Once released by the fracture of the core, the natural gas traveled up the Deepwater rig's riser to the platform, where it ignited, killing 11 workers and injuring 17. The rig capsized and sank on the morning of April 22, rupturing the riser, through which drilling mud had been injected to counteract the upward pressure of oil and natural gas. Without any opposing force, the oil began to discharge into the gulf. Due to multiple failed attempts at containing the leak, it stretched on for about 87 days, finally containing the leak on July 15.

Analysis:

The primary cause of the disaster was the breakdown of the cement seal over the oil well. BP, the oil rig owner, blamed the contractor for subpar cement, which was prepared with some nitrogen accelerated curing that was meant to make the process more economical but compromised on the quality. On top of this, there was some human error involved when the test results of the pressure check were conducted to ensure the seal was misinterpreted as safe. The engineers on site weren't consulted, and baseless assumptions were made to conclude. This was followed by multiple failures in the safety mechanisms in place, which either didn't work or were overwhelmed by gas and mud leaks.

When BP tried to activate the rig's blowout preventer(BOP), the fail-safe mechanism designed to close the channel through which oil was drawn malfunctioned. Later, some immediate permanent methods of closing the leak failed, and a temporary lower Marine Riser Package (LMRP) cap was fixed. Though fitted loosely over the BOP and allowing some oil to escape, the cap enabled BP to siphon approximately 15,000 barrels of oil per day to a tanker. The addition of an ancillary collection system comprising several devices also tapped into the BOP, increasing the collection rate to approximately 25,000 barrels of oil a day.

Finally, the "bottom kill" method, considered to be the most likely means of permanently sealing the leak, was implemented. This entailed pumping cement through a channel—known as a relief well—that paralleled and eventually intersected the original well. Pressure tests were conducted two days after completing the bottom kill method, and the leak was declared officially sealed.

Solutions:

Although some human error was involved in the build-up to this tragedy, safety measures are primarily set to counteract these and prevent massive disasters. Improving the process safety measures could have gone a long way in preventing the disaster.

Better quality checks of the cement, proper checks on the emergency equipment, patient and thorough analysis of test reports, better backup mechanisms in case of failures, etc, could have resulted in better handling of the deep water horizon oil spill.

A very effective way to ensure that there are no human casualties in such accidents is to have Remote shutoff capability to make sure that the devices can be shut off and emergency procedures take over without any personnel ensuring the safe evacuation of the workers.

The ultimate solution employed was the use of a relief well. In countries like Canada, the petroleum company must demonstrate that it has a viable system that can be deployed to drill a relief well in the same season To receive a deepwater drilling permit in certain Canadian Arctic waters. Such laws must be made universal.

Scientifically there should be a better understanding of the oil wells and their chemical environment before any sort of work progresses. Making sure that all the materials are chemically inert to the gasses involved and also helping manufacture better and newer quality materials. The chemical engineering discipline can help improve process safety standards in many ways.

Cleanup:
After the oil spill, To clean oil from the open water, 1.8 million gallons of dispersants—substances that emulsified the oil, thus allowing for easier metabolism by bacteria—were pumped directly into the leak and applied aerially to the slick. The use of more advanced technologies could improve surface cleaning. Floating booms can be placed around the source of the spill or at entrances to channels and harbors to reduce the spreading of an oil slick over the sea surface. Skimming, a method most effective in calm waters, can physically separate the oil from water and store it in collection tanks. Another approach is to use various sorbents (e.g., straw, volcanic ash, and shavings of polyester-derived plastic) that absorb the oil from the water. Only after all these attempts should chemical surfactants and solvents be spread over a slick to avoid the concentration of the remaining oil and accelerate its natural dispersion into the sea. Chemical engineers can play a major role in developing effective and economical methods for proper cleaning of such oil spills in the worst-case scenario where such disasters occur.

Conclusion:
Such disasters cause large-scale damage to humans and the environment leaving lasting impacts on our ecosystems. Any disaster like the deep water horizon oil spill can be prevented by paying more attention to process safety measures and ensuring that active efforts are being put in to make tangible improvements.

Some recorded data of major spills are as follows:

There have been 267 oil spills in the Gulf of Mexico.
There have been 140 spills in the northeast U.S.
127 spills have occurred in the Mediterranean Sea.
Even though the Persian Gulf War caused the largest oil spill on record, there have only been 108 documented spills in the Persian Gulf.
75 oil spills have occurred in the North Sea.
In Japan, there have been 60 documented oil spills.
There have been 52 spills recorded in the Baltic Sea.
In the United Kingdom, 49 spills have occurred in the English Channel.
In Singapore and Malaysia, there have been 39 documented oil spills.
There have been 33 spills recorded that have occurred off the coastal regions of France and Spain.
Korea has the lowest number of documented oil spills, with 32.
From 1970 through 2009, around 1.7 billion gallons of oil were spilled due to tanker accidents, based on data from the International Tanker Owners Pollution Federation.
In the United States, from 1971 through 2000, the Coast Guard recorded over 250,000 oil spills in U.S. waters.
Tanker oil spills from 1971 to 2000 accounted for approximately 45 percent of all oil spilled in U.S. waters.
During the same period (1971 to 2000), 16 percent of oil spills came from pipelines.
Onshore pipeline oil spills contributed 92 percent of the oil spills into U.S. waters.
Offshore pipeline oil spills were only 2 percent of all oil spillages from 1971 to 2000.

Recent Awards & Research Achievements

Faculty: 20 including visiting faculty
Publications: 130+ Publications in last year
Current strength of research scholars:26
Project Students: 04
Project Collaborations: DRDR, ISRO, BHEL, BARC, CSIR, DST, Royal Academy of Engineering London, UK, The Royal Society UK and So on...
Part-time Scholars: around 10

Awards and Achievements:

The Chemical Engineering Association 2021-2022 of NIT Trichy was inaugurated honored to have Dr. Praveen Linga Dean's Chair Associate Professor, Department of Chemical and Biomolecular Engineering, National University of Singapore as our chief guest.

The Indian Institute of Chemical Engineers' (IIChE) student chapter at NIT, Trichy has organized guest lecture series to celebrate IIChE's Platinum Jubilee Year.

An International Conference on "Environmentally Benign Processes, Products and Materials for Sustainable Ecosystem (EBPPM-2021)" was organised during November 2021.

Workshops sponsored by AICTE MARGDARSHAN and SICI were successfully conducted. 3 day Students level symposium "Alchemy 2022" was a grand success which witnessed having Dr.A.B.Pandit, Vice Chancellor, ICT, Mumbai as the chief guest.

During Alchemy 2022, Dr. S.H. IBRAHIM ENDOWMENT LECTURE was delivered by Mr. V.SRINIVASAN (Retd. Deputy Director, VSSC, ISRO, Trivandrum).

Bank Of Baroda Achiever Award :

A Pessimist Says The Glass Is Half Empty , An Optimist Says Same Glass As Half Full & An Engineer Says It Is Twice As Large As It Needs To Be

ALCHEMY