NEWSLETTER

of

THE MUMBAI REGIONAL CENTRE

INDIAN INSTITUTE OF CHEMICAL ENGINEERS

(www.iichemrc.org)

Volume 5 Issue 3 Jul / Aug 06

Editorial

From England comes a piece of news that should warm the hearts of chemical engineers – the number of students enrolling into chemical engineering courses in UK have increased by 9 % this year. According to IChemE, chemical engineering is fast becoming a more popular choice for young adults entering higher education compared with other mainstream science and engineering disciplines. But here in India, the scenario continues to be gloomy, with chemical engineering languishing as the bottom of the barrel choice for engineering aspirants. If the promised investment blitz in petrochemical projects materialises in the next five years, we could be in for some serious shortage of skilled chemical engineers. It is time for all of us to take some pre-emptive initiatives.

With India already having cornered the lion's share of the world's Contract Research business, Process Development and Scale-up could be the next logical step to move up in the value chain. The one-day workshop on this subject should offer interesting food for thought and also whet the appetite of professionals seeking to refresh their basics in this promising area. This programme is an effort to cement the collaborative spirit between Mumbai and Lote Regional Centres and could be offered as an example for other regional centres of our Institute.

K.Sahasranaman

Chairman's Message

Dear Fellow Chemical Engineers,

Greetings to all of you !
The year ahead of us is full of events. We have been allotted a stall at the India Chem 2006 Exhibition, being held in Mumbai between 8th & 10th November, 2006. IIChE-MRC is grateful to the organizers of India Chem and FICCI for this gesture. At this Exhibition, we propose to focus on the prospects for Chemical Engineering students highlighting the upcoming projects in Oil & Gas, Refinery & Petrochemical sectors, with a view to retain their talent within the country.
We have planned a one day workshop on Process Development and Scale-up jointly with the Lote Chapter on 23rd September at Chiplun. Our student community is active too. Chemergence06 is a 2-day state level festival organised by the Student Chapter of Thadomal Shahani Engineering College and Rangotsav is being planned by the Surface Coating Technology students of UICT.
On the projects front, India is gearing up for investments in Refineries & Petrochemical Plants. The recent announcement by the Government for separate SEZ for Petrochemical Parks is very encouraging and will pave the way for large investments in this field, which will benefit our country in the long run.
I look forward to your kind support in all the endeavours of IIChE-MRC and wish you and your families a "Happy Festive Season".

With warm regards,
P. D. Samudra

Lecture Abstract

Lessons for Chemical Engineers from the Columbia Disaster

About the Speaker

Mr. Scott Berger is Director of Technology Alliances and International Programmes for the American Institute of Chemical Engineers (AIChE). In that role, he also serves as Director of the Centre for Chemical Process Safety (CCPS), a major organisation that works with international corporations to develop process safety tools and guidelines.

The Lecture

The speaker gave the case history of four major mishaps, two of which are related to space programme of NASA and rest two from the oil/chemical industry. He showed a striking similarity among these events in terms of the organisational factors that contributed to the accidents. The emphasis of the talk was that the high-risk activities such as space programmes or chemical manufacture need considerable focus on safety culture and implementation at a managerial level though the actual cause of the accident may be related to some technical failure or human error.

Columbia Crash: On Saturday Feb. 1, 2003 the shuttle disintegrated during re-entry into earth's atmosphere after a 17-day mission in space. All seven astronauts were killed. Debris from the shuttle were scattered over 2000 sq miles of east Texas.

It was realised that during the launch a large piece of insulating foam broke off from the external fuel tank and impacted the underside of Columbia's left wing. At the time of impact the foam was moving at a speed of about 500 mph relative to the shuttle. The damage due to the impact was discovered on the second day of the mission during the review of launch videos. Considerable discussion ensued during the balance of mission but NASA management ultimately discounted its significance and no contingency plans were formulated. In reality the impact had created a hole in the heat resistant panels and during re-entry, the superheated air entered into the cavity in the wing behind the panel. Insulation was destroyed leading to subsequent melting of aluminium spars and catastrophic failure.

It should be noted that shortly after the discovery of insulation damage, on day-2, the mission staff requested additional photographs for further investigation but the request was overruled by high level NASA management. NASA was aware of at least six prior missions where the insulation had come loose from the same location. Damage to the TPS tiles on the underside of the shuttle from foam strikes had become a routine aspect of shuttle missions that had been normalised even though it potentially jeopardised crew safety and mission integrity. It was revealed that the management's lack of interest in understanding the problem and its potential implications made it more difficult for the technical experts to communicate and advocate their concern.

Columbia Accident Investigation Board (CAIB) report identified number of disturbing similarities in NASA's performance and safety practices that contributed to both the Columbia disasters and the challenger crash that took place about twenty years before (See the box for details). These audits revealed that many of the challenger's lessons related to organisational and cultural issues had not been well absorbed by NASA.

Challenger crash

The space shuttle lifted off from launch pad on Jan 28, 1986. 73 sec. Later it was destroyed in a catastrophic explosion, killing all seven astronauts.

Subsequent investigations revealed that a leak developed due to erosion of an "O" ring in the booster rocket field joint which continued to grow impinging on the lower portion of the external fuel tank which contained liquid oxygen and hydrogen vessels. These vessels subsequently started leaking severely leading to explosive burning of hydrogen. It should be noted that the concerns were raised by the technical staff on the erosion of the "O" rings well in advance and unfortunately it was treated as "acceptable risk".

Learnings

Following are the six cultural learnings that came out of this report.

1. Maintain sense of vulnerability: NASA's "can do" attitude that was inspired by the past successes discouraged individuals from stepping forward and suggesting "can't do". NASA was viewing near misses as successes rather than near failures. Organisations that deal with high-risk operations must always have a healthy fear of failures.

2. Combat normalisation of deviance: In all official engineering analysis and launch recommendations prior to the accidents evidence that the design was not performing as expected was reinterpreted as acceptable and non-deviant which dismissed the perception of the risk throughout the agency.

3. Establish an imperative for safety: Budget reductions, schedule pressures and additional programmes had placed NASA in a paradoxical position. Despite periodic attempts to emphasise safety, NASA's frequent reorganisation in the drive to become more efficient reduced the budget for safety.

4. Perform valid and timely hazard/risk assessment: NASA project leaders decided the foam strike was merely a maintenance problem long before any analysis was done. Many conclusions were based on subjective and qualitative judgments rather than hard analysis.

5. Ensure open and frank communication: The record of the activities during the mission shows that considerable analysis was being conducted, and that technical staff was sharing concerns within their own groups, but that this information was not being effectively shared across organisational lines.

6. Learn from the past experience and advance the culture: It showed that NASA continued to make many of the same mistakes that have led to the challenger disaster. Some of them include ignoring the importance of safety oversight function, overambitious launch schedule, relying on past performance as a guarantee for future, adopting policies that prevented free and effective communication.

The speaker also related these accidents to the other two major disasters in oil/chemical industry and again highlighted some organisational failures apart from the technical faults.

Piper Alpha: On July 6, 1988 this oil platform on North Sea experienced a series of explosion and fires. 165 people died and the platform was totally destroyed.

Subsequent investigations revealed that most likely, a release of light hydrocarbon occurred when the pump was restarted after the maintenance. A relief valve was removed for service and a blank was loosely installed. Subsequently the vapours found an ignition source.

Among the many reasons, the investigation group pointed out that not maintaining proper log entries and not implementing the permit-to-work system could have been the major causes. Serious concerns were raised one year before but management did not independently review the operation and assumed “the things were going alright”. Also, about one year before the management was cautioned that a large fire could pose serious concerns with respect to the safe evacuation; however the likelihood was discounted.

Flixborough disaster: On June 1, 1974, The Flixborough Works in UK experienced a massive vapour cloud explosion. 28 employees were killed and 36 injured. Plant was destroyed and was never rebuilt. 1800 houses and 167 businesses in the surrounding communities were damaged.

Subsequent investigations revealed that the most likely cause of the explosion was the failure of temporary piping modification. Estimated 30 tons of cyclohexane vapour were released. The vapour cloud formed found an ignition source, producing deflagration and releasing energy equivalent to 16 tons of TNT.

Apart from the mistakes in the design, there are certain issues that could have helped prevent the mishap. The works manager had left early in the year and had not been replaced, shifting the workload to other staff. There was no qualified mechanical engineer present on the site when modification was planned. The urgency to resume production distracted the staff from assessing the significance of what they were doing.

Dr. Sanjay Mahajani

New Executive Committee

(Effective 1st July 06)

P.D. Samudra (Chairman)
Dr. Ganeshan (Vice Chairman)
Dr. Shrihari (Hon. Secretary)
Dr. Sanjay Mahajani (Hon. Jt. Secretary)
V.Y.Sane (Hon. Treasurer)
Dr. S.S. Bhagwat
Dr. B.Chakraborty
M.V. Deshpande
M.P. Jain
Rakesh Jain
Prof. V.C. Malshe
J.N. Master
Satesh More
K.Sahasranaman
P.K.Saxena
V.K. Srivastava
Dr. R.N. Trivedi

Numerology

This column will feature Dimensionless numbers that rule the empirical world of Chemical Engineering. This month's number is Dean Number which is defined as

$$N_{De} = Re / (D_C / D)^{1/2}$$

Where
Re = Reynolds Number
D_C = Coil diameter
D = Pipe diameter

Dean Number characterizes the Dean Effect, which is the secondary circulation that is established perpendicular to the main flow when a fluid flows through a coil or curved pipe. This increases the friction relative to the straight pipe flow.

Website of the Month.

This month's website http://www.aiche.org/ccps/ belongs to CCPS (Centre for Chemical Process Safety) a non-profit, corporate membership organisation within AIChE that identifies and addresses process safety needs within the chemical, pharmaceutical, and petroleum industries.
.

Did you know?

Though the technique was developed by ICI in the 1960's the chemical industry started using Hazop Study widely only after the Flixborough disaster in 1974.

Increasing Appeal

We propose to go in for four-colour printing shortly to make this newsletter more visually appealing. In order to meet the higher expenses, members are hereby requested to bring in advertisements. For tariffs contact Executive Committee members.

Council Meeting

Change of Guard

Forthcoming Programmes

15/16 Sept	SCHEMCON 2006, at Anantapur
23rd Sept	Workshop on Process Development and Scale-up in Fine Chemical Industry at Chiplun. Jointly organised by Mumbai and Lote Regional Centres.
7/8 Oct	ChEMERGENCE 06, by Students Chapter of Thadomal Shahani Engineering College, Bandra
7th Oct	RANGOTSAV 06, organised jointly with UICT Surface Coating Technology students at UICT, Matunga.
8 – 10 Nov	Visit IIChE stall at India Chem 2006 Exhibition at NSE Goregaon.
27-30 Dec	CHEMCON 2006 at Bharuch

Keep watching our website www.iichemrc.org for further announcements.