

**PROCESS SAFETY ISSUES IN AMMONIA  
PRODUCTION, STORAGE AND TRANSPORT  
– A PROCESS SAFETY PERSPECTIVE  
FROM INDIA**

Presented at the  
“Ammonia World New and Old “  
conference at  
Technion- Israel Institute of Technology,  
Haifa, Israel

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15<sup>th</sup> and 16<sup>th</sup> November, 2017



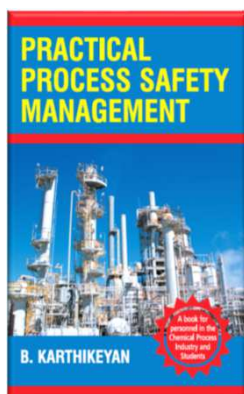
**PROFESSIONAL BACKGROUND**

- Chemical Engineer with over 38 years experience in operations, technical services and process safety
- 18 Years of Ammonia and Methanol plant operation
- Investigated root causes and human factors in many chemical process related incidents
- Implemented and audited PSM systems/provided services in over 100 organizations in India, Germany, Greece, Malaysia, Indonesia, South Africa, Israel, Jordan, Abu Dhabi, Oman and Bahrain
- Empanelled by Center for Chemical Process Safety (USA), division of AIChE, as instructor for their international PSM course



## PROFESSIONAL BACKGROUND

- Published many papers on Process Safety in National & International Seminars
- Published book and writes blog on process safety



*Proceeds from the book are donated to the surviving victims of Bhopal Gas Disaster*

Blog address:

<http://indiaprocesssafety.blogspot.in>

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## Moving Process Safety into the Board Room

*Article published in Sept 2015*



**AIChE**<sup>®</sup> American Institute of Chemical Engineers

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## AGENDA

- Overview of the fertilizer industry in India
- Process safety challenges in ammonia production, with plants of the older vintage
- Atmospheric storage of ammonia – process safety and security issues
- Transportation risks of ammonia
- Brief requirement of Indian regulatory requirements
- Some incidents involved with ammonia production, storage and transport

## OVERVIEW OF FERTILIZER INDUSTRY IN INDIA

- Second most populous nation in the World
- Total Fertiliser consumption 55 Million MT

Type of Fertilizer	Number of plants	Production
Urea	30	20 Million MT
DAP	12	8 Million MT
Complex Fertilizers	21	6.6 Million MT
SSP	99	4.4 Million MT

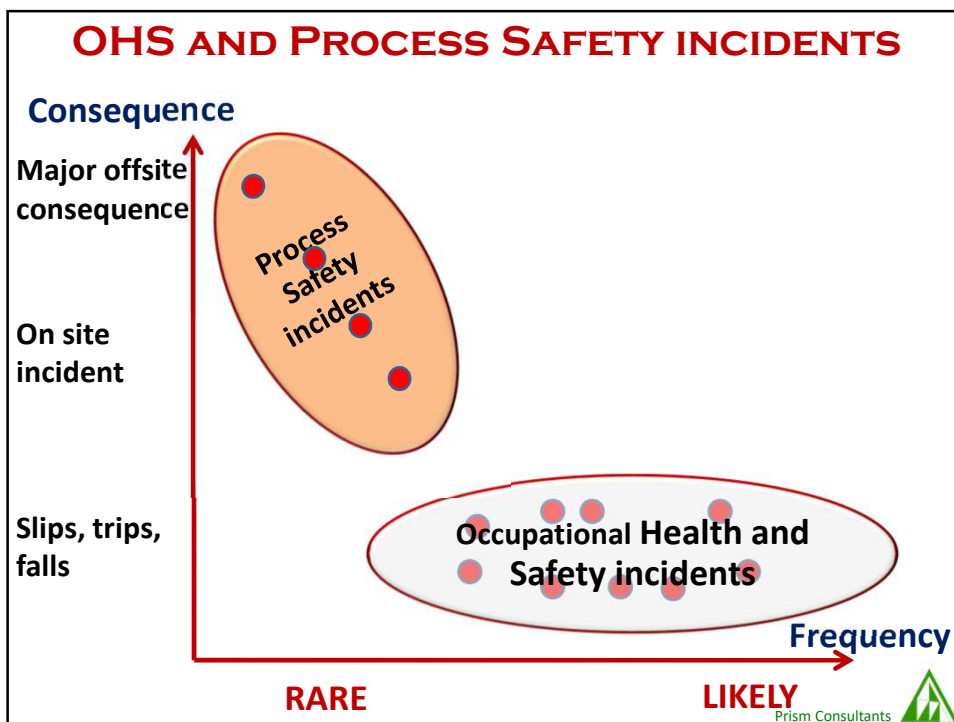
- Out of 30 ammonia – urea plants, 11 are pre 1980 and 19 are post 1980
- India imports 13% of the ammonia needs

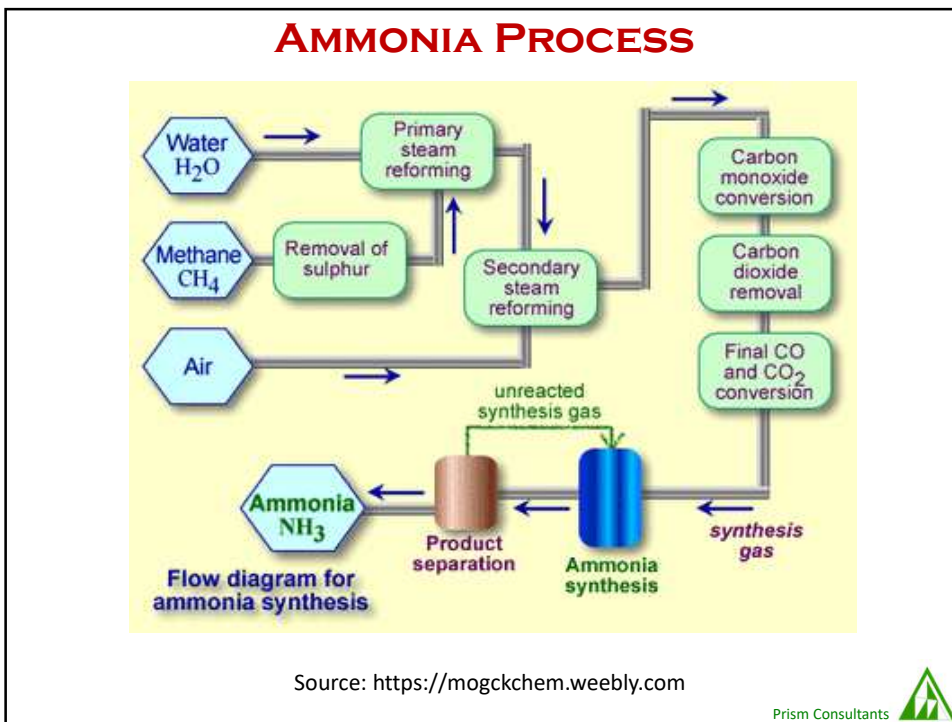
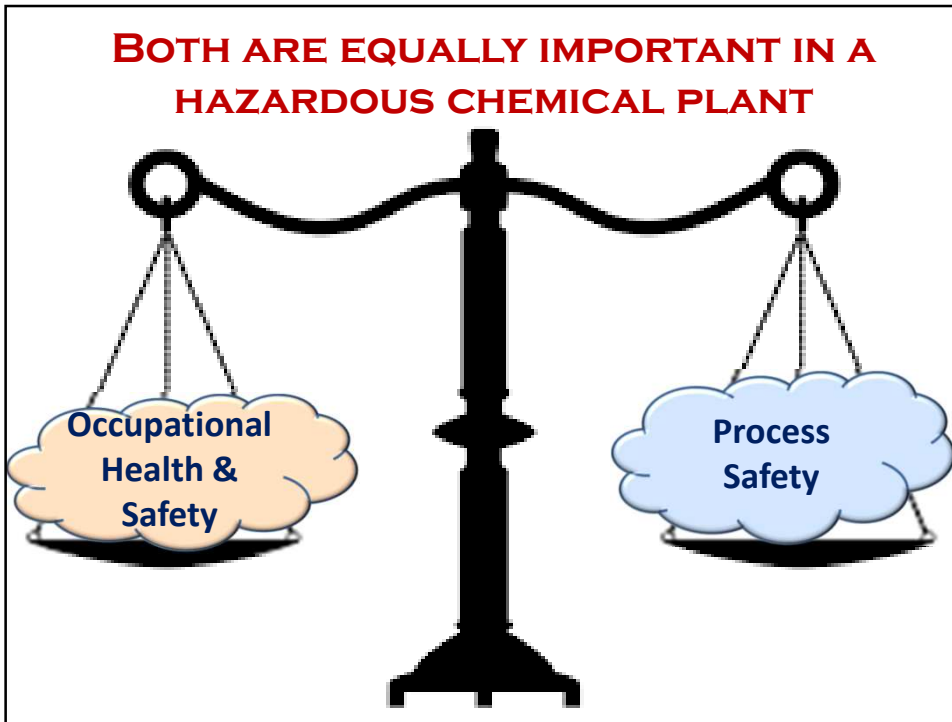
Source: Fertilizer association of India data

### DIFFERENCE BETWEEN OHS AND PROCESS SAFETY INCIDENTS

Occupational Health & Safety incident	Process Safety incident
<p><b>Incidents during man machine interface-</b> can injure or kill individual or few people</p>	<p><b>Loss of containment incidents-</b> toxic gas leaks/ hazardous chemical leaks/ fires / explosions – <b>Can kill many people and has business continuity implications</b></p>

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## **PROCESS SAFETY CHALLENGES OF AMMONIA PRODUCTION IN OLDER PLANTS**

Out of 30 ammonia – urea complexes, 11 are pre 1980 and 19 are post 1980

### **Process safety challenges:**

1. Maintaining asset integrity
2. Maintaining process safety knowledge database
3. Maintaining an effective management of change process
4. Managing retirements and manpower attrition

## **PROCESS SAFETY CHALLENGES OF AMMONIA PRODUCTION IN OLDER PLANTS**

### **1. Maintaining Asset integrity:**

- Capacity increase projects – inadequate checks of relief/flare system adequacy
- Higher pipeline velocities causing erosion/ heat exchanger vibration issues

## **PROCESS SAFETY CHALLENGES OF AMMONIA PRODUCTION IN OLDER PLANTS**

### **2. Maintaining process safety knowledge database**

**“There are no new accidents”** – Dame Judith Hackitt  
– former chair HSE UK

- Analysis of process near misses and upsets and learning from past incidents.
- Maintaining updated engineering documentation (P & ID's , PFD's, data sheets etc)



## **PROCESS SAFETY CHALLENGES OF AMMONIA PRODUCTION IN OLDER PLANTS**

### **3. Maintaining an effective management of change process**

Incidents occur in ammonia/urea plants due to the lack of managing changes effectively. Examples:

- Pipe failures during sealant injection to arrest flange/pipeline leaks.
- Wrong metallurgy used
- Incidents due to improper interfaces between old and new modifications



## **PROCESS SAFETY CHALLENGES OF AMMONIA PRODUCTION IN OLDER PLANTS**

### **4. Managing retirements and manpower attrition:**

The minimum manpower needs must be identified for current operating conditions, taking into account:

- Manpower for normal operations including planned start up and shutdown
- Emergency situations

The organization must then define a cut off point at which the recruitment actions will be initiated

## **ATMOSPHERIC STORAGE OF AMMONIA – PROCESS SAFETY AND SECURITY ISSUES**

India has about 5,422 kilometres of coastline in the mainland

Number of large atmospheric pressure ammonia storage tanks are located along the coast



## **ATMOSPHERIC STORAGE OF AMMONIA – PROCESS SAFETY AND SECURITY ISSUES**

### **Process safety issues:**

- Tanks require internal inspection every 10 to 12 years
- Corrosion of exposed structures to saline environment for tanks located along coast
- Some tanks exposed to Severe weather conditions like cyclones

### **Security issues:**

- Some tanks located near coastal areas
- Inland tanks exposed to expanding surrounding populations

## **TRANSPORTATION RISKS OF AMMONIA**

- Ammonia is transported through waterways, roads and sub sea pipeline
- Road transport of ammonia is a risky activity
- Regulatory requirements for road tankers are stringent
- Road tankers sometimes deliver the ammonia to refrigeration plants located in highly populated areas

### **BRIEF INDIAN REGULATORY REQUIREMENTS CONCERNING AMMONIA PRODUCTION AND STORAGE**

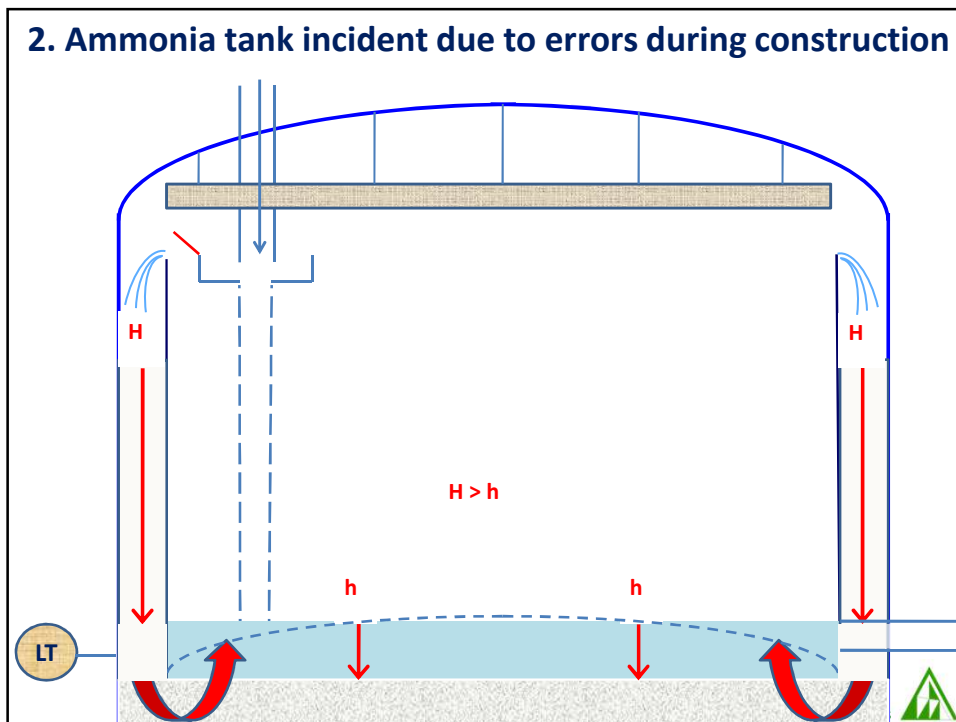
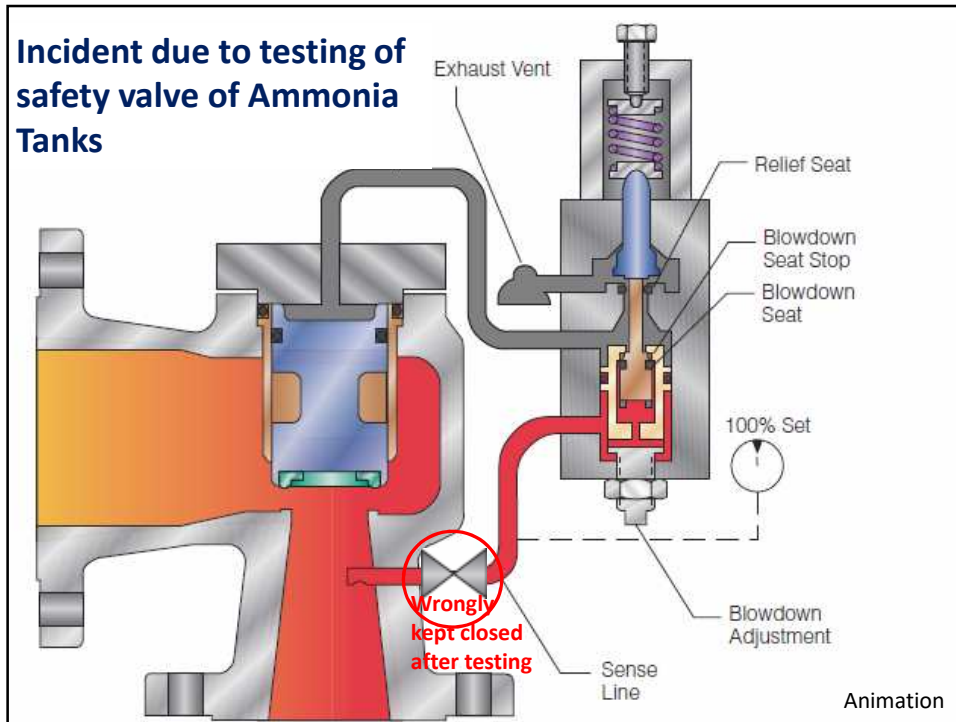
- Ammonia urea plants covered under Hazardous processes in Factories Act that address safety requirements
- Manufacture, Storage, Import of Hazardous chemical rules address ammonia safety requirements



### **SOME INCIDENTS THAT HAVE OCCURRED IN AMMONIA PRODUCTION, STORAGE AND TRANSPORTATION**

1. Inadequate testing procedure of safety valves
2. Incident due to errors during construction of ammonia storage tank
3. Transportation incidents – underwater pipeline and barge transport
4. Incident due to thermal expansion of ammonia





## **TRANSPORTATION RISKS OF AMMONIA**

### **3. Ammonia Sub sea pipeline damaged by dumping of rocks to prevent erosion of coast line**



## **TRANSPORTATION RISKS OF AMMONIA**

### **3. Ammonia barge Incident in waterway in Kerala, India**

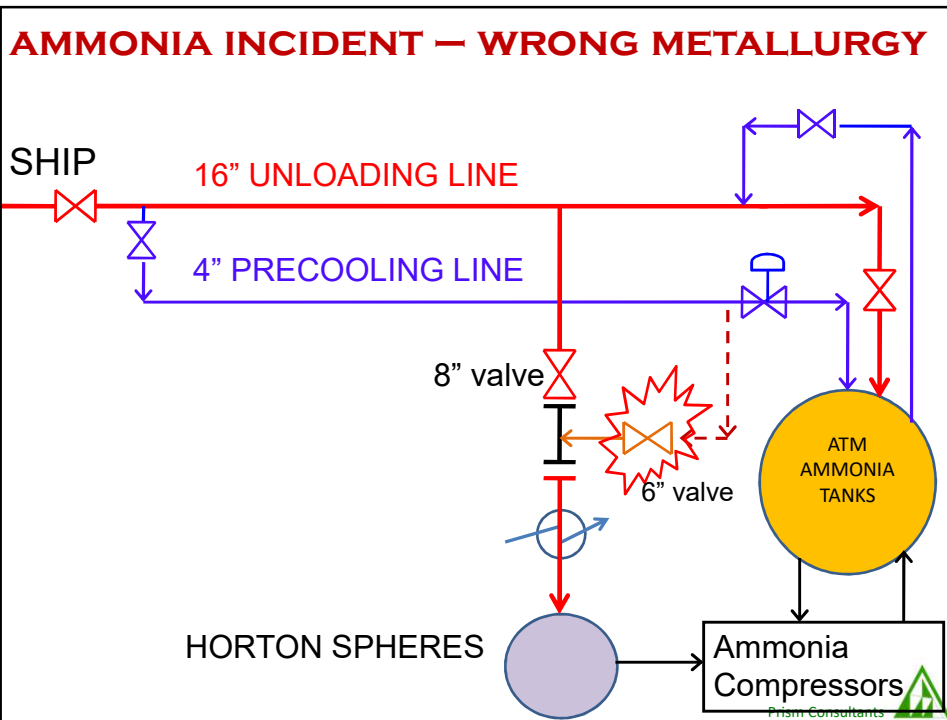
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### 4. Thermal expansion of Blocked in Ammonia, operator killed

Ammonia heat exchanger ammonia side blocked in advertently

Heat input to exchanger was continuing to passing of valves



Thank you!