





LPG Sector of Pakistan

LPG Cylinder Safety in Focus

Venue:

2nd International LPG Conference

Faletti's Hotel, Lahore

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Presentation Structure

"Whosoever killed a person... It shall be as if he had killed all mankind."

- The Holy Quran (5:33)

About 3,000 people have died during last decade due to LPG cylinder explosions

Pakistan's Energy Situation Pakistan's LPG Sector

Safety of LPG Cylinders in Pakistan

Way Forward

Primary Energy Supplies 2014-2015

70.26 Million TOE



Source: Pakistan Energy Yearbook 2015

Primary Energy Supplies 1994 - 2015



Source: Pakistan Energy Yearbook 2015

Natural Gas Outlook – LPG Role



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Prospects of LPG in Pakistan





Pakistan LPG Sector Statistics

- Local Production 600,000 tons/year
- Imports 532,000 tons/year (Land & Sea)
- LPG Marketing Companies 121
- Authorized Equipment Manufacturing Companies 42
- Total Number of LPG Cylinders 4 million to 7 million
- Independent LPG Cylinder Testing Facility Nil
 - LPG Cylinders are Loan Delivery Equipment (LDE)
 - Manufacturer & Marketing Company has Conflict of Interest in re-qualification of LPG Cylinders
 - HDIP Cylinder Testing Labs need to be upgraded to test and requalify LPG Cylinders

Properties of LPG

- LPG is a mixture of Propane & Butane stored as a liquid at pressure of 121 psi and ambient Temperature
- Boils @ 42°C at Atmospheric Pressure
- At 97°C Propane turns to vapor regardless of Pressure
- It expands 270 times when turned into vapor/gas
- LPG is cryogenic and can cause cold burns
- LPG is 1.5 times heavier than air, if leak occurs it mixes with air, accumulates forming a pan-cake cloud
- It is colourless, odourless, tasteless and non-Toxic
- Flammability has Narrow band (2.2% 9.5%)
- Burns cleanly and has very low emissions

Temperature effect on Steel Strength



LPG Cylinder Explosion - BLEVE

- LPG cylinder can fail in a catastrophic manner, called BLEVE (Boiling Liquid Expanding Vapor Explosion) releasing vast amount of energy in the form of:
 - Shock Wave
 - Primary Explosion of Stored Energy (<u>Pressure</u>)
 - Projectiles
 - Primary (Fragments of LPG Cylinder)
 - Secondary (Objects/parts nearby)
 - Thermal Radiation of Fire Ball caused by a Secondary Explosion (Chemical Energy)
 - Fire Hazard

LPG Cylinder Explosion - BLEVE



Which tank is likely to BLEVE sooner...

- Small Cylinders/tanks are because
 - Small Tanks empty sooner Liquid level drops
 - Steel heat-up faster
 - Thinner walls (Wall Thickness 1 mm to 2 mm)
 - Damaged and Corroded
- BLEVE Time
 - Small tanks in 2 4 minutes
 - Medium sized tank in 5-7 minutes
 - 25-30 tons Bowsers in 8- 12 minutes



LPG Cylinder Explosions - Ethical Aspect



Manufacturer's Product Quality

- OGRA specifies NFPA 58 Standard only to be registered as Manufacturer of LPG Equipment
- NEDA is not a standard for manufacturing of any

REQUIREMENTS FOR REGISTRATION WITH OGRA AS AUTHORIZED MANUFACTURER OF LPG EQUIPMENTS

Any interested party who wants to register with OGRA, may submit the application alongwith supporting documents to substantiate the following requirements: -

a) Should possess the required manufacturing and testing facilities.

b) Should possess adequate and qualified manpower, well conversant with NFPA-58 Standard. LPG Bottling Plant

Handling and filling in LPG Bottling Plant Distributor / Dealer points

Manufacturer's Product Quality

Standards for LPG Steel Cylinders US Standards DOT 4B/4BW - 240 International Standard ISO 4706 European Standard EN 84/527 British Standard BS 5045 Part 2 **Standards for Composite Cylinders** ISO 11119-3: 2013 Part 3 EN 14427:2014

Standards for Accreditation for product quality for LPG International Standards

Organization (ISO)

Committee of European Normalization. (CEN/EN)

UK LPGA Code of Practice

HDIP recommends:

ISO 9001 for Product Quality for LPG Equipment Manufactures DOT 4B/4BW-240 & ISO 4706 standards for LPG Steel Cylinders ISO 11119-3: 2013 Part 3 EN 14427:2014 for Composite Cylinders

Local LPG Cylinder Manufacturing

- 3,000 people died in last decade due to LPG cylinder related accidents as general public as customers is in direct contact with substandard LPG cylinders
- Cylinders are Loan Delivery Equipment (LDE) of LPG Marketing Company and must not be sold in Market
- Thickness of Substandard Cylinder wall is 1 mm or less whereas it should be 1.6 mm or 2.2 mm or more
- Single pass Weld Joint No record of Welder & WPQR
- Heat Treatment Annealing/Normalizing is not done
- There is no Public or Private Independent Cylinder Testing Facility for LPG Cylinder Testing

Local LPG Cylinder Manufacturers

- Manufacturer must be a private limited company
- It should have NTN and Sales Tax No.
- It shall be accredited for product quality by internationally recognized standard i.e. ISO 9001
- Have record of Welder Qualifications and WPQR
- Must have at-least one Mechanical Engineer
- It must have Post-weld Heat Treatment facility (Annealing 650°C or Normalizing 900 °C)
- Many Manufactures of LPG cylinders do not meet NFPA 58 recommended DOT Standards Cylinder Specifications or ISO 9001 Product Quality

Local LPG Cylinder Manufacturing

- Manufacturing steel MTCs for batch, Approved drawing, Cylinder Serial no., batch no., Tare weight, Valve certification, Water Liter capacity, Test/Working Pressure and relevant records shall be kept of all tests as required by DOT 4B/4BW240 should be retained
- Proper record of inventories, i.e. Work In Process Inventory, Finished Good Inventory, Rejected Parts Inventory shall be maintained
- Proper record of each testing instrument and welder shall be maintained for backward traceability
- Independent Evaluation, Testing and Requalification of Cylinders should be assigned to HDIP CTLs

Factory Area for Cylinder Manufacturing

Factory area should be at-least 4 kanal or 22,000 ft²

Lot Size 1,000

Batch Size 3,000

10.2 Batch testing

10.2.1 Inspection lots

For acceptance purposes the batch shall be divided into inspection lots not exceeding 1 000 cylinders. For selection of sample cylinders for either burst or mechanical tests, each lot is subdivided into sub-lots of 250 cylinders during the first 3 000 cylinders of a batch and sub-lots of 500 or 1 000 cylinders, depending on cylinder size, thereafter (see Figure 12).



HDIP role in LPG Sector

- HDIP is an autonomous body of M/o P & NR
- HDIP was established under an Act of the Parliament "to act as organization for inspection and testing, checking of quality, standards and specifications of hydrocarbons including crude petroleum, petroleum products, LPG and natural gas"
- Federal Government has designated HDIP to act as Technical Support Institution
- HDIP is not in OGRA designated 3rd Party Inspection
- HDIP Cylinder Testing Labs must be upgraded for requalification and testing of LPG cylinders

LPG Composite versus Steel Cylinders

Translucent

No adulteration

Steel LPG Cylinders

- Explosion risk
- Unable to check the level of gas
- Heavy in weight

Corrosiv

- Aesthetid
- Burhan Gas Company has applied for approval of manufacturing composite cylinder in August, 2015 High log
- No universal valve connection
- Age-old technology
- Easily damaged





Universal valve connection

d shape

bst

Composite LPG Cylinders

100% explosion proof

Lightweight

Visual control of gas level

- Advanced technology
- Heavy duty durable casing

LPG Composite **Cylinder do not** BELEVE

Transportation, Storage and Handling

Precaution to be taken







- Horizontal carrying of cylinder is a bad practice and dangerous
- Rolling /throwing cylinders on belly from Truck platform height is prohibited and dangerous



 Cylinder should always be stacked vertically on trucks during transportation
We recommend transport cylinders duly tightened to avoid falling/tumbling



- Preferably use smaller vehicles for delivering cylinder individual in cities and towns
- Preferably use STROLEYs while delivering cylinder to individual households



Way Forward for LPG Industry



The End

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