The EPA, Fugitive Emissions & Valves - We are All Involved

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United Valve
Refining & process industries ran at full speed for many decades

- Air quality was not addressed
- Asbestos packing worked well and was used everywhere
- No one was measuring FE leakage
- Jobs trumped health & safety
World War II put health concerns on the back burner

- The Production of 100, Octane fuel, Toluene & synthetic rubber during WWII boosted US refinery & petrochemical plant construction. Shipyards used asbestos products extensively.
Once Upon a day in Donora - 1948

THE 1948 DONORA SMOG

Major federal clean air laws became a legacy of this environmental disaster that focused national attention on air pollution. In late October of 1948, a heavy fog blanketed this valley, and as the days passed, the fog became a thick, acrid smog that left about 20 people dead and thousands ill. Not until October 31 did the Donora Zinc Works shut down its furnaces—just hours before rain finally dispersed the smog.
The air is always greener in Pasadena!
1970’s – 1980’s, things changed

- The elimination of Asbestos as a packing material
- The Clean Air Act
- Enforcement policy of the EPA
- State Regulations (i.e...California)
The Clean Air Act

- **Act of 1963**: Authorized development of a national program to address air pollution
- **Act of 1967**: Authorized enforcement procedures & expanded the scope of the document
- **Act of 1970**: Began to put real teeth in the program with increased standards & enforcement authority
- **1977 Amendments**: Further refined the requirements - things really began to happen
- **1990 Amendments**: The document as it is today: 230 toxic pollutants, phase out of ozone depleting chemicals, increased enforcement authority
“Who Moved My Cheese”

• No, Who moved my asbestos!
  – Unique fiber characteristics
  – Little degradation at high temperatures (800-1200 degrees F)
  – Made stronger with Inconel wire insert
  – Tiny fiber size enabled fibers to mesh without binders

• Initial replacement packings did not perform very well
State regulations

• Started in California and drifted eastward
• South Coast Air Quality Management District
• Bay Area Air Quality Management District
• “Best available control technology”
• 500 ppm initially, then 100 ppm
The bad stuff

• **Volatile Organic Compounds (VOC’s)** - any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

• **Hazardous Air Pollutants (HAPS)** - Any air pollutant listed in or pursuant to section 112(b) of the Federal Clean Air Act, and as amended by 40 CFR Part 63, Subpart C
Today’s EPA
(as of March 23rd, 2017)

• 500 ppm is the written limit, but.....consent decrees can state otherwise (100 ppm)
• Many revisions and additions during the past 8 years
• Mid-stream and upstream oil & gas have become big targets
EPA’s Sheriff - The Department of Justice

- Consent Decrees
- Fines
- Civil penalties
- “Environmental Justice”
- Criminal prosecution

(OSHA 1910 Process Safety)
Where is the EPA looking today?

- **Any facility** where the chemicals and compounds listed in the VOC definition in 40 CFR Part 51.100 are made or used and there is leakage into the atmosphere
- **230 chemicals and compounds** from Acetaldehyde to Xylyl bromide
- New aerial (drone) and outside-the-fence monitoring equipment is now employed
The usual suspects top the list

- Oil refineries
- Petrochemical plants
- Chemical plants
- And now…
  - Pipeline compressor stations
  - Pipeline valves
  - Wellheads
Some Clean Air Act non-refinery consent decrees & fines

The following were issued because of piping system FE leakage:

• Meat packing - ammonia
• Steel mill coke byproducts - benzene
• Automobile manufacturer - solvents
• Paint manufacturers - solvents
Some Clean Air Act non-refinery consent decrees & fines

- Specialty chemicals mfg. – nitric acid
- Biodiesel plant – methanol
- Industrial process refrigeration - refrigerants

The common denominator was they were all leaking volatile organic compounds or hazardous air pollutants into the atmosphere
Most valves in VOC & HAPS services should be qualified

- Linear valves – worst offenders (60% of population in refinery & petrochemical plants)
- Ball & butterfly – less concern
- Plug valves – less concern
- Check valves – gasket seals only
- Diaphragm valves – limited concern
- Bellows-seal valves – no real concern
Consent Decree

• Yes your honor, we are guilty, we promise to be:

  - Trustworthy
  - Loyal
  - Helpful
  - Friendly
  - Courteous
  - Obedient
  - Cheerful
  - Thrifty
  - Brave
  - Clean
  - Reverent

  ....And have no leaking valves
EPA – plant – packing & valve manufacturer marriage

Consent Decree

Requires

Enhanced LDAR program

Requires

Certified Low Leaking Valves

100 ppm for five years
Certified Low Leaking Packing Technology

“A valve packing product, independent of any specific valve, for which the manufacturer has issued a written warranty that the packing will not emit fugitive emissions at greater than 100 ppm and that, if it does so anytime in the first five years, the manufacturer will replace the product…”
Certified Low Leaking Valve Technology

“A valve for which the manufacturer has issued a written warranty that it will not emit fugitive emissions at greater than 100 ppm, and that, if it does so anytime in the first five years, the manufacturer will replace the valve…”
Certified Low Leaking Valve & Packing Technology

Both certifications require testing of the packing and testing of the valve as well as proper maintenance by the owner.

The maintenance requirement(s) are detailed and can be costly to the owner.
Current valve test standards

- API RP622 (packing qualification)
- API 624 (linear valves, graphite packing)
- API 641 (1/4-turn valves, graphite packing)
- ISO 15848-1 (qualification type test)
- ISO 15848-2 (production test)
API RP-622

“Type Testing of Process Valve Packing for Fugitive Emissions”

2nd edition, October 2011

- Utilizes methane
- A packing qualification test
- Graphite packing only
- Prerequisite for qualifying packing in API 624 & 641
API 624

- “Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions”
- 1st edition, 2014
- Utilizes methane
- 310 mechanical cycles
- $260^\circ C$ ($500^\circ F$) maximum temperature
- 100 ppm acceptance criteria
- Requirement of API 600 & 602
API 641

- “Type Testing of Quarter-turn Valves for Fugitive Emissions”
- Utilizes methane
- Test parameters based on rating of the valve
- 610 mechanical cycles
- Not yet required by API 608
- Valve selection procedure is complex
ISO 15848-1

- “Industrial Valves—Measurement, test & qualification procedures for fugitive emissions”
- Used primarily in Europe
- Helium or methane
- “Cafeteria” test (various levels)
- Helium test not recognized by the EPA
ISO 15848-2

• Production test for valves qualified under 15848-1
• Used primarily in Europe
• Helium is the test fluid
• Requires helium mass spectrometer
Wellhead valves (API 6A)

They are much tougher to certify via FE testing

- Pressures are too high (5000 psi+) for helium – gross leakage would occur
- Very high pressure methane testing is too dangerous
- American Wellhead Equipment Manufacturers Association (AWHEM) is considering Argon as a test gas. Argon molecule is similar to methane molecule
Dimensions & tolerances are critical for FE containment in linear valves

**Packing gland**
1) ID
2) OD

**Packing**
1) ID
2) OD
3) Must be RP622

**Bonnet**
1) ID
2) OD
3) Finish

**Stem**
1) Diameter
2) Straightness
3) Runout
4) Finish
5) Cylindricity
Quarter-turn valve FE compliance is easier

• No rising stem motion
• Shorter stems
• Easier component machining
• Proper alignment of components is easier
The two keys to FE containment success

1) Without proper dimensions, tolerances & correct torque, the very best low-emissions packing is useless

2) Quality manufacturing and repeatability are imperative for successful valve sealing systems
Tomorrow?

• Will all valves in VOC service require a FE production test?
• Will EPA adopt the 100 ppm acceptable leakage rate nationwide?
• Will there be more push for bellows seal-valves?
• Will there be more replacement of large OD gate valves with \( \frac{1}{4} \)-turn products?
• Will testing with argon become viable?
• Will EPA’s budget be slashed?
There is always the old school method
Regardless of the what the EPA asks for or demands in the future, the truth is that the air around our industrial plants today is tremendously cleaner than it was 40 years ago. The last 4 decades have seen end-users, sealing manufacturers and valve manufacturers make a concerted effort to eliminate FE leakage- which is something the industry can be proud of.
Questions?