Conclusion

QSWAS solves all the end user and Project problems of :

1. **Comply to ASME PTC Design**
2. **100% Sampling system is Make in India & Proven Globally.**
3. **Easy to Maintain**
4. **Low Foot Print.**
5. **Low Civil Cost of Space.**

Proprietary content

33

Thank You

WorkShop & Hands-on
by
M/S CCI VALVES

- Control Valve for Severe Service
- Physical display of Valve Internals
- Control valve functioning
- Practical issues faced in valve operation and its solution.
- Case Study

Presented by
Mr. Tarak Chhaya (President CCI India)
Mr. Pavitran Kottarathil

WorkShop & Hands-on
by
M/S AMETEK

- Analyser (Measurement in SRU)
- Safety feature in desingining of Anlayser for Hardeous area and Selection
- Sample handling
- Displaying of Analyser Probe -ASR Probe /HAG Probe
- Analyser Installation : Problem/Issues

Presented by
Mr. Jochen Geiger
(Director sales and services Ametek)

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Abstract for ISA Delhi meeting April 21 & 22 – 2017

By Jochen Geiger; AMETEK Process Instruments; Director of Sales and Service EMEA & India

And Anantha Kukkuvada, AMETEK Process Instruments; Manager Sales & Service India

Measurement in Toxic Gases and Hazardous Ambient

Based on the example of installations in Sulphur Recovery Plants

Some of the most toxic gases in a Refinery or Oil / gas Processing plant can be found in the Sulphur Recovery Unit. The following paper will review analyzer installations in such Units based on Health and Safety Issues as well as best practices of installation design

In Process, such as the Sulphur Recovery process high concentrations of Hydrogen sulfide (H2S) can be found. In some part of the process H2S can go up to 90 Vol % and above. In the following we will take a review based on this example of what does this mean to Analyzer installations. Is it we don't measure? Or; how can I make the installation SAFE!, Safety is the point which should be never argued only highest level should apply .

For sure there are other criteria for such critical measurements based on people's safety and operational points then for example to measure stack emission, which are important as well, but….in a very different way

H2S is highly toxic! I would say it is the most toxic component which can occur in Refinery / Petrochemical / Natural Gas Processing installations.

One of the highest risk factor for Human Health is the fact that H2S smell level is in the low ppm concentration <5ppm and it has a strong taste like rotten eggs. In one way, it is good but at a level of 200 ppm a kind of anesthesia applies and the sense of smell is getting lost. So just at the level where the concentration gets dangerous. H2S reacts with the red Blood particle and destroy them which causes a fast paralysis of our body breathing system. Without being a medical Doctor; bottom line when you get exposed to a concentration of 1000ppm (0.1 Vol %) for 10 seconds death is likely. Below some more figures

100 ppm feeling sick ; 500 ppm helplessness & convulsion ; 1000 ppm loss of control in seconds deep helplessness with consequence of death ; 5000 ppm Death in Seconds

So, in refinery applications we are not looking for a few ppm to measure we are in the Percentage range in one critical measurement we are looking for concentrations up to 95 Vol % so many thousand times above the deadly concentration.

So, what to do?

Skip the measurement as it is too dangerous? Sounds like a reasonable answer, so what would be the consequence of doing so? for sure this will lead into less process control which can cause lower quality product or, worth into higher emissions.

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For example, losing 1% Recovery Efficiency in a Modified Sulfur Recovery Plant may cause 1 Vol% higher SO2 emission.

Every ton of Sulfur recovered eliminates two tons of SO2 emitted into the atmosphere. In other words, good process control is essential to product quality and to Environmental protection. This leads direct into the answer of the question of removing the measurement, NO not possible!

So what to do? First each and every one in the process of planning process of a plant were toxic gases part of the chemical process, should be aware of the risk coming from such gases. All begins at the very first mechanical design stage. Different design disciplines need to communicate. A mechanical plant designer may not know about "how to make a Process Analyzer Installation Safe" same as the Analyzer specialist may not know about mechanical requirements in order to build a platform which carries vessels and process reactors. What is important here is good accessibility to the point sample should be taken, and if needed where it should be returned to process, venting of high toxic gases is not an option! Not only accessibility should be closely reviewed also right from first design an escape route need to be planned. Then to the next step, what is important for the measuring device itself. What are good and safe practices to avoid operating and maintenance staff to get exposed to health impacting gases.

Let us begin with the question how to get the gas we want/ have to measure to the analytical detector? A possible and easy answer could be ; let us use an INSITU Type of detector , sounds easy but raises many questions on the second view , what to do if the detector need maintenance or a check with test gases or … or … So not always the easy way is what is needed

First rule, and this rule should apply for ALL measurement of toxic components

LESS is BETTER

Using less fittings, less valves , less filter …. Eliminates the risk of leaks at connection points, off course the design must fulfill the requirement of the analyzer in use

NEVER ever use a mechanical pump to transport the gas. Pumps leak! Not today, maybe not tomorrow BUT for sure the day after tomorrow . For sure mechanical pumps are an adequate sample handling device for CEM's and other low toxic applications BUT not in applications where a leak can cause death within seconds

EASY Rule !

Keep the System as simple as Possible

Same applies for the environmental / weather protection of the Instruments. There is a believe that large Analyzers Houses is always a favorable approach. This might be true for many applications BUT for sure not for those where highly toxic Gases need to be measured. Think about the escape route – the possibility of a toxic gas pocket in the Larger Shelter, even opening a door without warning that the atmosphere inside of the Shelter is toxic can lead into heavy injury or death. The Market offers serval measuring devices which can operate with a minimum of environmental protection. Yes a Big Shelter is nice and convenient, most are even equipped with Air Condition, nice …. But is it safe!

So better is Lean – Simple – Easy to maintain and SAFE

This statement leads us directly into the next safety consideration point. All we discussed so far has to be done before the installation, but what is when the in instrument is installed? any safety considerations or we can close the topic and forget? The answer is simple NO

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ONLY A WELL MAINTAINED ANALYZER IS SAFE!

Good maintenance is essential under safety and operational aspects. Every measurement device / Analyzers need maintenance, some more, some less.

Let us look into maintenance programs/ procedures. No need to say an analyzer which is supposed to help and optimize Process Control need to work! In order to achieve the same a few basic rules should be followed, maintenance staff need training and parts for first trouble shooting. In addition, we found after many discussions and training classes that some basic process knowledge and awareness of the toxic nature for some components will help significant to increase the analyzer signal availability

Conclusion

Operational Safety and reliability of Process Analyzer installation start at the first day of design and only end at the day the unit is taken off from Operation

So call for expertise and plan well for the lifetime of the Instrument

Note:

References: Randy Hauer AMETEK Process Instruments; John Sames Sulfur Experts Inc

Critical Step Towards Healthy Environment

Emission and Immission Monitoring

Pankaj Kumar Rai
Chemtrols Industires Pvt. Ltd.

Importance of Climate Protection

- At standard atmospheric pressure, one ton of CO_2 occupies a cube the size of a three-story building (8.2m x 8.2m x 8.2m).
- This is the amount of CO_2 produced by an average person in an industrialized country in one month.

The Rationale for Air Pollution Monitoring - Epidemiology

A 10 μg/m³ increase in respirable dust yields an increased risk of death.

32% - Diabetes
28% - COPD (chronic obstructive pulmonary disease)
27% - Congestive Heart Failure
22% - Inflammatory Diseases

The Rationale for Air Pollution Monitoring Climate Change

- **An increase in infrared absorbers in the atmosphere is causing a variety of problems in the biosphere:**
- Desertification
- Extremes of heat and cold
- Surface water temperature increase
- Increased frequency and intensity of storms

The Rationale for Air Pollution Monitoring

Climate Change

- **Urban planning relies on air quality and source monitoring.**
- Validation of models
- Traffic planning impact
- Prevention of Significant Deterioration (PSD)
- "Hot Spot" evaluation

Air Pollution in Asia

Asia represents a major source of air pollution as a result of rapid population growth, explosive industrialization and few environmental regulations .

China:

China is polluted with sulfur dioxide (15 million tons) and particulate matter (20 million tons) because of the use of the high sulfur coal to generate energy.

Other Chemicals:

- 1. Carbon Dioxide from Industry
- 2. Greenhouse Gases from Industry
- 3. Nitrogen Oxides from Cars
- 4. Acid Rain

- With all these problems China has started implementing air pollution control technology.

Air Pollution in Asia

India:

- Most common air pollutant: Suspended particulate matter is due to use of coal in power plants
- Use of low quality coal produces 45 million metric tons of ash annually
- When particulate matter ash is mixed with auto exhaust the emissions cross limits, resulting in an increase in respiratory diseases and allergies

South Korea:

- SO_2 is the major pollutant in South Korea, however, it is being controlled by using air pollution control equipment

Hong Kong:

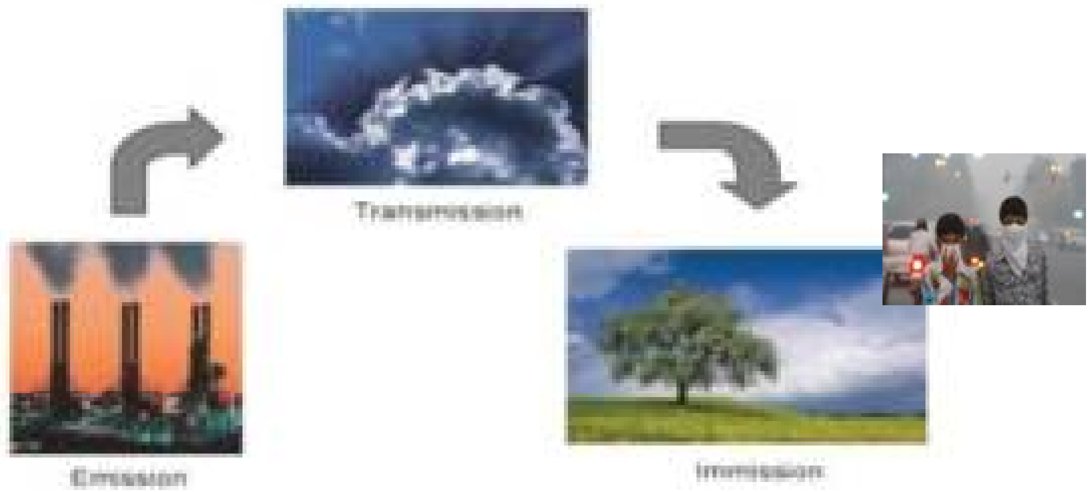
- Vehicular emissions contribute to air pollution problems with diesel powered engines being the prime culprit.

Critical Steps to Reduce Air Pollution

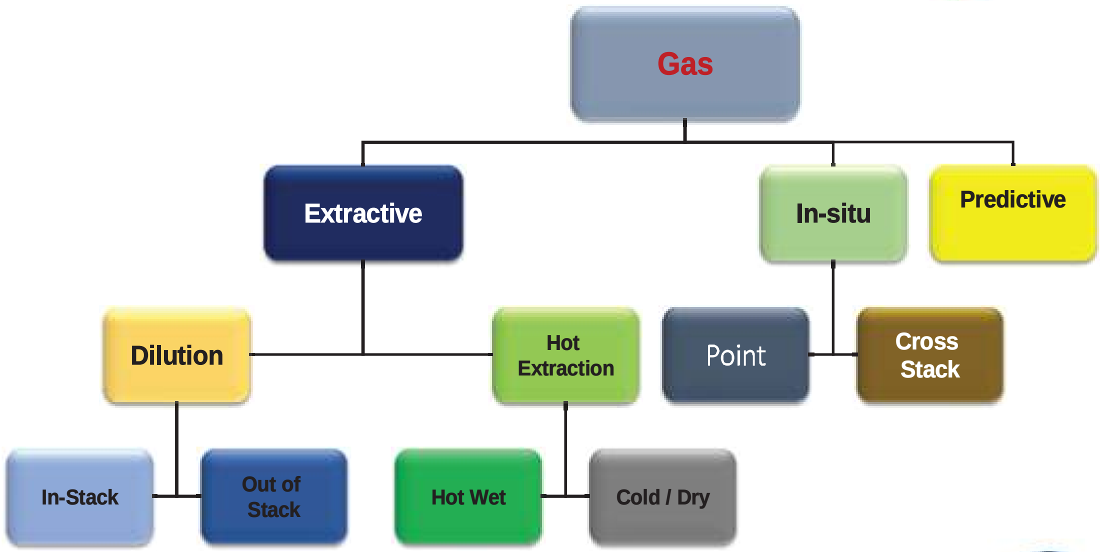
Efforts to reduce air pollution have largely fallen into three categories:

- **Regulatory Solutions:**
  - Regulatory solutions involve the passage of laws and the establishment of government agencies which attempt to reduce air pollution through government monitoring and punitive measures.
- **Technological Solutions:**
  - This includes the progress in emissions technology
- **Market-based solutions:**
  - These solutions allow firms the flexibility to select cost-effective solutions to achieve established environmental goals.

Emission Vs Immission



Emission - Measurement Techniques



Technique Selection

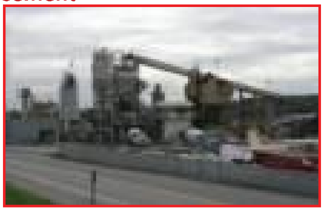
- Based on plant characteristics

Oil & Gas

Fertilizer

Power

Cement

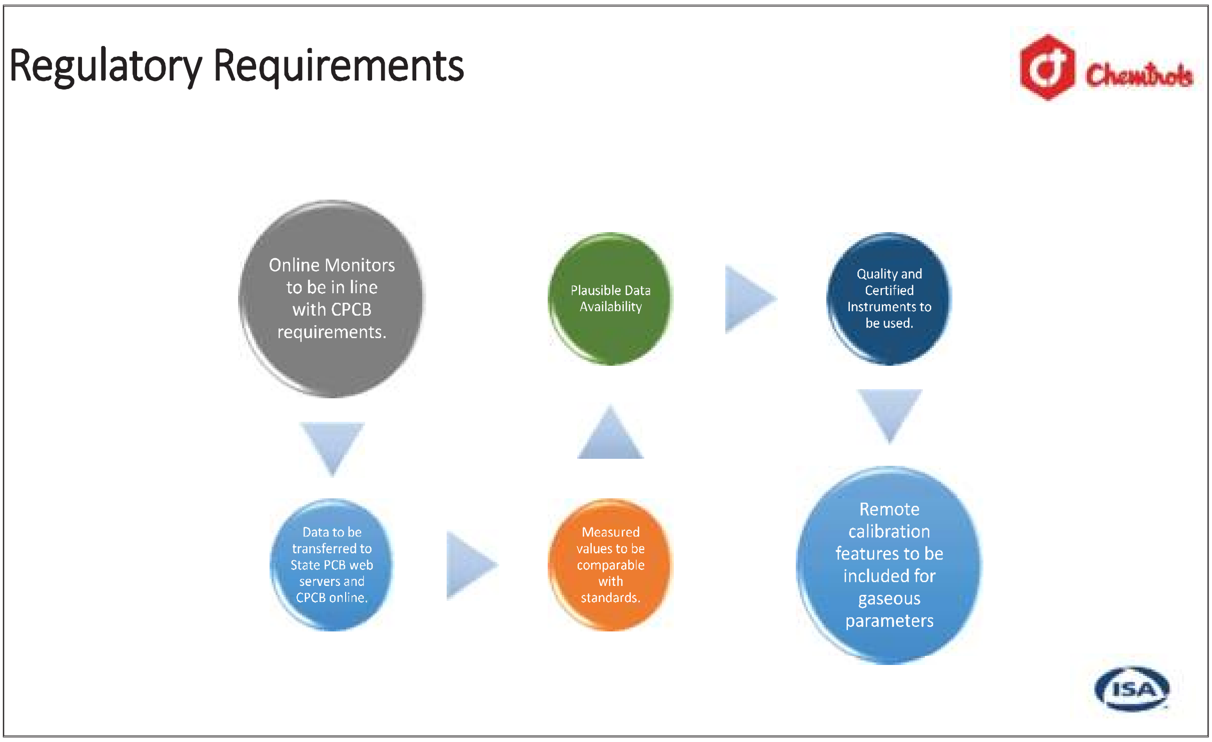


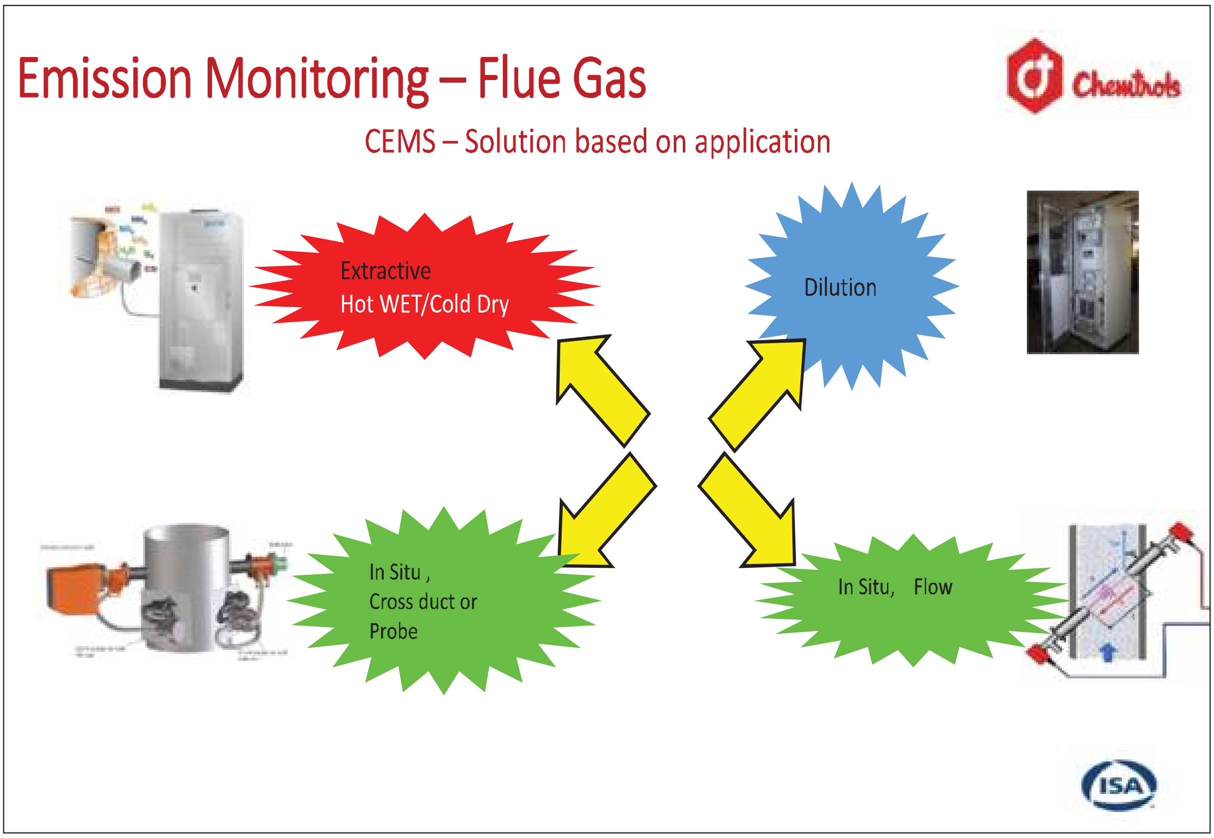
Chemical & Petrochemical

Steel

Plant Characteristics

- Corrosive environment
- Water Soluble Acidic Gases (NH3, HF)
- Wet Gases
- Dust Content
- Flue Gas Temperature


Regulatory Requirements
Chemtrols
Online Monitors to be in line with CPCB requirements.
Plausible Data Availability
Quality and Certified Instruments to be used.
Data to be transferred to State PCB web servers and CPCB online.
Measured values to be comparable with standards.
Remote calibration features to be included for gaseous parameters
ISA


Emission Monitoring – Flue Gas
Chemtrols
CEMS – Solution based on application
Extractive
Hot WET/Cold Dry
Dilution
In Situ ,
Cross duct or
Probe
In Situ, Flow
ISA

Selection of Technique

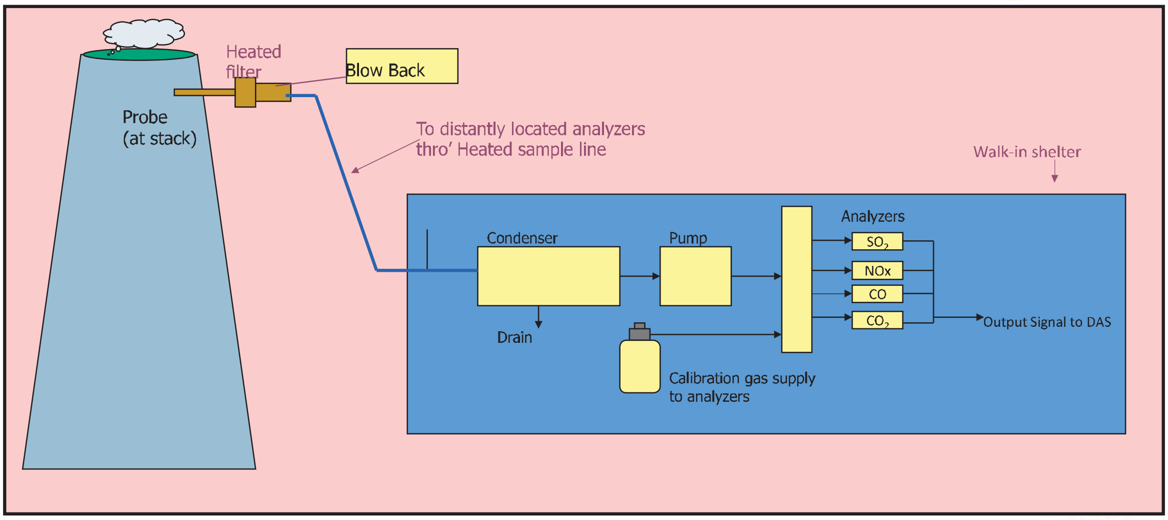
Step	Description	Hot Extraction	Dilution Extraction	Hot Wet Extraction	In-situ
1	**Components** HC HF Dust	 × × ×	 × × ×	 ++ + +	 × ++ +++
2	**Regulatory Compliance** USEPA TUV	 + ++	 ++ +	 ++ ++	 × +
3	**New Regulatory Requirements** Lesser Limit Values New Components Addition(Hg)	 +++ +	 +++ ×	 +++ +++	 × ×
4	**Change in Process / Fuel** Alternate Fuel FGD / DeNox Systems	 + +	 + ++	 +++ +++	 × +
5	**Identification of Critical gases in the fuel / raw material** NH3 HCl H2S				

Selection of Technique

Step	Description	Hot Extraction	Dilution Extraction	Hot Wet Extraction	In-situ
6	**Change in Operational conditions of the CEMS** Addition of Emission Control Systems	-	+	++	--
7	**Life –Time Cost of the system** Instrument air consumption Consumables (like gases, etc.,) Maintenance	 ++ ++ -	 - ++ ++	 ++ + ++	 -- + / - --
8	**Precondition to operate the system** Maintenance Validation of measurement	-- ++	++ ++	++ ++	+ --
9	**Environmental and Situative conditions of the Site**				
10	**Benchmark the capability of the Supplier**				

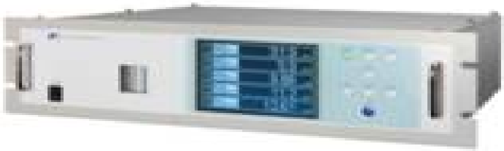
Cold Dry

Extractive System – Cold Dry



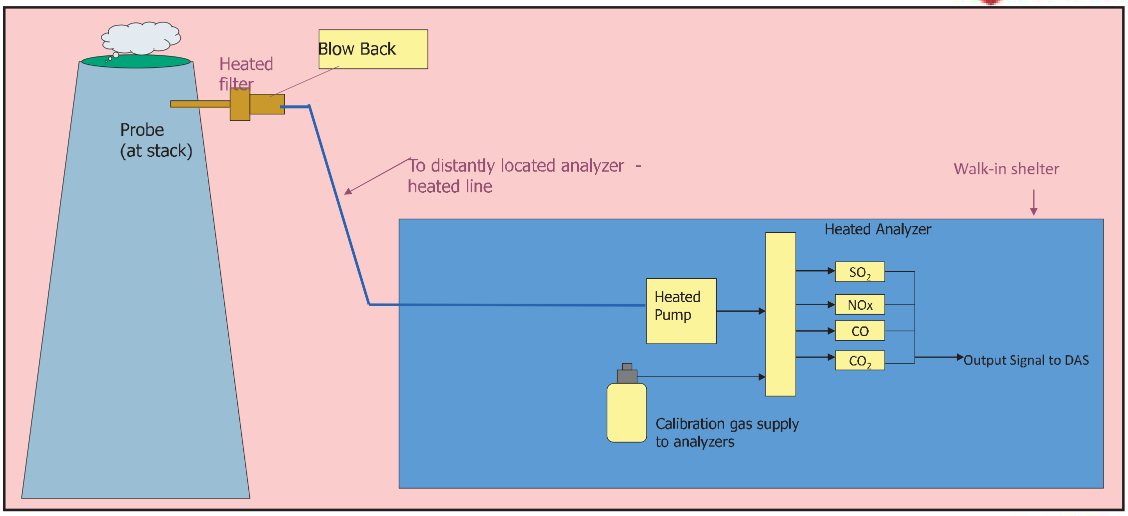
Extractive System - Cold Dry

- Proven System
- Multi-component Analyzers
- Automatic Calibration



Hot Wet

Hot Wet Extractive System



Heated Analyzer

Hot Wet - Cabinet

Easy access, only few parts to maintain

Standard System:

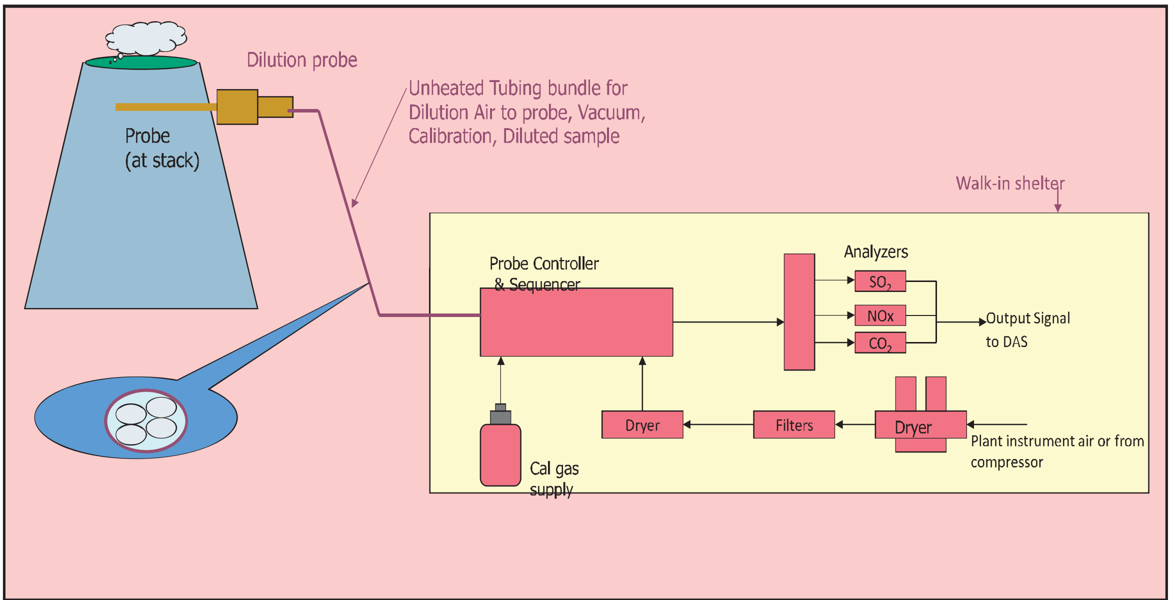
- Cabinet
  (2100 x 800 x 600 mm)
- In- /outputs
  through the top
- Heated membrane pump
- Easy installation
- Quick start-up

Advantages

- **High sample temperature**
- **Suitable for Complex gases like HCL, NH3**
- **Avoids reactions and sample losses**
- **Easy adoption to stack conditions**
- **Easy adoption to flue gas conditions**

Extractive Dilution

Dilution Extractive System



Advantages

- No Heated tube
- Suitable for Hazardous Area
- Less maintenance

27

In-situ Measuring Techniques

- Cross Duct
- Probe Type

Suitable Mainly for Acidic &

Non transportable gases

like HF, NH3, Hcl

Chemtrols

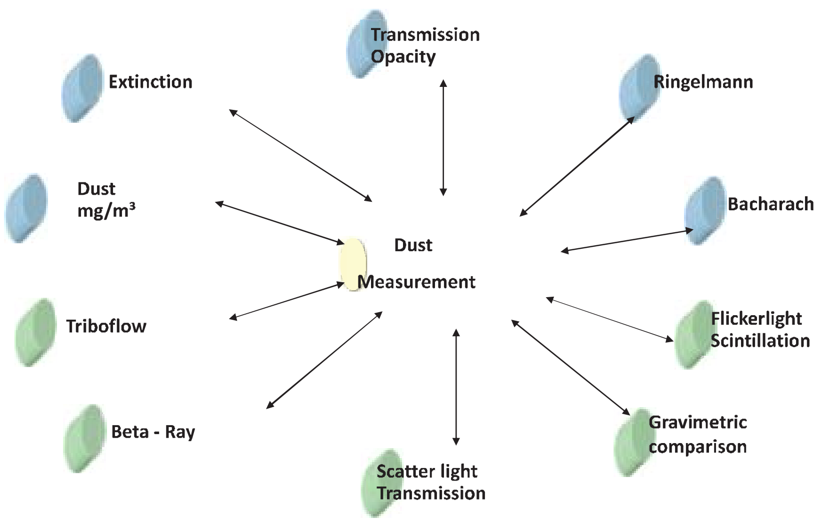
Laser Analyser - Features

- Quick Response : 1 to 5 Secs.
- Negligible Interference.
- Insitu system, Minimum Component, low maintenance.
- Excellent stability
- Single analyzer for CO + O2 Analysis.
- Special version for High temperature upto 1200°C
- Low Measuring Ranges for NH3 & HCL Possible.

ISA

Chemtrols

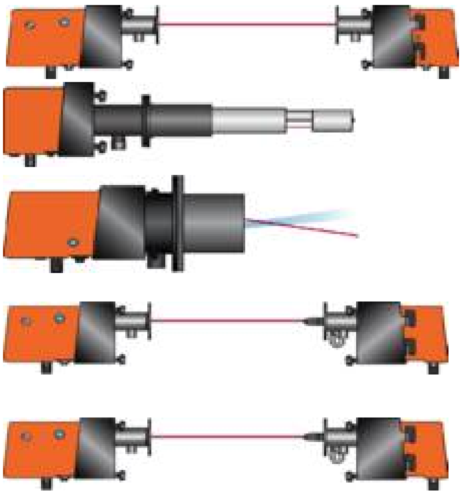
Dust - measuring principle



ISA

Emission Monitoring - DUST

Solution for Every Application



Transmission

scattered light probe

Scattered light backward

Scattered light forward

Transmission combined with scattered light forward

Technology selection of CEMS

- The choice of a suitable CEMS is never easy.
- The lowest initial investment may easily become the most expensive solution over the lifetime.
- Unfortunately, there is no general rule.
- CEMS market is heterogeneous in terms of solutions being offered.

Immission Monitoring

AAQM – Fixed Station

Parameters for as per MOEF & CPCB

- Sulfur Dioxide - SO_2
- Nitrogen Oxides - NO, NO_2, NO_x
- Carbon Monoxide - CO
- Particulate Matter - PM_{10} & $PM_{2.5}$
- Ozone - O_3
- Ammonia - NH_3
- Benzene - BTEX
- Benzo (α) Pyrene - BAP
- Lead, Arsenic, Nickel - Pb, As, Ni

Meteorological Parameters Influencing Air Pollution

- Wind Direction
- Wind Speed
- Relative Humidity
- Atmospheric Pressure
- Atmospheric Temperature
- Solar Radiation
- Rain

Approved Methods by MOEF & CPCB

POLLUTANTS	METHODS
Sulphur Dioxide	UV Fluorescence
Nitrogen Oxides / NH3	Chemi-luminescence
Ozone	UV Absorbance
Carbon Monoxide	Gas Filter Correlation
Benzene/ VOC	Gas Chromatography (PID/ FID)
Particulate Matters PM10 & PM2.5	Beta Attenuation Monitor/TEOM

Online Continuous Ambient Air Monitoring System

Fixed Station

Analysers mounted on Rack

Mobile Van

Mobile Van - Oil India Ltd

Mobile AAQM Van at TATA Steel

Inside View

- Analyser Rack

Sample Manifold

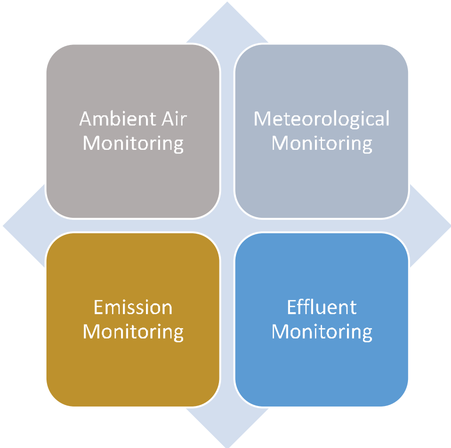
- PC based Datalogger

Mobile AAQM Van

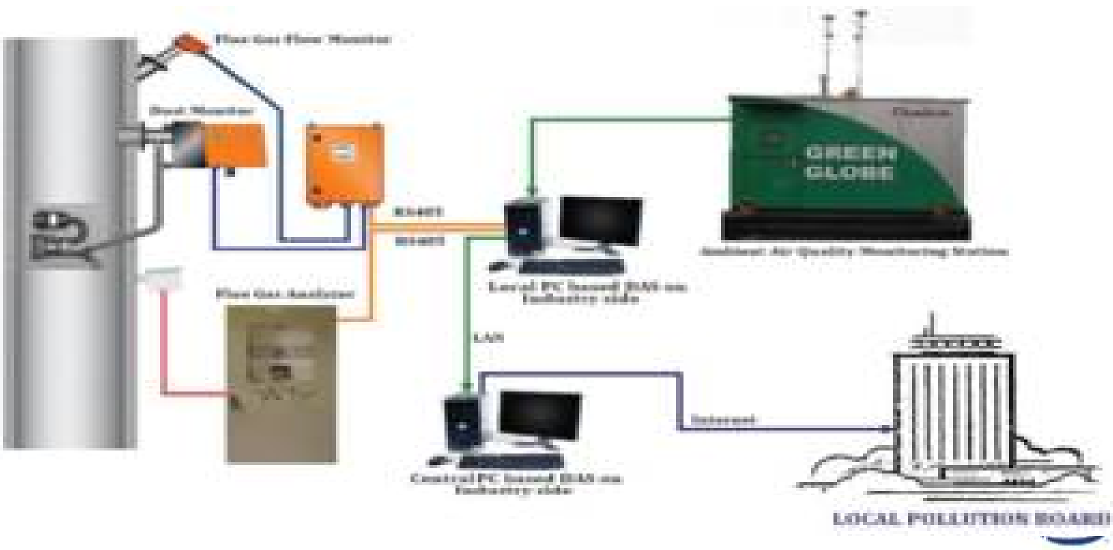
Mobile AAQM Van

Evolution of Real time Data Transfer

Data Processing & Reporting Software

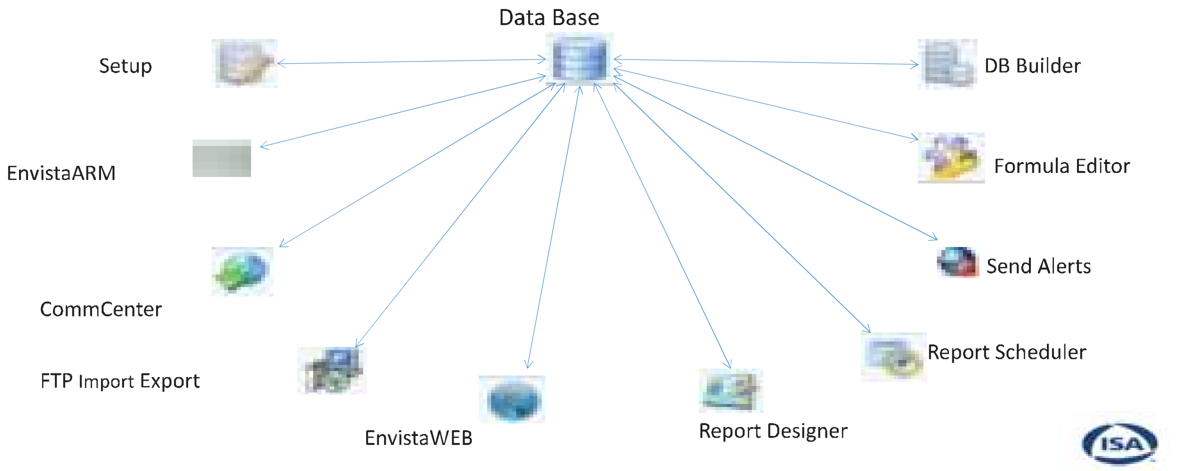


Reporting Emission data – General Layout



Software

Modular Concept



Main Features

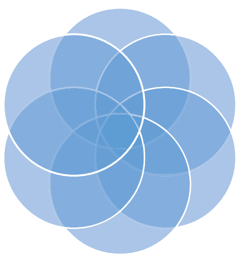
- Open System Architecture
- Designed for National / State AQM networks
- Manages upto 9999 remote stations
- Collects Data from remote stations at schedule time or upon request
- Supporting communication via TCP/IP, Cellular, Telephone, Leased Line and Radio
- Redundant System failover supported
- Automatic Data Back up
- Alert/Alarm Transmission via SMS & E mail
- GIS dynamic map (SHP Format) viewer
- Dynamic displays

Reports

User driven reports include

- Station Data Reports – Tabular and Graphical
- Period selection – Daily, Weekly, Monthly & Annual Report
- Mean Value Report
- Multi Station Report – As similar to station data report
- Monthly Matrix - Monthly Summary by hour and by Day
- 2 Y Time Plot
- XY Time Plot
- Wind & Pollution Roses
- Histogram
- Group Reports - Reflects a group of monitors related to one or more stations as set up by the user

Reports
User Driven



Reports

Operational & Information Reports

Calibration - Multi Point Calibration reports

Missing Data – Display every time a monitor have not received data

Edit History – Reports the edits that have been made to raw station data values

Station Information – Report about the measurement in each location (Station or Monitor type)

Reports

Operational & Information Reports

Status – Gives information about % of the data with various status codes

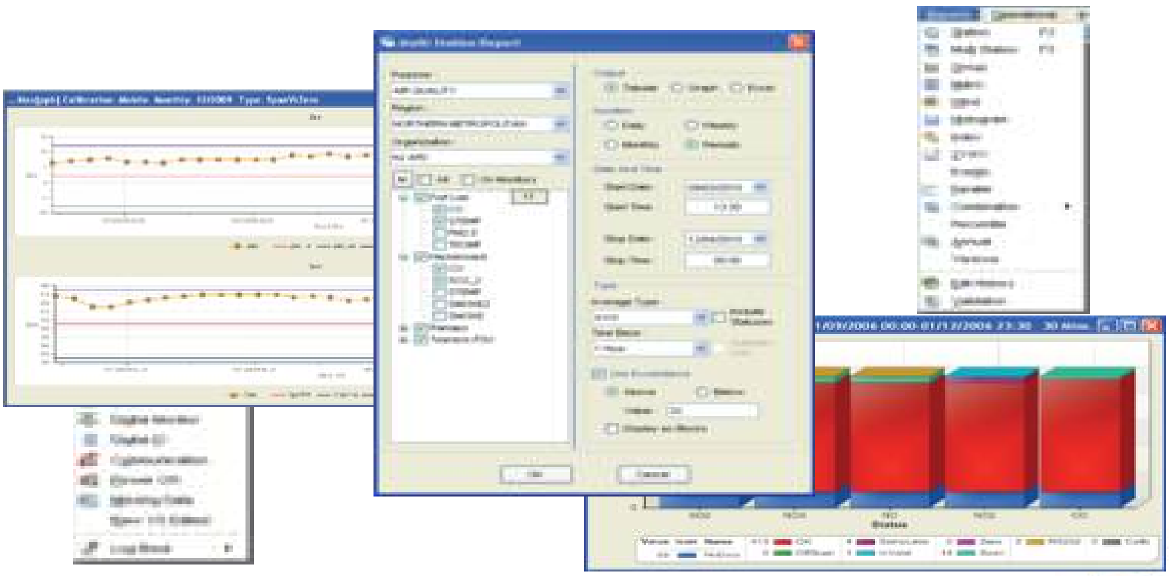
Dignostics – Diagnostic information collected from analysers

Power Off – Station Power failure report

Validity Reports – Validation performed on monitors

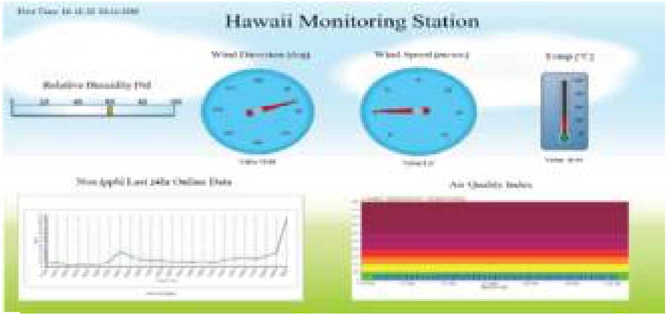
Dynamic Displays and Dash Boards

Reports



Triple-D - Dynamic Dashboard Displays

- New public and dynamic display application
- Displays graphical, textual and audio/video clips
- reflects and illustrates monitoring data from the air/stack monitoring sites.



- Available visual effects between transactions of clips
- Multi Sequences/clips

Microsoft Virtual Earth support

3D GIS Aerial Display

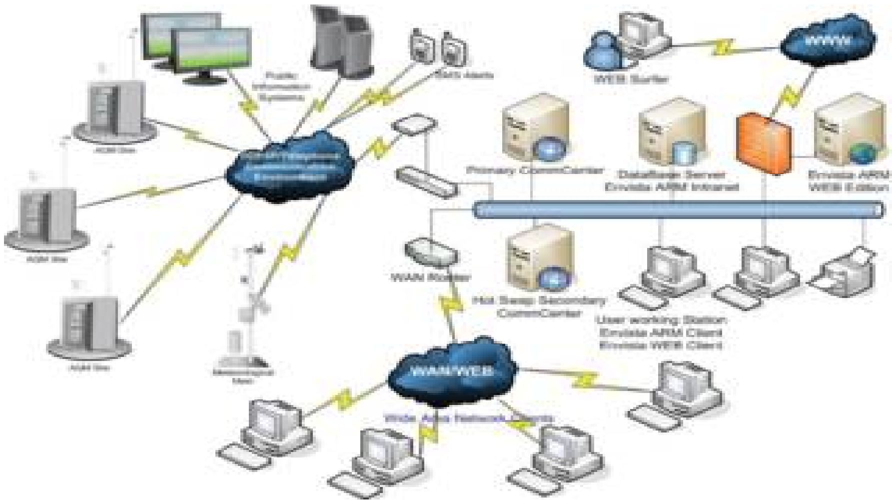
08/02/17 ISA Kolkata

Site Report

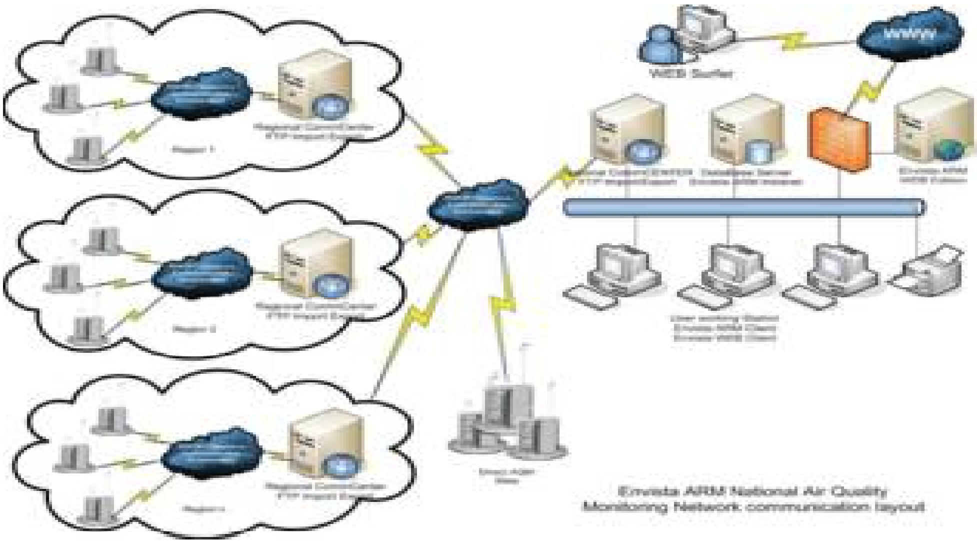
08/02/17 ISA Kolkata

Data on Mobile

Regional Network Structure



National Network Communication Layout



Mr. Pankaj Rai is the Asst. Vice President – Analytics Products for Chemtrols Industries Pvt. Ltd. He has been responsible for product management and business development of Emission and Ambient Monitoring System in India. Mr. Pankaj have over 22 years of extensive technical and marketing experience in instrumentation and environmental Industry and posses qualification in Electronics & Communication Engineering and MBA in Marketing. Experienced with various training programme by Teledyne API – USA, SICK – Germany, Chromatotec – France and Fuji – Japan, Mr. Pankaj has been working with various clients in government and private sectors as well as with various institutions across the country for their environmental and process monitoring needs.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21st April-22nd April 2017
Standards
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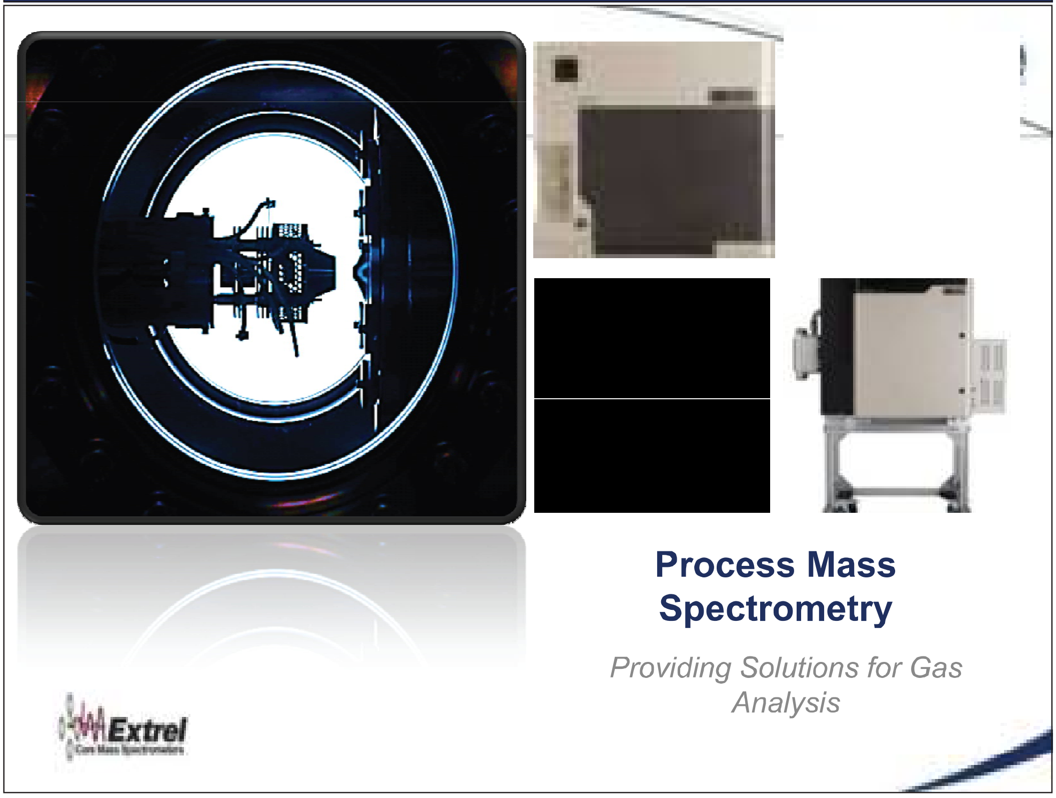
The International Society of Automation Delhi Section


Process Mass Spectrometry
Providing Solutions for Gas Analysis
Extrel

Extrel CMS, LLC

- For 50 years Extrel has supplied Quadrupole Mass Spectrometers systems and components globally.
  - Over 1300 Research Systems
  - Over 1500 Laboratory and 1000 Process Systems
- 3 Nobel Prize Recipients
  - Dudley R. Hershcbach & Yuan T. Lee received Nobel prize for Chemistry in 1985
  - Mario Molena received the Nobel Prize for Chemistry in 1995.

Spectrum Automation & Controls

Industrial Applications

- Ambient Air Monitoring
- Refinery Flare Monitoring
- Ammonia Process Control
- Methanol Process Control
- Ethylene Cracker Effluent
- Ethylene Oxide Reactor
- PE/PP Reactor
- Propane Dehydrogenator
- Hydrogen Production
- Natural Gas Analysis (BTU)
- Synthesis Gas

Spectrum Automation & Controls

Industrial Applications, Cont.

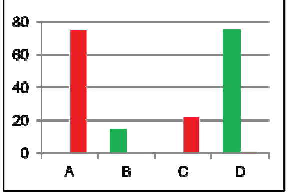
- Steel
  - Converter/BOP
  - VOD
  - Blast Furnace
  - Gas Blending
- Food and Pharmaceutical
  - Fermentation
  - Dryers
  - Solvent recovery
- Alternative Fuels
  - Corn to Ethanol
  - Coal Gasification
  - Biomass Gasification
  - Fuel Cells
  - Other Fermentation

Mass Spectrometer Advantages

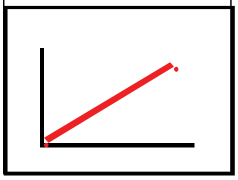
Speed of Analysis

Selectivity

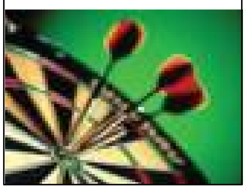
Dynamic Response



Dynamic Range



Accuracy
Precision



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Sample Requirements
Same for any Gas Analyzer

- Sample must be in the Vapor Phase
  - Non-condensing
- Sample must be free of Particulates
  - 5 micron filter
- Internal or external Stream Selection
  - Control from Data System or External Device
- Sample Pressure Range
  - 20 to 0.1PSI, 1036 to 68 torr
- Temperature
  - < 200C

Spectrum
Spectrum Automation & Controls

MAX300-IG Process Mass Spectrometer

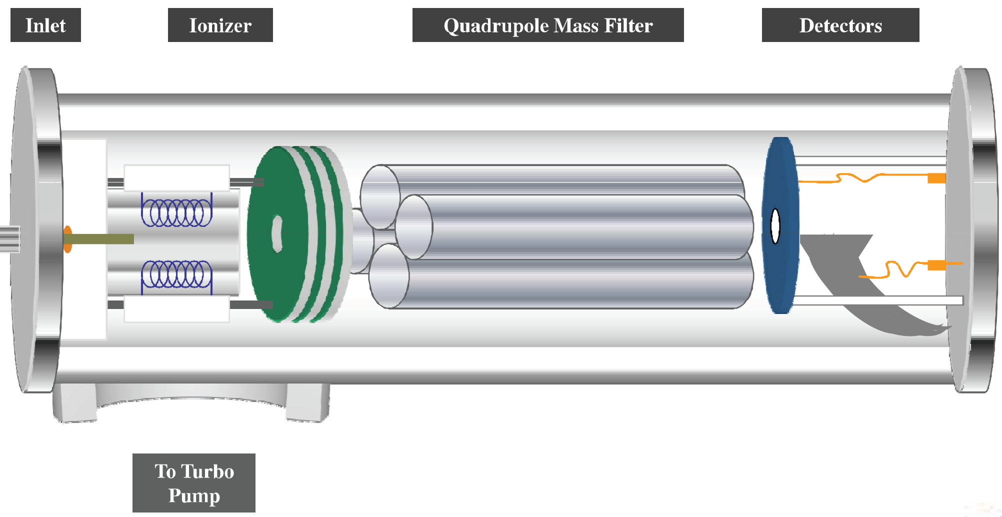
- 19 mm Quadrupole
- 1-250 amu
- Dynamic Range: 100 % down to 10 ppm Standard, 10 ppb with the electron multiplier
- Quantitative analysis performed at 0.4 seconds/ component
- Precession: ± 0.0025 on 1 % argon with no interference
- Stability: ± 0.005 over 30 days on 1 % argon

Mass Spectrometer Components

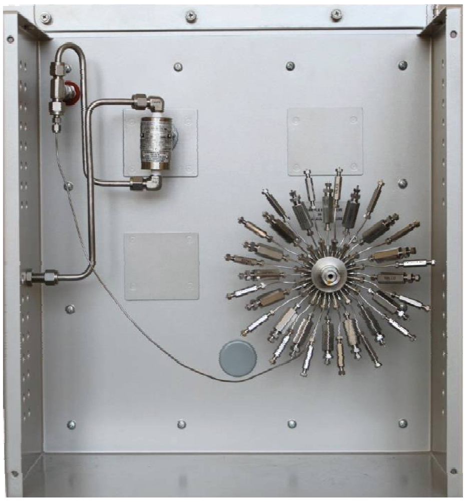
- Inlet
  - Sample Requirements
  - Stream Selection Options
  - Inlet Variations
- Ionizer
  - Electron impact (EI) Ionization
- Mass Filter
  - Quadrupole Technology
- Detector
  - Faraday Plate
  - Electron Multiplier
- Data System
  - Signal Acquisition, Processing and Display

Spectrum Automation & Controls

Mass Spectrometer Vacuum Chamber

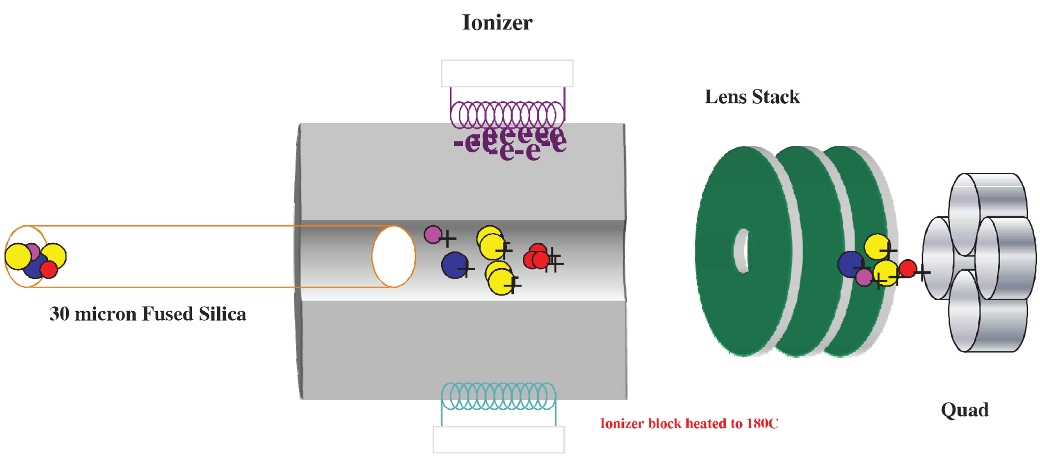


Mass Spectrometer
Inlet Configuration, 16 port Rotary Valve



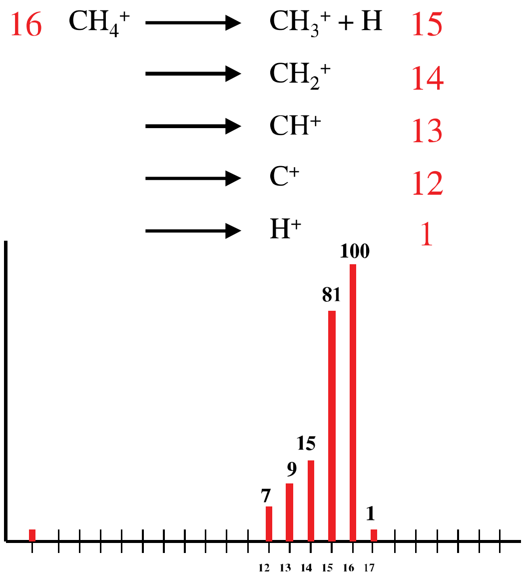
- Each port has a separate outlet
  - Cal gases can be plugged
- Mount up to 3 valves in series
- Recommended for process gases which should not be mixed due to possible reactions
  - Ammonia
  - Ethylene
  - Ethylene Oxide

A current is continuously applied to the (active) filament to heat it up and emit electrons



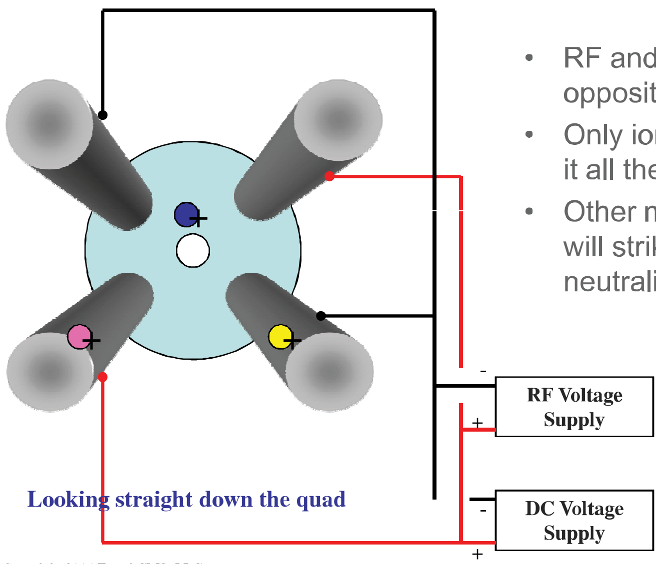
where it is bombarded by electrons to make positively charged ions

Methane Fragmentation



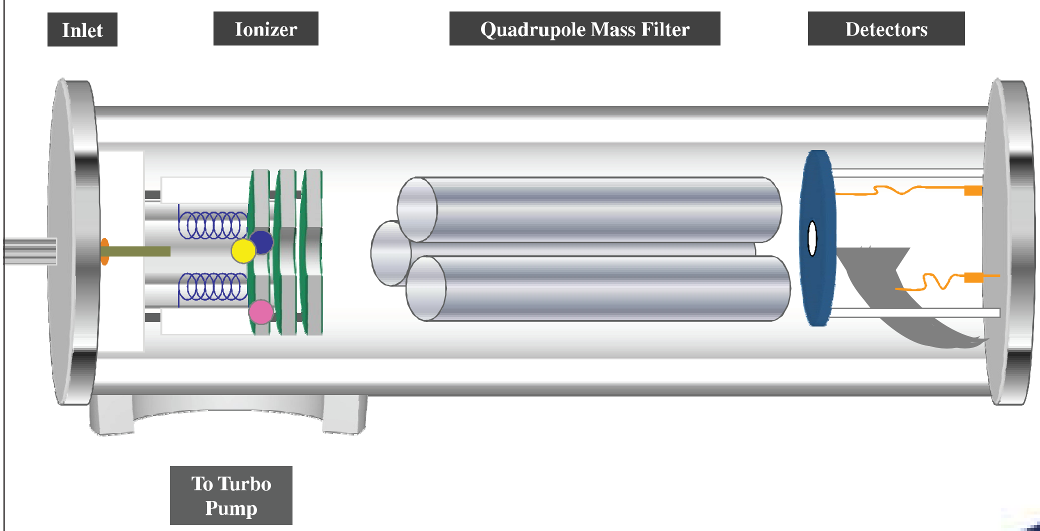
- First, Single Ionization occurs with the electron bombardment causing the CH4 to lose an electron and become CH4⁺
  - Largest peak at mass 16 (100)
- Then the electrons cause a large amount of the CH4⁺ to Fragment, losing a H and become CH3⁺
  - Mass 15 peak of (81)
- Less frequently, the electrons will cause subsequent H losses to CH2⁺,CH⁺ and C⁺ and H⁺

Mass Spectrometer Mass Filter

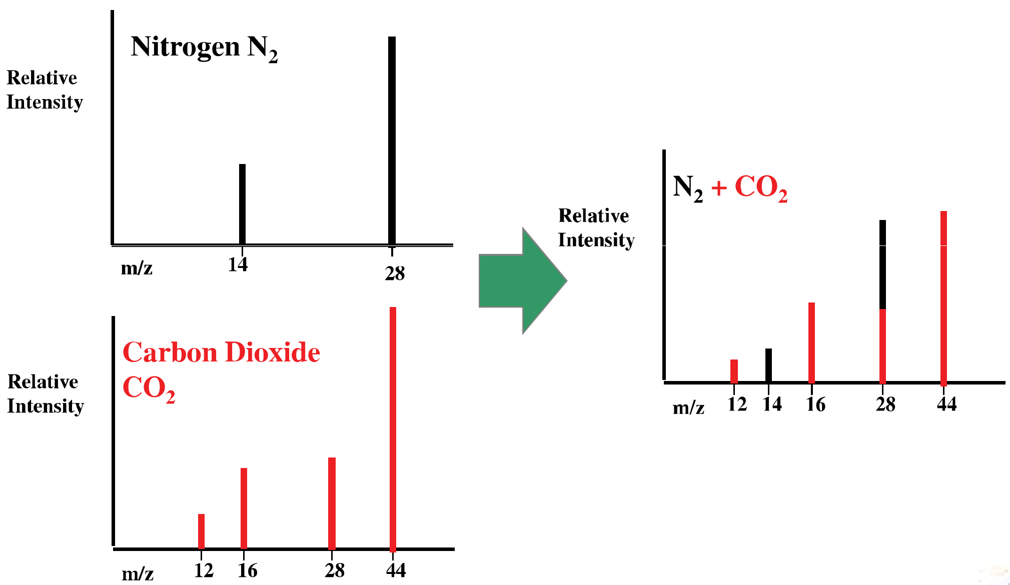


- RF and DC voltage is applied to opposite rods
- Only ions of the right mass make it all the way down the quad
- Other masses are unstable and will strike the quad and be neutralized and pumped away

Mass Spectrometer Vacuum Chamber

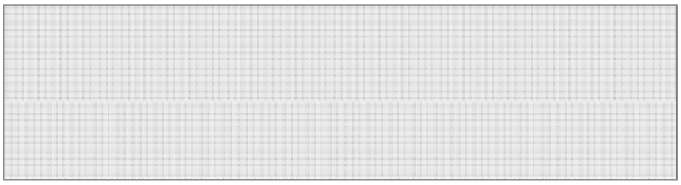


Gas Mixtures Fragmentation



Simplified Fragmentation Matrix

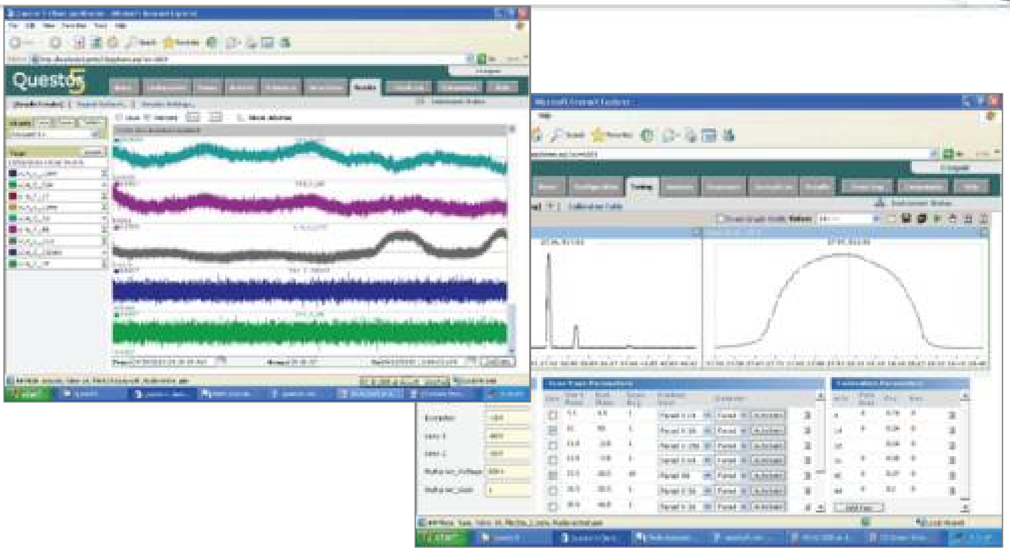
Each component's actual fragmentation pattern is measured using a binary gas mixture.



Questor™ 5 Web Based Application

- Windows® server provides control, data acquisition and data display
- Access via Internet Explorer ® web browser
  - Connection from a workstation or plant network via Ethernet
- Built in security features
  - 21 CFR 11 Compliant
  - Third Party Audited

Easy to Use Web Page Format



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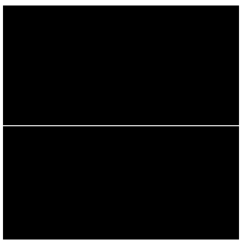
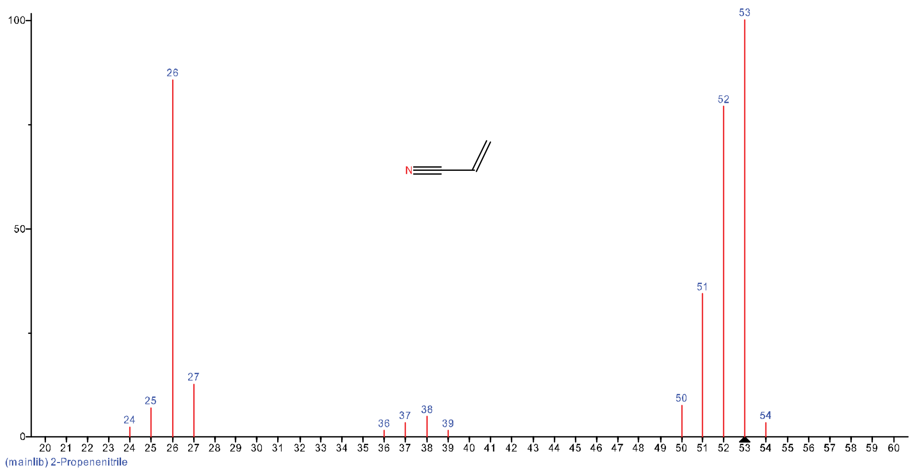


Ambient Air Monitoring

Providing Solutions for Gas Analysis

40, 80 or 160-port Analysis System

Fragmentation of Acrylonitrile

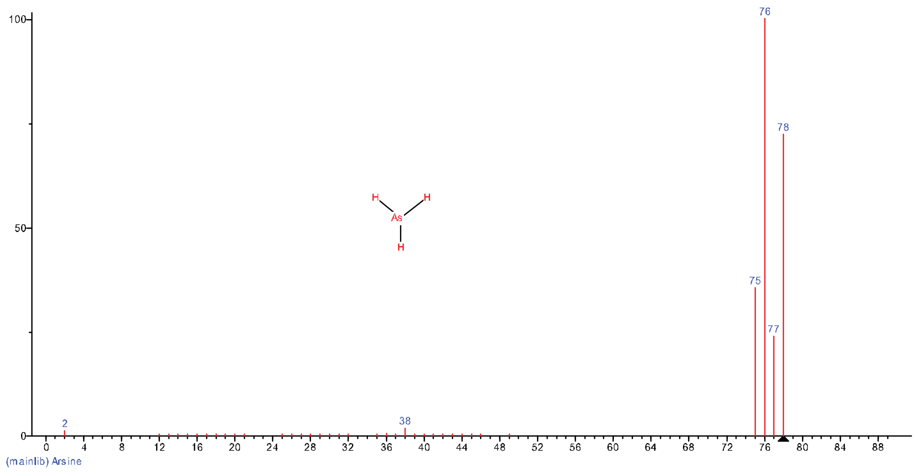


Acrylonitrile in Ambient Air

Fragment	Est. Conc.	m/z 53	m/z 28	m/z 32	m/z 44	m/z 40	m/z 18
Acrylonitrile	0.0001%	100.0	4.0				
Nitrogen	78.00%		100.0				
Oxygen	21.00%			100.0			
Carbon Dioxide	1.00%		11.0		100.0		
Argon	0.93%					100.0	
Water	5.00%						100.0

Measurement	Est. Conc.	Sens.	Det Mass	RIF	RSD(F)	RSD(M)
Acrylonitrile	0.0001%	1.000	53	< 0.01		1.291
Nitrogen	78.00%	1.000	28	< 0.01	0.03	
Oxygen	21.00%	0.980	32	< 0.01	0.07	
Carbon Dioxide	1.00%	1.860	44	< 0.01	0.22	
Argon	0.93%	1.500	40	< 0.01	0.26	
Water	5.00%	0.800	18	< 0.01	0.15	

Fragmentation of Arsine



Arsine in Nitrogen

Fragment	Est Conc	m/z 28	m/z 76
NITROGEN	99.90%	100	
ARSINE	0.0011%		100

Measurement	Est Conc	Sens.	Det Mass	RIF	RSD(F)	RSD(M)
NITROGEN	99.90%	1	28	< 0.01	0.0306	
ARSINE	0.0001%	1	76	< 0.01		4.0825

Repeatability 40 PPB+/- 1.9 PPB
Detection Limit 1 PPB

Benzene, Toluene and Xylenes (BTX)

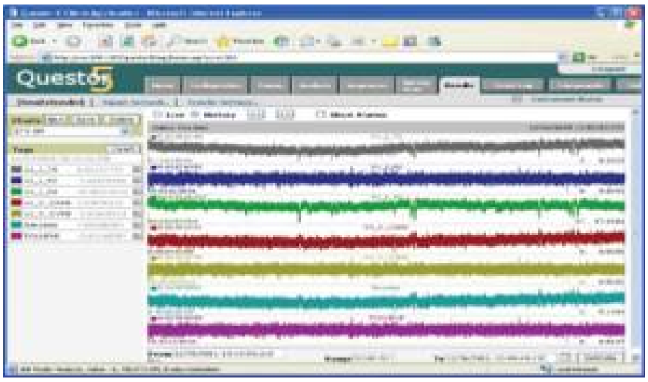
Fragmentn	Est Conc	m/z 28	m/z 32	m/z 40	m/z 18	m/z 78	m/z 91	m/z 106
NITROGEN	78.08%	100						
OXYGEN	20.94%		100					
ARGON	0.93%			100				
WATER	5%				100			
BENZENE	0.0003%	2				100		
TOLUENE	0.0003%	1		1			100	
O-XYLENE	0.0003%	0.3		2.2		8.4	100	39.8

Measurement	Est Conc	Sens.	Det Mass	RIF	RSD(F)	RSD(M)
NITROGEN	78.08%	1	28	< 0.01	0.0347	
OXYGEN	20.94%	0.98	32	< 0.01	0.0676	
ARGON	0.93%	1.5	40	< 0.01	0.2592	
WATER	5%	0.8	18	< 0.01	0.1531	
BENZENE	0.0003%	2	78	0.84		3.9158
TOLUENE	0.0003%	2	91	10.00		9.5743
O-XYLENE	0.0003%	2	106	< 0.01		1.447

Benzene, Toluene and Xylenes (BTX)

Data Collection: 33 hours

- Toluene at 3.94 ppb
- Benzene in air at 5ppm
  - repeatability of 4.6 ppb
- LDL = 3*STD= ~10 ppb



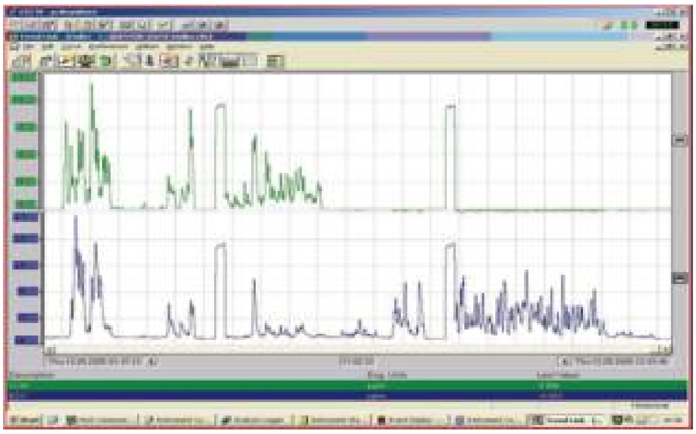
Ethylene dichloride (EDC) and Vinyl Chloride Monomer (VCM)

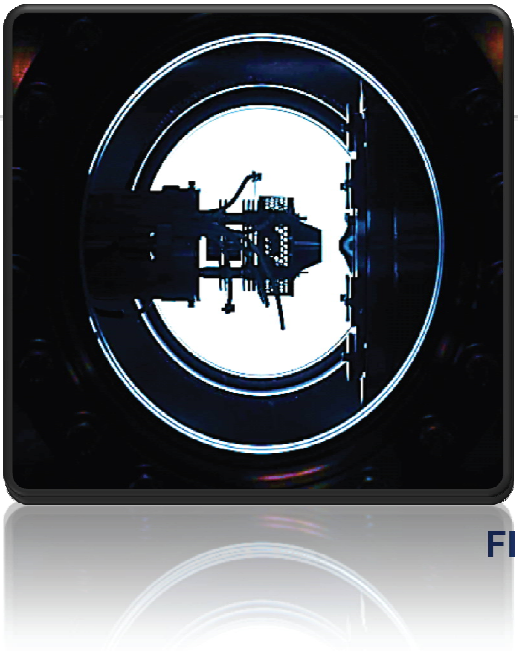
Fragment	Est Conc	m/z 28	m/z 32	m/z 40	m/z 18	m/z 62	m/z 49
NITROGEN	78.08%	100					
OXYGEN	20.94%		100				
ARGON	0.93%			100			
WATER	5%				100		
VINYL CHLORIDE	0.0001%	1				100	1
1 2-DICHLOROETHANE	0.0001%	5	0.79			100	50

Measurement	Est Conc	Sens.	Det Mass	RIF	RSD(F)	RSD(M)
NITROGEN	78.08%	1	28	< 0.01	0.0347	
OXYGEN	20.94%	0.98	32	< 0.01	0.0676	
ARGON	0.93%	1.5	40	< 0.01	0.2592	
WATER	5%	0.8	18	< 0.01	0.1531	
VINYL CHLORIDE	0.0001%	2	62	1.00		1.291
1 2-DICHLOROETHANE	0.0001%	2	49	0.02		1.3038

Ethylene dichloride (EDC) and Vinyl Chloride Monomer (VCM)

- VCM and EDC outbreaks in 0 to 20 ppm level
- EDC at 3ppm +- 30 ppb
- VCM at 6ppm +- 90ppb





Flare Gas Analysis

Providing Solutions for Gas Analysis

Extrel

40 CFR PART 60 SUBPART Ja

- 60.100a Applicability
  - Affected Facilities in Petroleum Refineries
    - Fluid Catalytic Cracking Units (FCCU)
    - Fluid Coking Units (FCU)
    - Delayed Coking Units
    - Fuel Gas Combustion Devices (Flares)
    - Sulfur Recovery Plants

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40 CFR PART 60 SUBPART Ja
Fuel Gas Combustion Devices (Flares)

60.102a Emissions Limitation

- Each owner or operator of an affected fuel gas combustion device shall comply with emission limits
  - SO2 in excess of 20ppmv determined hourly on a 3 hour rolling average and SO2 in excess of 8ppmv on a 365 daily rolling average

  OR
  - H2S in excess of 162ppmv hourly on a 3 hour rolling average and H2S in excess of 60ppmv on a daily on a 365 daily rolling average
  - Span 0 to 300ppmv

  AND
  - BTU for allowable Emission Rate

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40 CFR PART 60 SUBPART Ja
Fuel Gas Combustion Devices (Flares)

60.103a Design, equipment, work practice or operational standards

- Each owner or operator of an affected flare that is subject to this subpart shall develop and implement a written flare management plan
  - List of all refinery units
  - Assessment of whether discharges affect flares from these process units.
  - Description of each affected flare
  - Evaluation of baseline flow
  - Procedure to minimize or elimination gas discharge to the flare
  - Procedure to reduce flaring due to imbalance
  - Procedure to minimize the frequency and duration of outages of the flare gas recovery system

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40 CFR PART 60 SUBPART Ja
Fuel Gas Combustion Devices (Flares)

- 60.107a Monitoring of Emissions
  - Each owner or operator shall install, operate, calibrate and maintain an instrument for continuously monitoring and recording concentrations of total reduced sulfur in the gas discharge to the flare.
  - Accurately measure concentration of H_2S between 20 to 300ppmv
  - Span value should be based upon the maximum sulfur content of the gas that can be discharged to the flare (1.1 to 1.3 times maximum), but may be no less than 5,000ppmv

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40 CFR PART 60 SUBPART Ja
Fuel Gas Combustion Devices (Flares)

- 60.108a Record Keeping
  - Each owner or operator subject to an emissions limitation shall notify the administration of the specific monitoring provisions the owner or operator intends to comply.
  - Record of discharges greater than 500 lbs. in any 24hr period
  - The date and time the discharge was first identified and the duration
  - Measured or calculated cumulative quantity of gas discharged
  - For discharges greater than 500 lbs. in any 24hr period, the measured total sulfur or measured H2S and estimated total sulfur
  - Steps that the owner or operator took to limit discharge
  - Root cause analysis and corrective actions required

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Fuel Gas Combustion Devices (Flares)

- Gas released as a waste product from the petroleum and other industry
  - Flare gas is a process waste stream which has traditionally been used to incinerate normal process off gas and as an outlet for a process during startup, shutdown and upset conditions.
  - Due to the remote location of many oil fields, either at sea or on land, this gas is simply burnt off in gas flares.
- Flare gas is controversial as it is a pollutant, a source of global warming and is a waste of a valuable fuel source.
  - Process gas is flared in many countries where there are significant power shortages.
- With increasing focus and regulation on green house gases the current objective is to measure BTU and total sulfur compounds.
  - The challenge is to measure normal operating conditions and during upset conditions.

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Fuel Gas Combustion Devices Flare Example

Table 1 Examples of Flare Waste Gas Compositions-Constituents of Interest and Variability

	Flare 1		Flare 2		Flare 3	
Component	mole %	mole %	mole %	mole %	mole%	mole%
Hydrogen	86.18	48.77	0.02	0.04	37.11	0.00
Methane	5.93	3.52	86.22	47.09	14.73	0.70
Ethane	0.81	0.26	1.06	0.41	0.44	0.21
Ethylene	0.02	0.01	0.13	0.22	0.18	16.37
Propane	0.34	0.14	0.10	43.30	0.07	0.89
Propylene	0.00	0.01	0.01	0.23	0.12	24.29
N-Butane	0.11	0.05	0.02	0.21	0.35	0.03
i-Butane	0.11	0.06	0.03	0.05	0.02	0.00
Cis, 2-Butylene	0.16	0.06	ND	ND	0.24	0.01
Trans, 2-Butylene	0.17	0.06	ND	ND	0.26	0.00
Isobutylene	0.12	ND	ND	ND	0.21	
1,3-Butadiene	ND	ND	ND	ND	0.74	0.01
N-Pentane	0.03	0.08	0.02	ND		
i-Pentane	0.05	0.05	0.03	ND		
Pentenes	ND	ND	ND	ND		
C_6^+	0.01	0.01	ND	ND		
CO	0.02	0.04	ND	ND	{	{
N2	4.99	45.80	0.38	1.69	31.01	50.40
O2					}	}
CO_2	0.06	0.04	1.11	0.07	0.15	
Hydrogen Sulfide	0.24	0.35	0.00	0.00		0.03
Water Vapor	0.68	0.70	0.73	0.87		
Totals	100.02	100.00	89.86	94.18	85.63	92.94

40 CFR PART 60 SUBPART Ja
Fuel Gas Combustion Devices (Flares)

- Mass Spectrometer measurement strategy
- Measure
  - Hydrocarbons: Methane, Ethane, Propane, Iso-Butane, N-Butane, C5+
  - Sulfur Compounds: H2S, COS, CS, Methyl and Ethyl Mercaptan
- Reporting
  - Total Sulfur (summary)
  - BTU (calculated)
  - Individual compounds for Root Cause analysis

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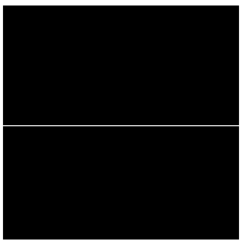
Flare Gas Fragmentation Matrix

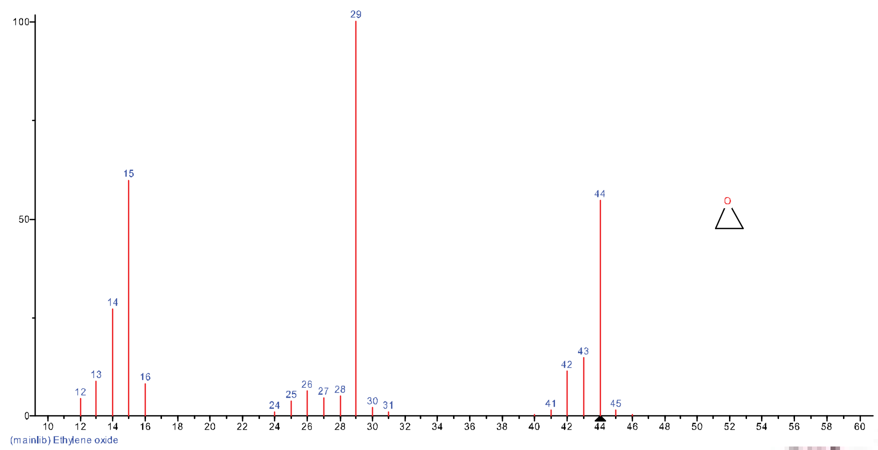
Name	m/z 2	m/z 12	m/z 16	m/z 17	m/z 18	m/z 26	m/z 27	m/z 28	m/z 29	m/z 30	m/z 32	m/z 34	m/z 38	m/z 41	m/z 43	m/z 44	m/z 47	m/z 54	m/z 56	m/z 57	m/z 60	m/z 62	m/z 76
Hydrogen	100.0																						
Carbon Monoxide		2.7	4.4	0.1				100.0	1.1	0.2													
Methane	0.5	6.6	100.0	1.0				0.1	0.4														
Ammonia			80.0	100.0																			
Water			1.0	20.0	100.0																		
Acetylene						100.0	1.1																
Ethylene		1.0	3.0			62.0	65.0	100.0	1.0														
Nitrogen							0.1	100.0	0.8	0.0													
Propane	0.8		0.1			9.0	40.0	59.0	100.0	2.0			4.0	12.0	24.0	30.0							
Ethane	1.2	0.9	0.1			25.8	36.2	100.0	21.2	23.2													
Oxygen			10.0								100.0	0.4											
Hydrogen Sulfide											44.0	100.0											
Propylene		1.0				12.0	41.0	1.0					19.0	100.0	2.0								
N-Butane	0.6	0.3	0.2			8.9	42.0	33.8	44.2	0.9				31.7	100.0	3.3		0.2	0.8	2.7			
N-Pentane		1.0	1.0			5.0	40.0	10.0	25.0					45.0	100.0	1.0		1.0	1.0	10.0		1.0	
Carbon Dioxide		3.8	10.0					11.0	0.1							100.0							
Methanethiol (Methyl Mercaptan)		1.0									3.0					6.0	100.0						
1-3-Butadiene						10.0	35.0	20.0					4.0					100.0					
1-Butene						9.0	32.0	28.0	13.0				3.0	100.0				1.0	40.0				
Hexane						1.0	25.0		35.0					60.0	70.0	1.0			55.0	100.0			
Carbonyl Sulfide			1.0					13.0			60.0	2.4				8.0					100.0	4.0	
Ethyl Mercaptan		0.8	0.8			17.3	66.8	51.0	84.5	2.0	6.4	21.2				5.1	76.9		1.1	6.0	1.2	100.0	
Carbon Disulfide											22.0	1.0				18.0							100.0



MAX300-IG ™ for Process Control in Ethylene Oxide Production

Providing Solutions for Gas Analysis

Ethylene Oxide Fragmentation



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Ethylene Oxide Production Objectives

- Maximizing production
  - In order to optimize product yield they must be able to tightly control process parameters such as carbon and oxygen balances and conversion rate
    - Tight control allows them to **SAFELY** run closer to optimum reaction set points
- Controlling the catalyst
  - Want to measure ppm level of chlorinated inhibitors used to control catalyst activity

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Ethylene Oxide Production Process Control

- Nitrogen Ballast
  - Nitrogen is the balance gas in the process streams
  - Utilized during startup and shutdown
- Methane Ballast
  - Methane is the balance gas in the process streams
  - Typical operational mode
  - Achieves higher yield

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Ethylene Oxide Production Process Control

- A 100 ppm deviation in the analysis of a component causes a large deviation in the calculations of the control parameters.
  - depending on the algorithms the balances deviation can be as large as a 0.8
- The desired repeatability of the carbon and oxygen balances is 2%
  - Reactor Inlet
    - Reactor inlet is a combination of a "fresh" feed stream and a recycle stream
  - Multiple Reactor Effluents
    - Outlet streams contain the EO product
  - Absorber Overhead
    - Optional measurement

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Ethylene Oxide Production
Reactor Inlet and Outlet

Component	Reactor Inlet	Reactor Outlet
Oxygen	8.00%	6.00%
Ethylene Oxide	100ppm	2.20%
Water	25.00%	75.00%
Carbon Dioxide	4.00%	5.00%
Nitrogen	2.00%	2.00%
Argon	6.00%	6.00%
Methane	50.00%	50.00%
Ethane	0.50%	50.00%
Ethylene Oxide	30.00%	28.00%
1,2 Dichloroethane	2ppm	
Vinyl Chloride	2ppm	
Ethyl Chloride	0.10ppm	

Control Parameters

- Carbon Balance
- Oxygen Balance
- Conversion Rate
- Carbon Efficiency
- Oxygen Efficiency

Ethylene Oxide Production
Reactor Inlet (Methane Ballast)

Component	Concentration	Mass	%RSD	Std Dev
Oxygen	8.00%	32	0.11	0.0088
Ethylene Oxide	100ppm	42	8.02	0.0008
Water	0.25%	18	0.67	
Carbon Dioxide	4.00%	44	0.11	0.0044
Nitrogen	2.00%	28	0.87	
Argon	6.00%	40	0.10	
Methane	50.00%	15	0.06	
Ethane	50.00%	30	0.88	0.03
Ethylene Oxide	30.00%	26	0.10	
1,2 Dichloroethane	2ppm	49	2.88	
Vinyl Chloride	2ppm	62	4.90	
Ethyl Chloride	0.1ppm	64	29.40	

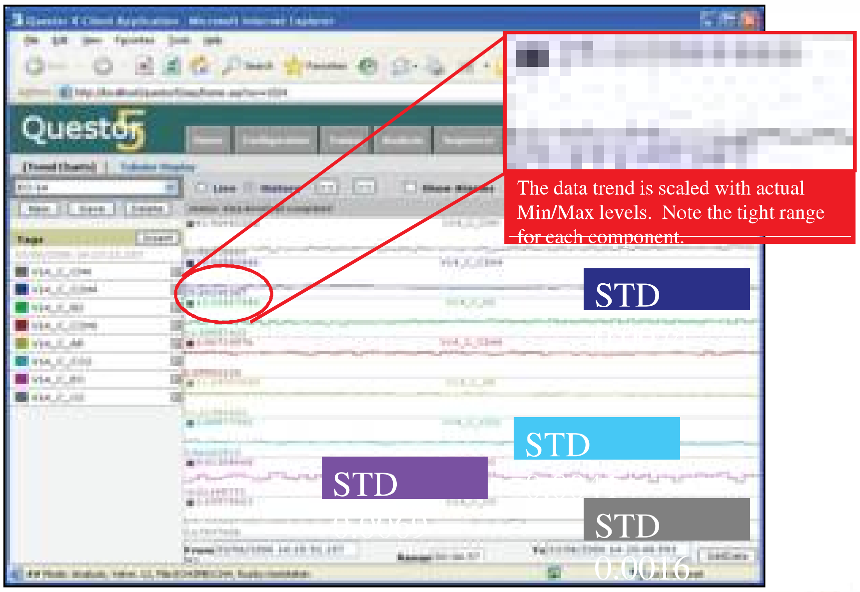
Standard deviation is better than 100 ppm

Ethylene Oxide Production
Reactor Outlet (Methane Ballast)

Component	Concentration	Mass	%RSD	Std Dev
Oxygen	6.00%	32	0.12	0.0072
Ethylene Oxide	2.20%	42	0.54	0.006
Water	75.00%	18	0.38	
Carbon Dioxide	5.00%	44	0.11	0.0055
Nitrogen	2.00%	28	0.84	
Argon	6.00%	40	0.10	
Methane	50.00%	15	0.06	
Ethane	50.00%	30	0.96	0.028
Ethylene Oxide	28.00%	26	0.10	

Standard deviation is better than 100 ppm

Ethylene Oxide Production
Reactor Inlet Process Data



Mass Spectrometer
Precision and Accuracy

- Precision or repeatability is a function of the component and the stream composition
  – Repeatability allows the operator to run closer to the optimum set points and increase the yield

- MAX300-IG meets or exceeds the repeatability for the major components of O_2, CO_2, EO and Ethylene

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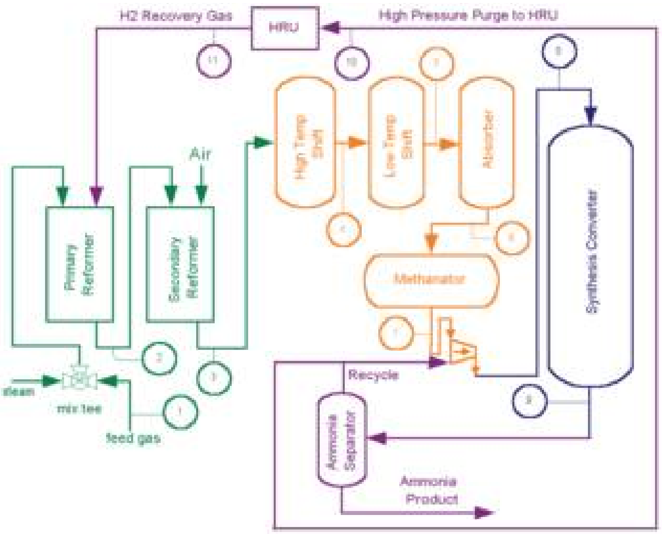
MAX300-IG ™ for Process Control in Ammonia Production

Providing Solutions for Gas Analysis

Ammonia is made in a multistage process based on steam methane reforming of a natural gas feed



Some plants are designed to use alternative feed stocks such as petroleum feedstock

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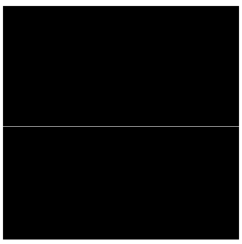

Polypropylene/Polyethylene Analysis

Providing Solutions for Gas Analysis

Polypropylene/Polyethylene Market

Thermoplastic is available in a range of flexibilities and other properties depending on the production process, with high density materials being the most rigid.

- Polyethylene (PE)
  - Polyethylene can be formed by a wide variety of thermoplastic processing methods and is particularly useful where moisture resistance and low cost are required.
  - Primary use are in films, packaging, bags, piping, containers, food packaging, laminates, liners, wire & cable applications, ...
  - The annual global production is approximately 80 million tones.
- Polypropylene (PP),
  - Polypropylene is one of those most versatile polymers available with applications, both as a plastic and as a fiber.
  - Primary use are in automotive applications , household goods, containers, appliances, film, packaging, electrical/electronic applications, general purpose, automotive interior parts, industrial applications, ...
  - The annual global market for polypropylene had a volume of 45.1 million tons.

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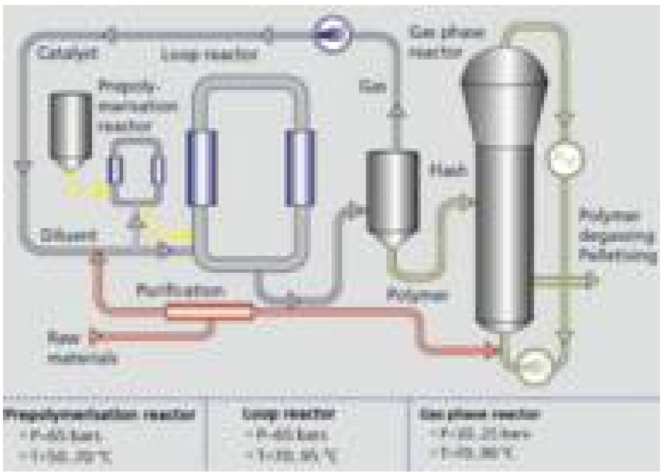
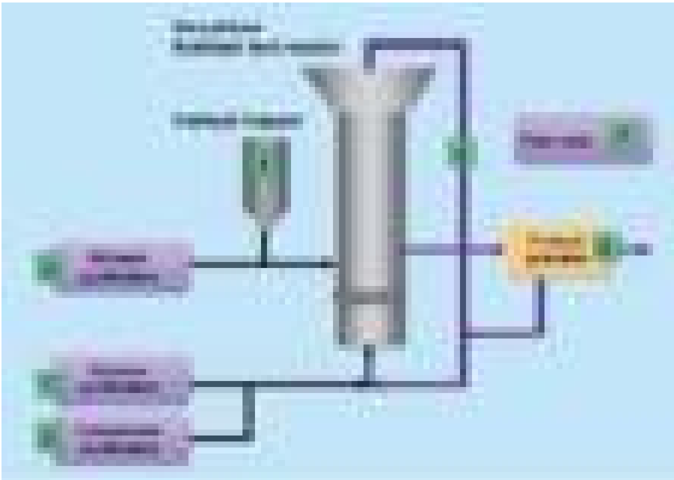
Polypropylene/Polyethylene Loop Reactor



Polypropylene/Polyethylene Fluid Bed Reactor



Polyethylene Measurement Points

Sampling point	Sampling stream	Component Meas. Range
1 Ethylene purification	CO	0 – 2 ppm
	CO2	0 – 2 ppm
	Methanol	0 – 10 ppm
	Acetylene	0 – 5 ppm
	Total Sulfur	0 – 2 ppm
	Ethane	0 - 400 ppm
	Moisture	0 – 5 ppm
	Oxygen	0 – 2 ppm
2 Comonomer purification	Moisture	0 - 100 ppm
3 Nitrogen purification	Moisture	0 – 10 ppm
	Oxygen	0 – 10 ppm
4 Catalyst feed	Oxygen	0 - 10%
5 Cycle gas	Nitrogen	0 - 100%
	Hydrogen	0 - 50%
	Carbon Monoxide	0 – 10 ppm
	Methane	0 - 10%
	Ethane	0 - 20%
	Ethylene	0 - 100%
	N-Butane	0 - 5%
	ISO-Butane	0 - 5%
	1-Butene	0 - 25%
	Trans-2-Butene	0 - 1%
	ISO-Butene	0 - 5%
	CIS-2-Butene	0 - 2%
	Hexane	0 - 10%
	1-Hexene	0 - 20%
	C6 plus	0 - 10%

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Product Transitions Speed of Analysis

- Each plant must change the materials inside the reactor to alter the type of product being output
- During transitions in product Formulation
  - Raw materials mix with the reactor
  - Risk of fouling
  - Out-of-spec Product is produced
    - This product has to be stored and blended
    - Sold as off specification or not be sold

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Polyethylene Analysis

Name	Est. Conc	Sens.	Det. Mass	RIF	RSD(F)
HYDROGEN	0.0.1%	0.25	2	5.60	4.87
NITROGEN	60%	1	28	0.44	0.05
ETHYLENE	10%	1	26	0.74	0.18
ETHANE	10%	1	30	0.09	0.21
PROPANE	1%	1	29	0.37	0.11
1-BUTENE	1%	1	56	2.01	0.82
ISO-BUTANE	1%	2	43	2.59	0.4
N-PENTANE	1%	2	57	0.86	0.91
1-HEXENE	0.50%	1	84	0.33	0.87
1-OCTENE	0.50%	1	70	0.09	0.61

Analysis Methods
GC and MS Response

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Several other applications

- Dehydrogenation Propylene
- Ethylene production
- Fermentation
- Gas Quality monitoring
- Gasification
- Hydrogen production
- Methanol production
- Solvent drying
- Reaction monitoring
- & many more…..

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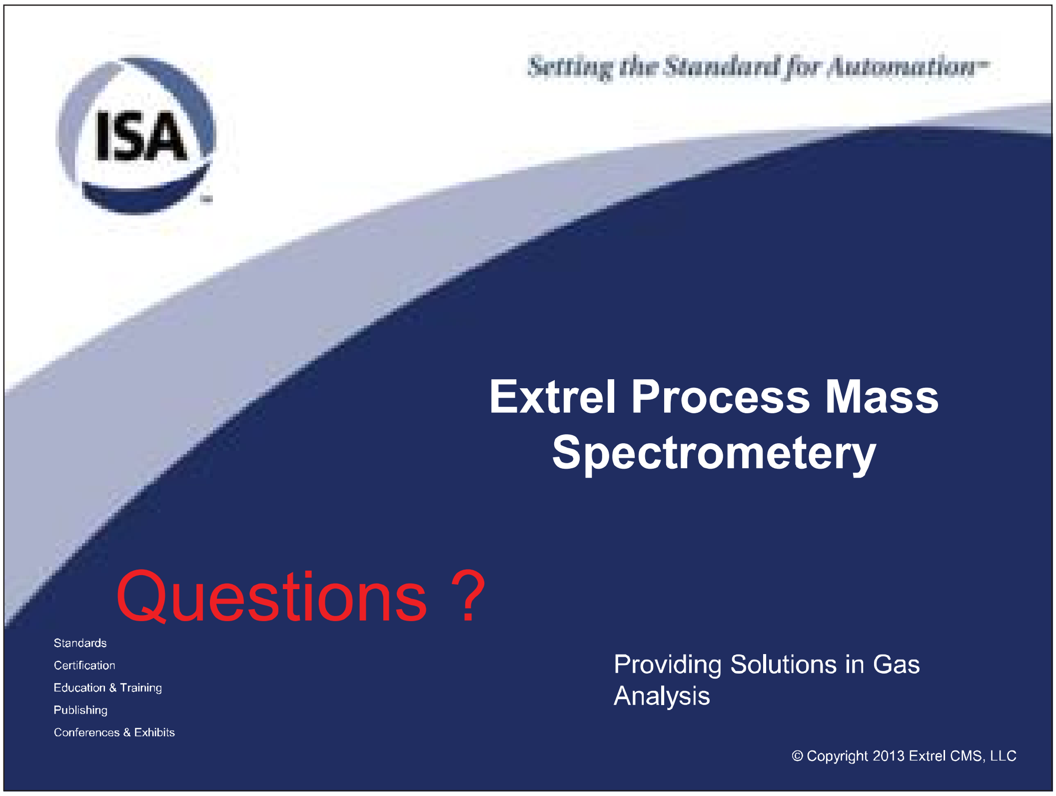
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UNIFIED HMI

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ABSTRACT

Packaging concept in a coal fired power plant has many advantages; the first & foremost being that of cost. But needless to say, one of the de-merits is the plethora of control system (DCS & PLC) & consequently the variety in HMI. Uniformity of the front end to the process being controlled has always been the wish list of the end user i.e. the operator, being oblivious to the underlying dynamics of the control platform. One of the traditional & very obvious approach of achieving this is to go for a total turnkey package, with a single DCS for the main plant.

This paper presents the concept of Unified HMI through DCS inter-operability, a technology alternative to achieving the same through total turnkey packaging. In this concept, the drives of one DCS is operated by the HMI of another DCS, leading to a single unified HMI for the control room. The design considerations in evolving this concept has been described along with details of implementation in intra package and inter package scenarios.

KEYWORDS

Unified HMI, Distributed Control system (DCS), OPC, Modbus, Response time, Inter- operability

1.0. INTRODUCTION:

Ever since the introduction of Distributed Control Systems (DCS), the operator interface to the process had undergone a sea change; from push button stations to CRT to latest state of the art workstations & large video screens (LVS). Today, fast Operating systems, both for the control system as well as for Human Machine Interface (HMI) .The communication network between the control system and HMI was also proprietary, requiring system specific interfacing hardware and software. Now with systems based on open navigation, trends, LVS based annunciation provide the operator all tools for effective operation.

The DCS/PLC based systems of early 90's eras were based on proprietary architecture & commercial off the shelf (COTS) hardware, the capabilities of the HMI have increased many fold; so are the demands from these systems. Availability of process data from open architecture systems & the portability of the same to third party software through