Introduction to CEMS

By
Ty Smith

Engineered technical solution to meet every need...

CEMTEK Group
Cemtek Systems
Cemtek KVB-Enertec
Cemtek Instruments
www.cemteks.com
• Cemtek recently acquired B&W CEMS division called KVB-Enertec. Now the largest CEMS integrator in the US
• New company is Cemtek KVB-Enertec.
  • 40 years in business (KVB)
  • Main Focus is on gas monitoring
  • Leader in Power, Refineries, Chemical, Cement, Glass, Steel, Industrial applications etc.
  • Ambient monitoring stations
  • EPA Compliance & Process Monitoring
WHAT ARE CEMS

CONTINUOUS EMISSIONS MONITORING SYSTEMS

• An integrated system comprised of sample extraction, sample conditioning, gas analyzers, cabinet or shelter & data acquisition engineered to meet a specific rule requirement or process monitoring need.

• In short a pump draws gas out of the sample point, analyzes it and sends the data to a computer or control device.

• Sometimes add on equipment required like opacity, flow, particulate (PM), moisture, temperature & pressure monitors are required.

• The air permit or in some case a consent decree determines the need for a compliance CEMS.

• The process determines the type of CEMS & instrumentation.
Typical System Integrator Scope

- Sample extraction (sample probe)
- Sample transport (sample line), pumps, heaters
- Sample conditioning, filters, scrubbers, chillers
- Gas Analyzers: NOx, NO2, CO, CO2, O2, SO2, HCl, NH3, H2, CH4, HCN, THC, Cl2, H2S etc.
- Calibration Equipment (Daily & CGA QA/QC) Valves, regulators.
- System control (PLC) or Datalogger. (SEAL unit)
- Data acquisition, storage and reporting (DAHS)
- Shelter or Enclosure, cabinet, open sided
- Peripheral: Flow Monitor, Opacity, PM, Mercury
- Installation
- Startup & Training
- Certification & RATA
- Maintenance & Service
PROBE TYPES:

- Extractive, hot/wet, dilution, high temp, high pressure. With or Without Heated probe tubes?
- Probe material is important. SS, Inconel, Hastelloy, Restek Coated.
- Probe temperature is important. Dew Point, Process temp. Area Classification. Ambient conditions.
- Low pressure sampling probes for Laser Analyzers.
- Probe location, port size & clearance.
- Area Classification, Hazardous C1D1/2, Group A/B/C/D or General Purpose
SAMPLE BUNDLE (UMBILICAL)

Umbilical Types & Tips:

- Heat traced. What temperature?
- Type of CEMS determines How many tubes
- Tube materials SS or Teflon? Why?
- Umbilical length and cutting to length
- Controlled or self limiting
- Cut, dressed & terminated correctly
- Understanding heat trace design
- Accurate measurements crucial. What to do with excess length
Sample Conditioning Types & Tips:

- Process conditions determine equipment needs
- Types & Size of gas coolers. Don’t undersize
- Flow rates are important
- Flow & Pressure Control
- Dealing with acid mist or excess moisture
- Filters for particulate, acid mist & NH3
- Extra moisture removal
- NO2, NH3, HCl, SO2 loss
- Gas entrance & exit temperature.
GAS ANALYZERS

- Large selection of gas analyzer manufacturers.
- Go with quality & proven performance
- Price of spares very important
- Parts availability regular & emergencies
- Tech support & site support. Training.
- Laser based analyzers for direct & extractive
- Analyzer ranges, dual/single range (Air permit)
- Some technologies better at low ppm or ppb
- Dealing with harsh conditions
- Remote analyzer & CEMS support if IT allows.
Certified Cal Gas: What Standard to use & why?
Gas mixtures & dual ranges
Daily cals, light-off cal, linearities, CGA’s
Ordering, storing, transporting cal gas cylinders
Regulators on or off cylinder with braided hoses
Low range NOx. Procedure for changing cylinders. O2 & moisture in braided hoses
NH3 & NO2 for converter checks
Safety when handling cylinders
- Shelter selection. Do you need to write a full specification for the shelter or let the vendor choose?

- State & local building code requirements

- Earthquake, hurricane, wind ratings & PE Stamped drawings

- Materials, inside/outside walls, flooring, ambient air quality. HVAC special requirements for dust & acids

- Hazardous Area or General Purpose?

- Cabinets, Enclosures, 3 sided?
OTHER ANALYZERS & MONITORS

- NH3 slip monitors: Cross Duct TDL. Extractive CRD TDL, Differential NOX - NH3 Converter
- HCl – For compliance or process. Cross Stack TDL or CRD TDL Extractive Low pressure, Dilution System
- Opacity – Brand options, upgrades, installation, certification
- Flow – Pitot tube, ultrasonic, Thermal Mass
- Particulate Monitors – Brand & Technology options – Back/Forward/Side Scatter, Beta Gauge
Subpart Ja & RSR CEMS Rule compliance

Mass Spectrometer will measure all necessary components including H2S, Total Sulfur, Net Heating Value btu/scf – Hydrogen, Methane, Ethane, etc
TDL installed on Tri-Mer APC System
DAHS OPTIONS

- Data Acquisition & Handling System receives data from analyzers and other system inputs
- System Control – Daily Calibration Checks, Probe Blowback, Fault Annunciation, Alarming, Sequencing
- DAHS stores raw and calculated data
- Data Correction – Automatic correction for Drift
- Data Averaging – TWA in blocks and/or rolling (hourly, 3 hour, daily, weekly, monthly etc)
- Data Conversion – ppm to mg, accumulated masses
- Compliance Monitoring – Excursions, levels within legal boundaries
- Data Archiving and validation – Part 75 standard file structure
- Reports – Facility Data, Monitoring Data, Unit Data, Control Equipment Data, Monitoring Plans, Certification test data and results
- Missing Data Substitution – Editing
- DAHS “flags” emissions exceedances and other alarm conditions and generates alarms
- Some regulatory agencies require transmittal of daily data to agency ie RECLAIM
CAPABILITIES

- 34 Service Techs
- Preventative Maintenance Plans Daily, Weekly, Monthly and Quarterly
- Emergency Repair
- CGA’s
- QA/QC Plans
- Monitoring Plans
- EDR & DAS Reporting
- Installation
- Upgrades
Training, Repair & Spare Parts

- CEMS * DAHS * Analyzer and hardware training
- Large Stock of spare parts for many different analyzers
- Late day spare parts shipping

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Types of CEMS

- **Dry Extractive**
  - Gas or Oil Ultra Low level Measurements < 5ppm.
- **Dilution Extractive**
  - Coal or Solid Fuel, Glass, high level measurements, and corrosives
- **Hot/Wet FTIR Extractive**
  - Solid Fuel, Cement Kilns, mid to high level measurements, high corrosives
- **Insitu TDL Cross Stack**
  - Gas, Oil, Coal or Solid Fuel
  - Ultra Low to high level measurements
- **Path Monitor: FTIR & DOAS**
  - Ambient Perimeter Monitoring
  - Head space safety monitoring
CEMTEK provided a new Siemens Maxum II gas chromatograph in a Class I, Div II interior and exterior shelter.
Supplied CEMS in a NEMA 4X Class I, Div II Stainless Steel shelter to measure NO\textsubscript{X}, SO\textsubscript{2}, & O\textsubscript{2}. 
2 Fully Extractive Turbine Stack CEMS in Shelter
Fully Extractive CEM Hot/Wet Basis

- Typically used on corrosive application, water soluble gases such NH3, H2S, VOC’s
- Hot/Wet Sample Extraction
  - Simplicity of sample system – 4 components
  - Entire sampling system kept at 185°C
  - Eliminates gas coolers and sample losses
  - Measures tough gases such as HCl and NH3
  - Provides direct measurement of water
- Hot/Wet FTIR Analyzer
  - FTIR analyzer measures all gases of interest simultaneously with real time correction for interference gases
FTIR Analyzer

Heated Probe Assembly

Heated Sample Line

Heated Sample Pump

FTIR Analyzer
# APPLICATION Choices Summary

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Fully Extractive</td>
<td>Low &amp; Ultra Low concentrations</td>
<td>Higher maintenance</td>
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<tr>
<td></td>
<td>Gas fired Boilers, Turbines, IC Engines, Refinery</td>
<td>Lower availability</td>
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<tr>
<td></td>
<td>Some oil fired</td>
<td>High Corrosive applications</td>
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<tr>
<td></td>
<td></td>
<td>Not good measuring moisture solution gases such as NH3, HCl</td>
</tr>
<tr>
<td>Dilution Extractive</td>
<td>Low maintenance</td>
<td>Low concentration</td>
</tr>
<tr>
<td></td>
<td>More reliable</td>
<td>Cannot measure O2</td>
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<tr>
<td></td>
<td>Coal fired Power Plants, Glass, Paper, Refinery</td>
<td>Limited analyzer manufacturers</td>
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<tr>
<td></td>
<td>Lower Cost</td>
<td></td>
</tr>
<tr>
<td>Hot/Wet FTIR</td>
<td>Multi Measurements &gt; 5 analyzers</td>
<td>Ultra Low concentrations</td>
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<tr>
<td></td>
<td>Dirty or Corrosive</td>
<td>Lower availability</td>
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<tr>
<td></td>
<td>Incinerator, Cement, Biomass, Refinery</td>
<td>One Analyzer for all measurements.</td>
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<tr>
<td></td>
<td>Measures Moisture</td>
<td>EPA RATA uses other analyzers &amp; reference methods</td>
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Tunable Diode Laser Spectroscopy
\( \text{NH}_3, \text{HCl, H}_2\text{S, HF, HCN, CO, O}_2 \)
HCN Process Measurement

Application Summary

- Replaced original NDIR analyzer system
- TDL analyzer housed in remote laboratory room and fiber optically coupled to extractive cell for worker safety
- Extractive dual pass cell housed in a Z-purged enclosure
- Class 1, Div 2 application
Thank you so much!

Questions?

*a technical solution to meet every need*

CEMTEK KVB-ENERTEC.
2849 Sterling Drive,
Hatfield, PA, 19440
800-400-0200
www.cemteks.com
Refinery Process Pics
New CEMS for refinery heaters in seamless fiberglass shelter rated for NEC Class 1, Division II, Group C and D with stainless steel HVAC and fresh air intake stack. City of Los Angeles electrical code and inspection requirements. System utilizes Teledyne NO$_x$, CO, and Servomex O$_2$ per CFR Part 60 and SCAQMD RECLAIM requirements.
Refinery Heater CEMS
Reﬁnery Heater CEMS

Shelter Class 1, Div 2 HVAC

Air Cleanup System
CEMTEK supplied a new CEMS for monitoring sulfur recovery unit tail gas incinerator emissions. The new CEMS was integrated into the existing Class 1, Div 2 CEMS shelter measuring NO\textsubscript{X}, SO\textsubscript{2}, CO, wet & dry O\textsubscript{2}, and stack flow. Also provided was a custom built, 18 foot multi-point heated probe for measurement of a stratified stack.
Cemtek provided a new CEMS in a fiberglass Class I, Division II shelter for measuring NO$_x$, SO$_2$, CO & O$_2$ utilizing a Circor modular sampling system and a custom probe for measuring low level SO$_2$ in the presence of NH$_3$ on a caustic scrubber for SCAQMD RECLAIM reporting.
Supplied CEMS in a NEMA 4X Class I, Div II Stainless Steel cabinet to measure NO$_x$, CO, wet and dry O$_2$, ammonia and stack flow. Included field installation supervision services, start-up, training and certification services. Certified 2005
CEMTEK provided a new SCAQMD RECLAIM CEMS in a NEMA 3R cabinet for measuring NO$_x$, O$_2$, & ammonia.
Cemtek provided four new NEMS (NO\textsubscript{X} Emissions Monitoring Systems) in a NEMA 3R cabinet for measuring inlet NO\textsubscript{X}. These replaced 20 year old process systems.
CEMTEK provided a new CEMS in a Class I, Div II shelter for measuring inlet $\text{NO}_x$ and stack $\text{NO}_x$ & $\text{O}_2$ utilizing ABB analyzers and M&C Products probes for classified areas.
Cemtek provided a new process O\textsubscript{2} monitoring analyzer panel in an open rack configuration to meet area classification.
DOAS In-Situ Optics (SO2/NO/NO2)

TDL In-Situ Optics (CO2)