# EXPLOSION PROTECTION FOR THE DAIRY FOOD INDUSTRY

A review of the problems and advancements in Explosion Prevention and Protection Systems Development with respect to the rigid requirements of the Dairy Food and related industries.

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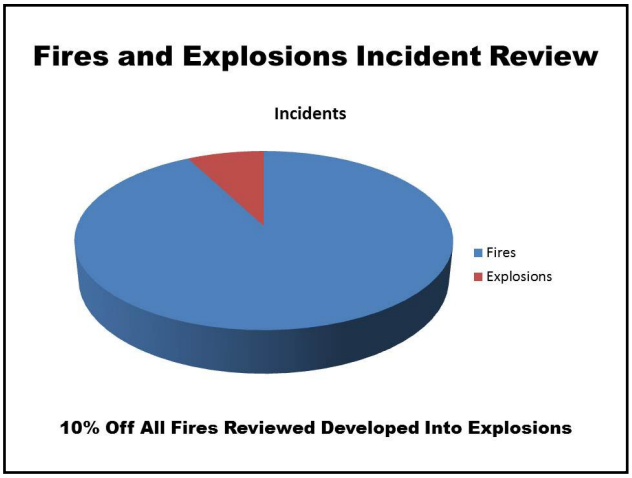
# Explosion Protection For The Dairy Industry

## The Dairy Industry Problem

Fires and Explosions in the European dairy Industry were becoming an increasing problem. In the early 1990's two groups of people from industry, insurance providers and suppliers of protection equipment came together to analyse events and case studies, to find a new approach to solve the persistent problem.

The first now statistically confirmed finding was that the problem really was a fire hazard rather than a problem belonging to the area of explosion hazards. The analysis of a statistic database on 116 incidents in the milk powder processing industry showed that five of these incidents experienced an explosion, while another three had explosion like effects that could be traced to pressure effects of an explosion. The remaining incidents were fires only, with damages ranging from medium to total loss of the drying unit.

More than 90 % of these incidents could be traced directly back to self heating processes within the drying installation. The five (eight) explosions in most cases, if not all, were found to have been a consequence of the fire not the other way around.




Another analysis looked at 240 incidents that occurred in spray driers in the food industry from 1953 to 1993. 20 incidents were reported to have experienced an explosion, 210 were fires only. Even though the data of this source did not allow tracing the cause, it is considered that in most cases, if not all, the fire was the initiator of the explosion. The result of the statistic analysis defined the further steps of the new approach:

**The First Groups Findings: Ten percent of all Fires became explosions. By studying the plant details ignition sources such as internal mechanical and/or outside introduced ignition sources were ruled out. Solution: The problem could be solved if an appropriate detection method can be found to detect heating before it develops into open combustion.**

Simultaneously a group of researchers in the UK and Ireland were studying the same phenomena. The researchers studied Irish Dairy Industry Incidents from 1980 – 1987. During that period 12 incidents were reported involving fires in spray drying plants. In 5 of these cases explosions were reported. Also studied were UK Dairy Industry Incidents from 1972 to 1982. During that period 7 explosions were reported in spray drying plants.

**The Second Groups Findings: The researchers in Ireland and the UK decided that the dairy industry required a deflagration protection system with the following capabilities:**
**Effective reduction of the overpressure to a safe level**
**Large volume protection**
**Non-contaminating suppressant**
**Non-explosive actuation**
**Easily maintained**
**Low maintenance costs**

## Early Solutions – Prevention and Protection

From their independent research and concerns the result was naturally two different directions. The first group focussed on fires as the cause. Therefore they surmised that if fires could be detected and prevented very early most spray dryer explosions could be prevented. The second group understanding the problem as the event itself decided that a solution was a method to suppress the event as it developed. But a method of suppression was not yet available that meets the true needs of the industry.

## Prevention

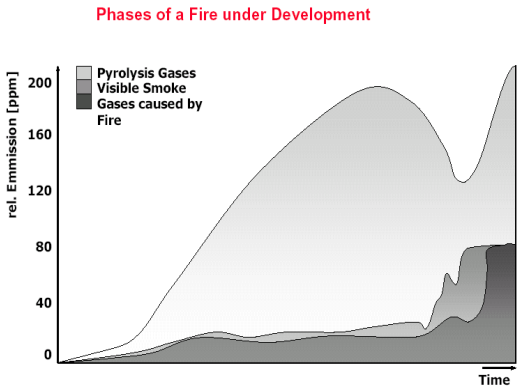
In spray driers, for the production of milk powder, fires and explosion are a serious problem. Basically all four necessary preconditions for an explosion can be present:

- Fuel (milk powder) powder deposits and swirling dust
- Oxygen
- Ignition sources – Decomposed Milk Products
- Confined Space

With fuel and oxygen in abundance the only requirement to complete the combustion triangle was an ignition source. If the ignition source could be eliminated or mitigated a deflagration might be prevented in most cases.

Operating experience shows, that the primary source of ignition for fires or dust explosions in drying installations or in secondary installations such as filters and dust precipitators, are smouldering spots or self-igniting milk products. Even with the best safety measures and process controls in place, it is not possible to effectively prevent the deposit of milk products in spraying drying devices or air diffusers, nor can caking on the vessel walls be avoided. The danger exists that, through long-term exposure to hot air, a thermic decomposition of the deposits will be initiated and that this will lead to smouldering spots and/or self-ignition of the products.

Depending on moisture, fat content and on the air flow, smouldering nests in milk products will form solid and compact structures, to which new added products will continue to adhere. Because of the bad diffusion of oxygen through the pores, the smouldering nests will expand from inside outwards rather slowly. Various conducted tests have indicated, that small smouldering spots of milk products have quite low surface temperatures and, that therefore they are not very effective sources of ignition for their dust-air mixtures. The low surface temperature makes them very hard to see with standard IR sensor technology until they break apart exposing the hot surface providing an ignition source.




As a rule, such compact glowing deposits will only become a source of ignition when, they detach themselves and fall into the lower tower areas, or are transported into secondary installations, where potentially explosive dust-air mixtures may be present. As a consequence it is essential to detect smouldering material in an early stage, in order to be able to take appropriate measures. If a method could be developed to detect the growth of these deposits at an early stage the product flow could be stopped eliminating the hazard. The potential ignition source can then be dealt with manual and /or automatic means before product supply was returned.

## Early-Warning Fire Recognition Through CO detection

An early recognition of smouldering fires at an initial stage is possible through inspection of the exhaust air from drying installations for the presence of carbon monoxide, a gas which is the product of the thermic decomposition of milk products. Because of the high air flow rate within milk powder drying installations, the produced carbon monoxide is diluted so strongly, that an extremely sensitive measuring system is required, in order to be able to detect small smouldering fires at an early stage.

With the usual exhaust air volumes up to 100,000 $m^3$/hour, an increase of the CO content in the exhaust air of less than 1 ppm can be an indication of a smouldering spot. On the other hand, due to environmental contamination, it is possible that the air intake to the drying installation is biased and already contains substantially higher concentrations of CO, which would lead to a false alarm from the early-warning system.

This problem could be solved by means of differential measurements between the air intake and the exhaust, where only the CO content actually produced in the drying apparatus is taken into consideration.

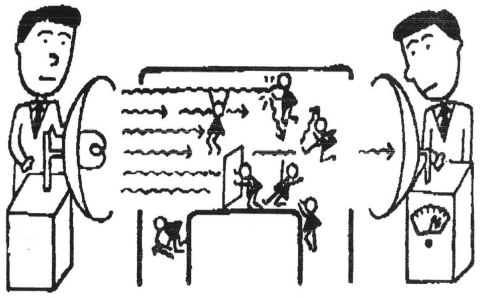
## Infrared Gas Analysis and the Challenge

The characteristic of the heteroatomic gas CO, to absorb infrared light in specific bands between the frequencies 2.5 and 12 pm, is used in infra-red spectroscopy to provide a means for determining concentration levels. With NDIR, the Non-Dispersive Infra-Red Absorber, a measuring principle is available which is suitable for detection of traces of carbon monoxide levels. NDIR CO gas analyzers, with a measuring range of 0 to 10 ppm, have been tested in the area of emission control under harsh conditions, allowing them to be considered as reliable means for this type of measurement.

To accomplish the measurement small gas samples would be continuously extracted from the drying apparatus and pumped through a measuring cell, which has been fitted with windows that permit infrared rays to penetrate. A ray of light, which is directed through the windows and penetrates the gas, is weakened in the area of certain frequencies, before it meets the detector. This absorption correlates with the CO concentration and is defined by Lambert-Beersch's law:

$$A = \frac{I_0 - I}{I_0} = 1 - e^{-e.c.l}$$

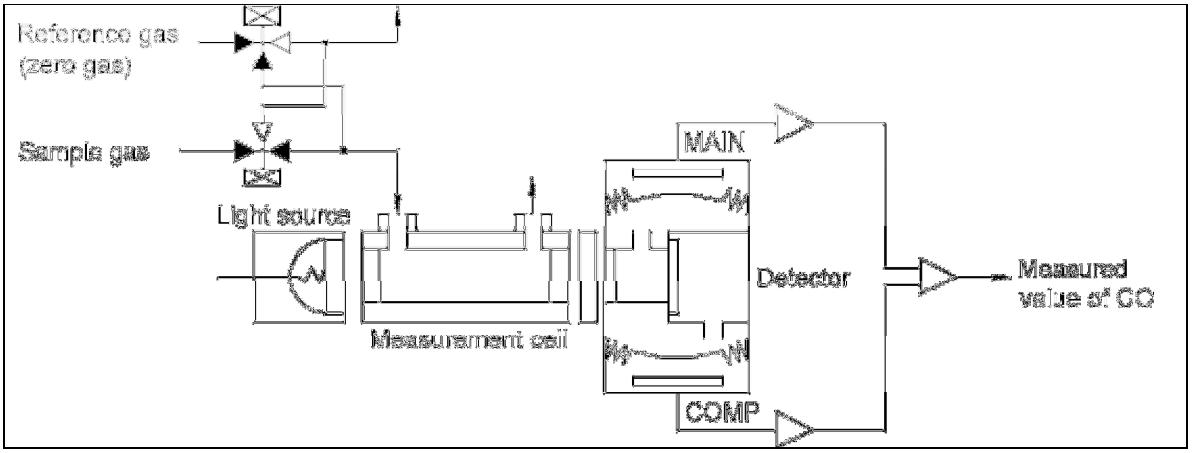
A = absorption
$I_o$ = incident radiation capacity
I = emission radiation capacity
e = extinction coefficient
c = concentration
l = length of cell



The required calculation of the difference between the exhaust air and the air intake of the drying process would require a procedure using one analyser that would require extensive time to review gases in a series procedure or using two analysers to accomplish a quicker comparison. Both methods would require an external processor to determine the differential result. The choice was time or cost, neither one acceptable. Researchers understood that if both samples could be compared together then the time would be cut in half with a more economical system. By using a so-called cross flow-modulation procedure the air intake of the drying apparatus is used as a reference gas. The exhaust air sample, which is to be measured, and the reference gas, is alternately introduced into the measuring cell through a micro solenoid valve. In contrast to other infrared analysis techniques, the optical path in the cross flow process is the same, for both the gas to be measured and the reference gas, considering optical cutter (diaphragm) is not required for the calculation of a difference, which reduces the signal noise and the sensitivity to contamination.

# Principle of Cross Flow Modulation

As shown in the Figure below, the sample gas and the reference (zero and inlet) gas are alternately (Frequency =1 Hz) sent to the measurement cell at the specified flow rate by continuously switching the solenoid valves. In case of an incident in the spray drier the sample gas (outlet) will contain more CO (which absorbs infra-red light) than the reference gas. The infra-red light intensity reaching the detector is therefore modulated. The magnitude of this modulation is the basis of this measurement.



Infra-red light generated from the infra-red source passes through the measurement cell and enters a detector containing the gas to be measured. When zero gas is sent to the measurement cell, more infra-red light reaches the detector. On the other hand, when sample gas is sent to the measurement cell less infra-red light reaches the detector. The degree of this infra-red light attenuation is related to the concentration of CO gas in the measurement cell.

The detector contains a movable membrane which detects pressure changes in the optical cell. If there is any difference in absorbed energy between the reference gas and the sample gas a pressure change will occur within the optical cell and therefore be detected. This difference is amplified and output as an electrical signal. As such, no membrane displacement occurs when the concentration of the measured gas does not change during a cycle (normal Spray Drier operation, the sample gas concentration is the same as the reference gas concentration). Therefore when the same gas is sent to both the sample and the reference lines in the APMA 370, the detector produces a zero output with essentially no drift. A detector set-up using two optical cells in series is used to sense measured components and interference components in the front cell (MAIN) and is used to sense mainly interference.

## Basic Design Of An Early-Warning Fire Detection System

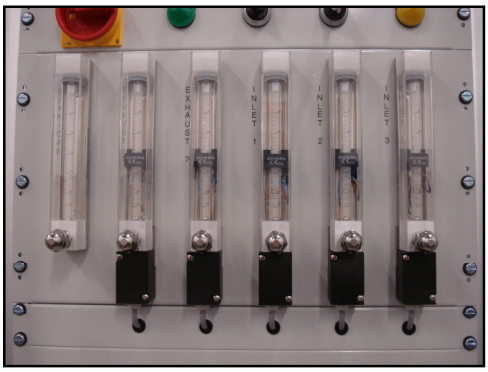
An early-warning fire detection system, which is based on CO detection, consists of the following main components:

- gas sampling probe
- sample gas preparation
- analyzer
- process system controller interface

To be acceptable as a Prevention Alternative a Co Early-Warning Fire Detection System must provide quick recognition of smouldering fires while avoiding false alarm activations, considering the associated process downtime cost.

First the Process System must be analysed to determine the proper points of sampling to get a true picture of the systems process flows. In summary probe locations must assure all air in = all air out are measured with respect to the CO content of the air.

Because the exhaust gases are loaded with dust and have a high dew point temperature, a dust and water removal system is required. The input air to the analyser must first go through various air preparations to remove moisture from the line and balance the flows to the analyser. This ensures that the measured signal can be stably obtained with the minimum interference effects. The reaction time of the system is an additive combination of the time, during which the air is present in the system, the residence time in the gas sampling lines and the device response characteristics of the analyser and system.




To avoid a false alarm, caused by a sudden rise in CO content in the intake air (for instance as a result of heavy traffic), the transit time in the sampling lines must be balanced. The gas sampling lines to the analyzer should be kept as short as possible, in order to avoid unnecessary delay times. Note: This proved to be an insurmountable task when considering direct fired dryers.

Since infrared gas analyzers are very sensitive to contamination, the gas samples must be carefully pre-conditioned, by removing humidity and product residues. H20 is the chief interferent in the NDIR measurement of CO. The output from the COMP detector is then used to correct the main signal for any concentration of this interferent which might be present. The correction is made in real time.

## Practical tests

A CO detection system was tested on an industrial level, during a test program organized by the "BG Nahrungsmittel und Gaststatten" in Germany. The system, consisting physically of an infrared gas analyzer, proved itself capable of detecting smouldering spots, which, because of their size, could not be effective as a source of ignition. One of the important perceptions of these tests was that smouldering fires lead to a significant increase in the CO content in the exhaust gases from such installations. This increase can be clearly differentiated from the normal variations in the CO content, due to the production process.

## Detection of a smouldering fire

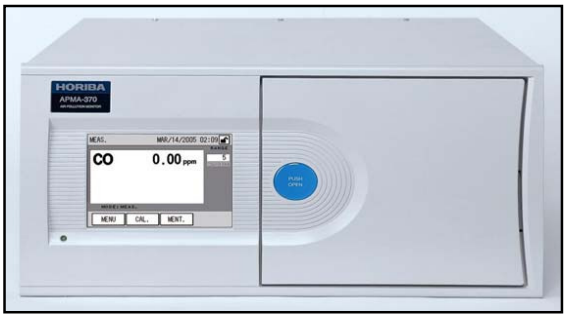
A comparison between the progression of CO content in the exhaust gas and the concentration noted from an artificially introduced smouldering spot was made. An increase from 0 to 1 ppm CO developed within 7 minutes, within a further 16 minutes the CO content rose from 1 to 5 ppm, and thereafter the value rose within 15 seconds to 8 ppm. 4 minutes later water was introduced, and after 3 hours of shut-down the installation could be used again. The test installation was not equipped with a dedicated alarm system at that time.

If we assume that clear signs for a smouldering fire were already available below 1 ppm CO, then the operator lost 15 minutes (900 seconds) of time, during which he could have initiated safety measures. The alarm threshold for the initiation of safety measures, such as switching to feed water, must be individually definable, in accordance with the requirements of the end-user and the size of the installation.

From the experience gained with the test installation it can be concluded that an unusually steep increase in CO content in the exhaust air can best be used to trigger a pre-alarm. With such an advance warning, the operator would have sufficient time to localize and remove the smouldering spot, without having to accept long-term shutdowns. The initiation of a forced shutdown, or the activation of fire extinguishing installations, should occur automatically, after a certain individually determined threshold has been exceeded.

## First Generation ACOM early-warning fire detection system

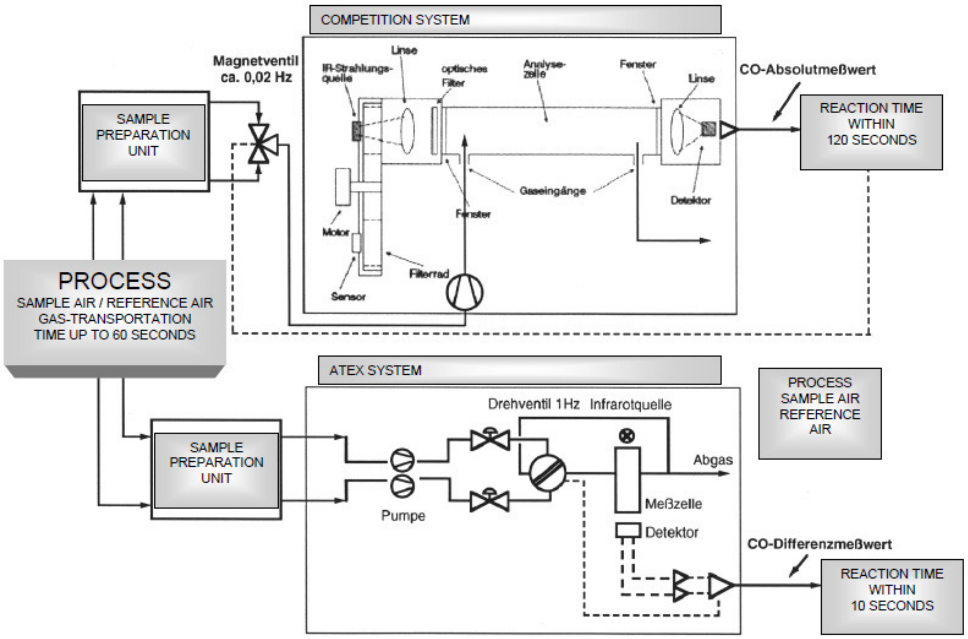
The ACOM detection system provided a complete system of safety measures, which can be operated industrially on a long-term basis. This system offered was an expanded and improved version of the test installation, which was set up by the "BG Nahrungsmittel und Gaststatten".




The introduction of a microcomputer, with an interface to the control systems of the drying installation significantly reduced the detection delay. In addition it allowed reduce settings for the alarm thresholds, while at the same time it guarded against false alarms and assured that the associated safety measures will not be actuated in such cases.

The CO detection system named ACOM consists of an IP 54 housing, in which the sample gas pumps, the cleaning, conditioning units, gas analyzer and processor evaluation unit were installed and protected from the harsh operating conditions of the installation. The evaluation unit is connected to a display unit in the control room. The NDIR gas analyzer functions according to the tested cross-flow principle, in which the intake air of the spray drier is used as a reference gas.

The unit calculates the differential value of the CO concentration, between the exhaust and the intake air of the drier. In this way, only the CO value actually created within the spray drying unit is used. The ACOM detection system makes use of a Programmable Logic Controller (PLC), which permits a permanent supervision, as well as a gradient-oriented definition of the alarm threshold values. By means of a chain of relays, it is possible to set malfunction messages, two pre-alarms and a main alarm. The alarm thresholds, and the safety measures to be taken, can be defined individually and in consultation with the end-user.




*Comparison of Standard CO System and ATEX ACOM System*

The ACOM system is capable of recognizing the operating mode of the installation by means of an interface and can automatically activate a different set of threshold values, so as to prevent false alarms, for instance while taking the installation into operation or during ventilator shutdown. All parameters, which are essential to the availability of the ACOM system, are monitored for correct functioning. The electronics of the evaluation unit is self-monitoring and goes into a malfunction mode, if any faulty functioning is detected.

## Next Generation CO Early Fire Prevention Systems

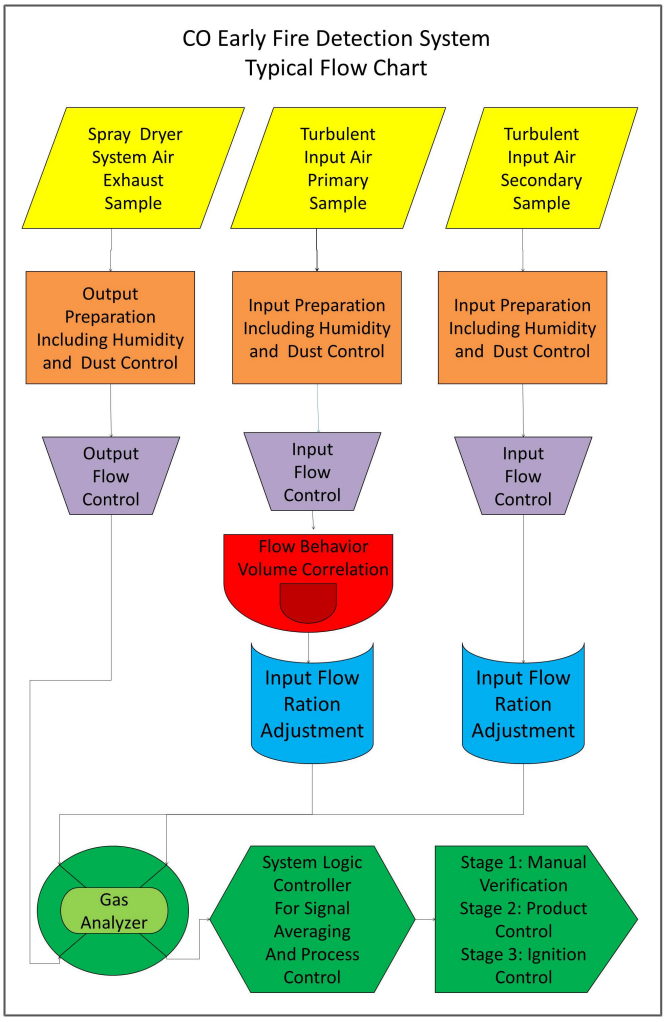
If success was based solely on the ability of the system to prevent explosions, then the first generation system exceeded expectation. But, unfortunately success lead into many new challenges. Plant operating conditions, process parameters and or burner type created unstable conditions for use of first generation systems. Various methods were used in CO to compensate for these environmental CO changes. But while offering a degree of effectiveness they did not prove to work for the wide range of applications required. In addition signal fluctuations could be observed when CO entered the inlet sample. Based on sampling delays a false differential might be indicated. Various separate inputs with different flow rates required attention. And like any company ATEX wanted to pursue all business potential not just the standard ones. To meet our customers' requirements and expand the systems availability ATEX developed a new generation of CO monitoring designed to compensate for internal and external environmental CO changes and flow conditions. While understanding the problem was simple CO input and output must be measured at the same point in time so the effects of the process volumes had to be eliminated. If they could solve these problems they could expand protection to direct fired dryers.

The developers started with the advantage of the Cross Flow Analysis which makes a measurement in seconds while other systems are measured in minutes. To gain a further advantage for signal processing the engineers went to the analyser manufacturer and with their assistance lowered the detection time significantly further. The T-90 time or the time required to exchange from one sample stream to another is down to 20 seconds providing the maximum desired analysis time. Unlike other systems that were too slow to offer anything other than token processing control the super-fast ATEX ACOM system enabled ATEX design engineers to develop a new integrated analysis methods providing increased performance without sacrificing the system benefits that made the ATEX original product superior to others.

The first of these system modifications performed a volumetric correlation of vessel flows. Through a combination of calculation algorithms, flow control, flow mixing and volumetric adjusting components the behaviour of the dryer could be compensated for and fine-tuned as required to meet field conditions. The new buffer system to adjust the real time system flows to effectually allow the inlet sample and outlet sample to be analysed at the same relative point in time. This unique ACOM system development reduces significantly the potential of a stray CO signal entering the inlet and causing the indication of a CO rise because of the Spray Dryer Volumes delaying effect on the flows.

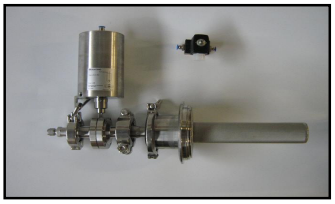
As the systems became more and more accepted new challenges presented themselves. Customers wanted protection for multi input systems. This presented the possibility that the different sources had different ambient CO levels and flow rates. By performing a ratio calculation we are able to determine the flows required to compensate for this abnormality. To perform this ATEX augmented there standard flow controls with additional inlet controls to balance the inlet between multiple devices with potential CO differentials, not to compensate for flow timing as in the original flow gauges, but to compensate for flow rate differentials in the level of CO.

On reviewing the systems flow chart ATEX engineers determined the system had increased time unnecessary for calculation speed. On reviewing the system controller they determined a very large amount of power was still available (especially considering other systems that needed the controller to make system decisions). With the knowledge of the algorithms and detection methods used in their advanced explosion detection system they were able to develop a Running Average Function. This function evened out the signal changes to create a more sloped output eliminating the potential rapid change signal fluctuations from causing unwanted signals without adding any significant additional time to the signal processing.




By adding systems to decrease timing factors, average signal outputs, compensate for signal delays, and flow imbalances the result was an extremely stable CO system still functioning in half the time of any other system available.

The Next Generation system also provides increased maintenance and operational benefits. The exclusive new Automatic Leak Test Feature provides an efficient way to monitor your sampling lines preventing system problems. The Semi-Automatic Calibration system with key control provides a user friendly and safe method to calibrate your CO system.



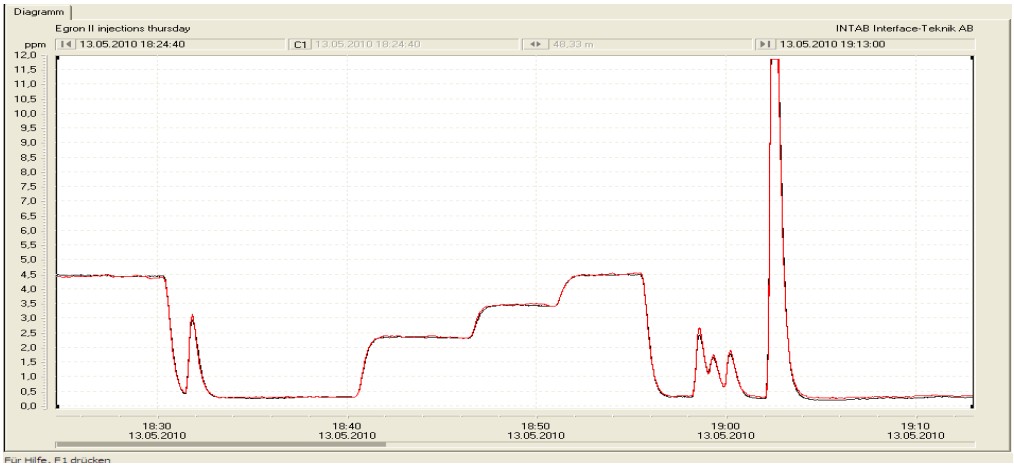
*Sample Probe with Leak Check System*

ATEX systems are now able to compensate for CO peaks generated by external sources caused by for example other industrial activities, coffee roasters or burning agricultural waste. It is possible to monitor several installations, or to introduce further sampling points within complex drying systems through an optionally available multiplexing system. And with this new increased filtering power they have a system that can deal efficiently with the effects of most direct fired dryers. While they do create a challenge considering the CO fluctuations in involved, most dryers can be provided with protection as long as the air flow from the burner is not laminar in nature but turbulent.

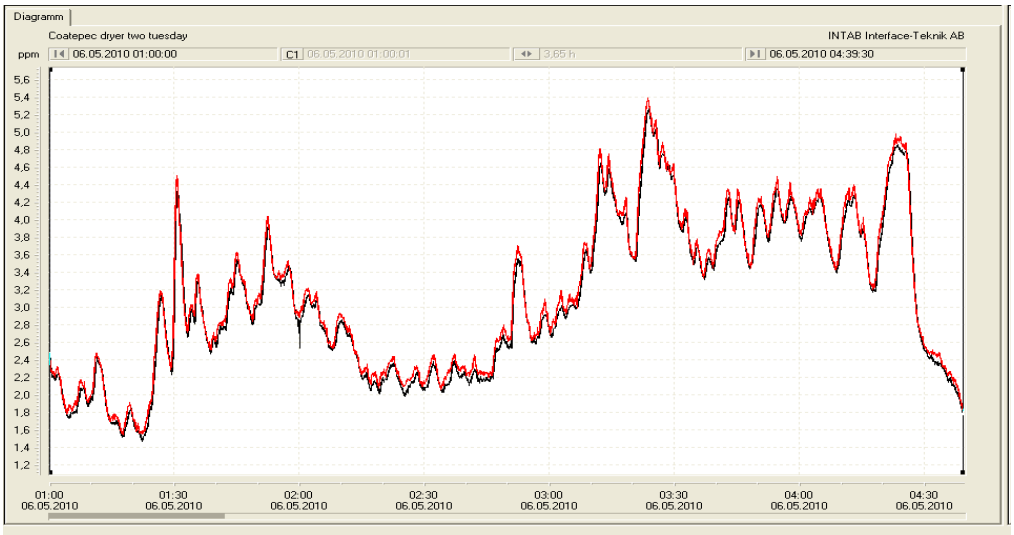
The interface of the system to the user's facility requires a complete exchange of operational information to understand the right interface between the three stages of system signalling and the available process controls.

As for installation the system requires no Instrument air supply. A normal floor drain meets the drain requirements. Power requires a standard 220 volt, 1 phase supply. The probe installation requires a small 1 inch diameter hole for each vessel mounted probe. The remainder of the installation can be completed while the system is on line.

Typical Resultant Synchronisation and Measurement Readings




*System Synchronisation*




*Process Measurement*

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# Advantages ACOM Atex-CO-Monitoring

1. Reference and exhaust are measured at the same time.
   - Continues information of delta CO value and the possibility to do additional averaging if we encounter strong CO fluctuations on the inlet of the dryer.

2. Analyser with T90 time of 20 seconds.
   - Faster response and shorter change over time from one stream to another. This means that if we have 80 seconds to measure each stream, we only need 20 seconds rinsing time and still have 60 seconds for continuous monitoring (and averaging if needed).

3. Sample preparation/conditioning system is integrated in the analyser cabinet.
   - Installation cost reduced to a minimum and less impact in process area.

4. Automatic Leak Test System for all exhaust sample probes.
   - Safety issue.

5. Semi-automatic calibration system, with key switch.
   - Reliable, safe and maintenance friendly.

6. No consumption of instrument air.
   - Cost issue.

7. Customer specific solutions (Different filter types available).
   - Depends on the application.
   - Re-usable filter elements
   - Process filters easy to change

8. CIP option available.

9. Rockwell Allen Bradley PLC and Panel view (Rockwell).

10. Internal Data logging.

11. Remote diagnostics (via modem or World Wide Web)

12. Low cost of ownership.

13. Easy on maintenance.

14. Automatic analyser safety test before start-up.

15. Bag Filter monitoring even if the plant is not in production.

## Protection

As indicated a group of Irish and British researchers at the same relative point in time were looking at ways to deal with a developing deflagration.
They determined the following needs for a Protection System:

1 – Keep Deflagration Overpressure to a safe non-destructive level
2 – It must be good in large volume areas
3 – Considering the hazard it could not be a contaminant
4 – An explosive actuator would be a contaminant so it could not be used
5 – Easily maintained
6 – Low Cost maintenance

Since Explosion Suppression Systems were used to protect industry successfully for years the next step was to review existing protection systems to determine if any were suitable or could be modified to be suitable for use. First they reviewed Dry Chemical. But it could not meet the large volume requirement without high pressures, used an explosive actuator or gas generator that in itself was a contaminant and finally in most cases required expensive factory maintenance. The Halons and Gas presented system cost and distribution problems that resulted in high maintenance and operational costs. Finally water was reviewed and while meeting most of the requirements did not have a delivery system available to allow the droplet size required. In addition water cooling effect on Hot Dryers could be just as problematic as the deflagration itself.

Through research they understood that if water could be released in a droplet size below 50 micron an explosion could be suppressed. But limitations in pressure, energy cost and flow presented major roadblocks to success and the small orifices required to reduce the droplet size were problematic and unreliable.

They then turned there attention to Pressurized Hot Water but it too had its development concerns. First it had to be shown to be reliable and efficient for the application. The operational parameters had to be defined and finally they had to be tested for the required range of $K_{st}$ and $P_{max}$ values.

To evaluate Hot Water Suppression, as a potential solution, a test program was developed and performed. Tests were performed in two different sized vessels with different geometrical characteristics. The first vessel was a 2.8 m³ ISO test rig. The second was a 28 m³ test vessel with a 7:1 aspect ratio to mimic a typical tower dryer.

The results of the test indicated that droplets under 50 microns in size performed the best deflagration suppression. A comparison to other agents found water droplets under 20 micron to function as a total flooding system with extinguishing values twice that of the Halons and equal to or better then the Dry Chemical agents used for explosion protection.

With the tests a success a suppressant was found, water droplets under 50 micron. A review of pressure heated water found that water heated to its boiling point increases its liquid heat content, temperature and pressure. This surplus energy increase the amount of flash steam produced. In addition when stored and discharged from a storage cylinder the Pressurized Hot Water has a more constant discharge flow rate then a Nitrogen pressurized cylinder.

Researchers noticed a major problem with dry chemical systems because they released like a shot gun. They only hit what they were aimed at with constantly lowering velocity. The result was a

system requiring more release points and a limited discharge distance. Many times the distance was under half of the vessel diameter limiting the size of vessel they could handle. But the Pressurized Hot Water had an advantage, when released into the protected vessel it flashed to a vapour accelerating in a $360^0$ pattern as it does so providing the ideal agent for a large volume application like a spray dryer.

First Generation Hot Water Explosion Suppression System

Using Industry available explosion detection and control equipment the only thing required was a Hot Water Storage and Deployment System. Development produced a dual lined Stainless Steel Vessel with a Water Heater up the middle to produce an $180^0$ C temperature resulting in a 10 bar pressure level. The method of release a gas generator operated valve that release a seal puck when activated. The valve used had a 4" diameter opening. An intricate pressure control system was put in place to provide operating controls and safety features. The Deployment system chosen was an open boar pipe discharge.

The Pressurized Hot Water system provided the following industry required protection needs:

1 – Reduced Pressures ($P_{red}$) were acceptable for Vessel Protection
2 – It was effective for all vessel volume ranges
3 – Water is a food safe substance
4 – A gas generator was used out of the product stream eliminating contamination
5 – The system was designed to be easily maintained
6 – By using water the maintenance was expected to be lower in cost.
7 – Equipment must be provided in Stainless Steel Execution as with the Spray drying facility they protect. Standard Mild Steel Suppressors would not be acceptable.

Detection was provided by static metal diaphragm sensors used in the industry for many years. Control Equipment was as used for Dry Chemical protection.

The system was implemented with great application success. As time went on though problems with service, reliability and maintenance developed. It was obvious that while a great product in theory the final products engineering left a lot to be desired.

Second Generation Hot Water Explosion Suppression System – The ATEX AIS System

Atex had been reviewing the Hot Water solution themselves. Eventually around 2000 ownership in the existing system decided to sell the design rights to ATEX. The first step ATEX took was to go back to the drawing board from detection to control and redesign the system with the knowledge of industry problems at hand.

The ATEX Solution

To provide protection for a Spray Dryer System four major components were required:

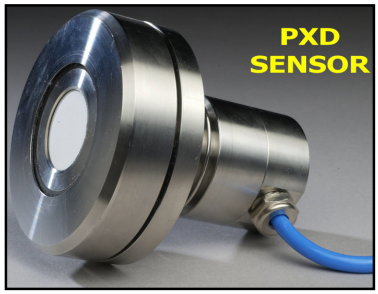
- Detection
- Suppression
- Dispearsal System
- Control System

Sensors

At this point static sensors were the standard for explosion protection. While reliable they offered four major disadvantages. First the setting had to far enough above the operating pressure to at times delay the protection firing point. Second the sensor required maintenance. Since the sensitivity adjustment was controlled by a screw in a vibrating process the adjustment could change in time. Third point was the sensor was subject to false signal operation by vibrations and product impingement. Finally it could not be supervised for functionality.

ATEX reviewed existing new analog sensor technology that offered solutions to the problems above. Through the use of rate of pressure rise algorithms the new sensors could offer quicker detection at faster speeds. And since they used a ceramic disc vibrations were not a problem and the set point was very reliable. In addition the analog principle eliminates an actual setting point as a concern. But it still offered limited suppervisability for function and presented a static electricity problem new to this kind of sensor as that could result in a false slope signal because of an electrical spike on the line.

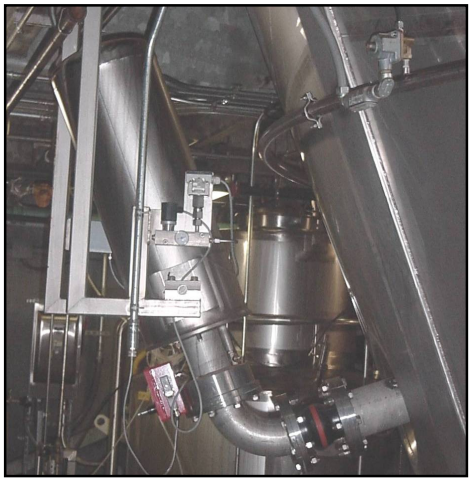
ATEX then developed the PXD Sensor that incorporated the many benefits of an analog sensor while increasing its reliability. The first need was reliability so the unit was provided with a heart beat signal to constantly monitor the sensors ability to detect a pressure signal. The unit was a decentralized intelligent device that stored each event it witnessed for future analysis. This allows a single event to be indicated by each sensor separately a major benefit in event cause diagnosis. With an intelligent device ATEX was able to program it with an advanced proprietary algorithm that analysed the slope for small duration spike type signals. The final result was an intelligent decentralized device that monitored itself for functionality and provided the most advanced false signal prevention available.




Up to then most systems wire in parallel for reliability or in series for false signal protection making you choose one or the other. With the PXD controller you don't have to choose reliability verse false release protection. ATEX the sensors are programed in a, series type, confirmation mode to prevent false release. But if the system determines through its heart beat monitoring that a sensor is not responding it will automatically reprogram itself to a single sensor response providing the higher degree of reliability without compromising the false alarm signal processing under normal conditions.

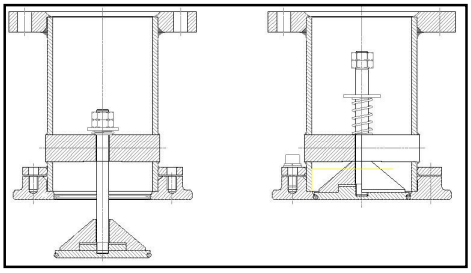
Suppressors

The suppressors need to function as a storage system keeping the suppressant at the right temperature & pressure ready for activation. ATEX was able to reengineer the Hot Water System to eliminate the early problems. The cylinder was redesigned to eliminate the stress effects of the heat on the life of system components. The Heater Controls were simplified and remote connected to lower problem potentials and make user servicing simpler. The Pressure Regulator for Temperature Control was also remote mounted via a high pressure flexible conduit to reduce heat effects.



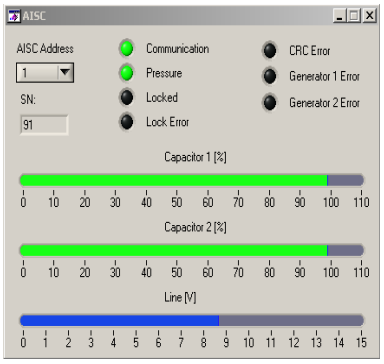
Using the basic design of their highly successful Dry Chemical System a new release valve was developed. The release system provided a reusable and removable valve that lowered the cost of system reconditioning and therefore the total operational cost.

Deployment System



The first generation system discharged through an open orifice which did not provide a hygienic seal as required in Dairy Systems. ATEX again went to their proven Dry Chemical T System Spreader. By enlarging it to handle the hot water flows the system provided a reusable nozzle for system release. The Pop-Out SS design with flush O Ring Seal provided a food grade surface for the industry it served. Without penetrating the vessel until deployed it was ideal for Spray Dryers and Cyclones.

As for the controls system ATEX had already developed a Dry Chemical Suppression based system for control and maintenance. The ATEX Control System provided three levels of customer interface. The control cover level provided operator information for normal operation requirements. The interior of the control provided an independent LED indication for each sensor and suppressor connected to the system and exclusive feature to ATEX equipment. And the third level using a computer interface and the ATEX APLOG software allows pin point viewing and programing of the various status and subcomponent levels. For example if a problem occurs with respect to vessel pressure the indicated suppressor can be interrogated from the panel and will specifically indicate the source of the problem as low pressure. Using ATEX Log Modules the entire system became field addressable with the ability to monitor not only system components but also the subcomponents of each suppressor. It no longer took a factory trained technician days to find a wiring fault or damaged component. Components and wiring problems could be pinpointed to the individual component or wire length. This allowed almost all problems to be solved fast with the software tool. In most cases this allowed the process system to be restored before a field technician could get to the airport.




*Typical Suppressor APLOG Display*

All ATEX Sensors are electrically certified as Intrinsically Safe allowing simplified rope style wiring in critical small sensor areas. ATEX systems supervise the functionality of all system components. If a component can not be supervised as with a Gas Generator two are provided for redundancy. Because of our design standards requiring redundancy where devices can not be supervised our systems have been able to achieve ANSI SIS SIL certifications. Currently all ATEX Suppression Systems carry SIL Level 2 Certification.

## Advantages of ATEX AIS Hot Water Suppression System

- **Detection**
  - **PSD Sensors provide Analog and Static adjustments to meet all system conditions**
  - **ATEX Algorithms provide analog response while eliminating short duration spikes from electrical noise**
  - **Direct Sensor communications and heartbeat check provides the first truly performance based sensor supervision**
  - **Independent sensor response curves allows for signal verification and diagnostics**
  - **Additional ancillary components allow temperature controls to meet the most demanding System Temperatures**
  - **Fail safe signal response with confirmation protection against false triggering.**
- **Controller**
  - **Integrated modular controller allows for unlimited expansion and system configurations.**
  - **History Function provides a time date stamped indication of all Sensor and System status changes**
  - **Reliability plus Logic Control to provide false release protection with redundant sensors but the reliability of independent sensor release for reliability.**
  - **Three stage signal levels provides varied data to meet user needs**
  - **Control Panel Self diagnostics pinpoints system signals to the individual sensor and suppressor**
  - **Computer aided software allows diagnostics to individual cables, sensors and sub component suppressor status conditions.**
  - **Addressable Devices allow review of individual sensors, suppressor and subcomponents.**
- **Suppressor**
  - **Provides simplified High Voltage Controls away for dryer and suppressor heat extending the systems life cycle significantly.**
  - **Provides OSHA required integral Lock-Out Tag Out feature with turn of locking rod. Does not require unsafe loosening of system bolts etc.**
  - **Low voltage Control box with plug in connector does not require working with explosives to disconnect the unit.**
  - **Redundant Gas Generators and other components for increased reliability for devices that cannot be supervised.**
- **Spreader Deployment System**
  - **T System meets dairy industry required sanitary 3A design**
  - **Flush design does not require the use of contaminating and costly blow off caps**

**The entire system is provided with ANSI SIS SIL Level 2 Approval for an independently certified reliability. Only ATEX provides the redundant components to meet this rigid safety calculation.**

**The only system to meet the latest NFPA codes before they were released. Our system did not require changing to meet the code. Our features are even superior to today's latest version.**

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