PREVENTIVE EXPLOSION PROTECTION

Monitoring | Control | Inerting

robecco Turnkey Safety Concepts for Preventive Explosion Protection in coal and secondary fuel combustible dust environments, **Monitoring, Control and Inerting**

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About robecco

General:

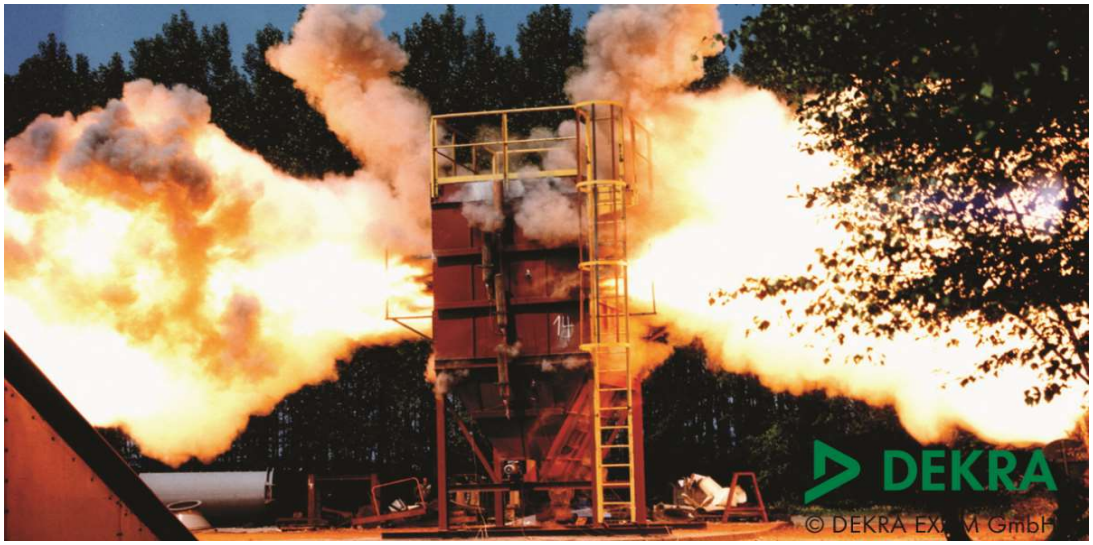
- Company: Founded 1995, owner leaded
- Portfolio: preventive explosion protection, monitoring systems, automation
- Clients: plant manufacturers, power plants, cement plants, limestone plants, steel industry, food industry

Performance:

- Engineering and Design (electrical and mechanical)
- Training, Seminars, Audits (international)
- Control concepts, programming
- Control cabinet manufacture
- Erection and commissioning service
- Maintenance and After Sales Service
- Inerting systems

More than 25 YEARS DEVELOPMENT OF CUSTOMER-ORIENTED SOLUTIONS.

We Are Living In A Dangerous World…



Explosion Pentagon

Inert gases prevent the occurrence of critical operating conditions and consequently any resulting explosions and fires. Effectiveness of different inert gases acc. VDI 2263 part 2 - guideline

- **Carbon dioxide / CO_2**
- **Steam**
- **Flue gases**
- **Nitrogen / N_2**
- **Noble gases / Argon**

Acc. to VDI explosion protection conference every year some 400 dust explosions happen in Germany - What about your country ?

Monitoring And Control

What are the Regulations:

- CEN TR15281
- VDI 2263-2
- IEC 60079
- VDE in total
- ATEX 2014/34/EU
- PED 2014/68/EU
- ISO 20024

Safety and Control Devices according to ATEX

Example of **total safety systems**:

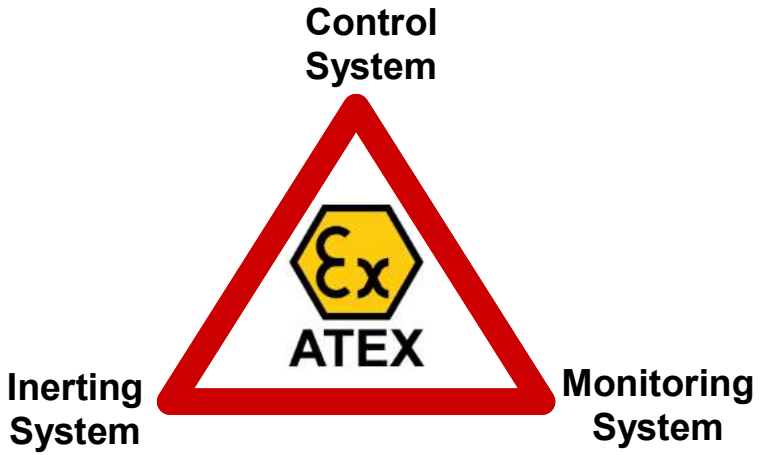
- Control units in a safe area for a monitoring system
- Gas sensors (Monitoring System) in hazardous areas in order to take appropriate measures
- Protective equipment like inerting systems for operation in emergency situations

Safety and Control Devices according to ATEX

Safety systems (e.g. sensors, actors and a PLC) are part of a **total system**.

It doesn't matter if parts are outside (e.g. a PLC) or inside (e.g. a sensor) of an explosive area.

The safe and reliable functionality of devices and protection systems is required by ATEX to prevent uncontrollable explosions.



- **Control System** in a safe area for a monitoring system
- Gas sensors (**Monitoring System**) in hazardous areas in order to take appropriate measures
- Protective equipment like **Inerting Systems** for operation in emergency situations

By **June 2006** the directive requires employers to protect workers from the“**Risk of Explosive Atmospheres**”:

29.3.2014 EN Official Journal of the European Union L 96/329

ANNEX II

ESSENTIAL HEALTH AND SAFETY REQUIREMENTS RELATING TO THE DESIGN AND CONSTRUCTION OF EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

1.0.1. PRINCIPLES OF INTEGRATED EXPLOSION SAFETY

Equipment and protective systems intended for use in potentially explosive atmospheres must be designed from the point of view of **Integrated Explosion Safety**.

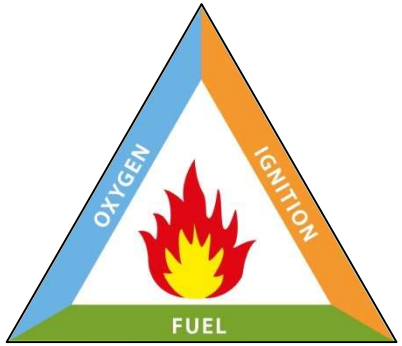
Above all, if possible, to **prevent the formation of explosive atmospheres** which may be produced or released by equipment and by protective systems themselves ➡ **INERTING**

To **prevent the ignition** of explosive atmospheres, taking into account the nature of every electrical and non- electrical source of ignition

Should an explosion nevertheless occur which could directly or indirectly endanger persons and, as the case may be, domestic animals or property, to halt it immediately and/or to **limit the range of explosion flames and explosion pressures to a sufficient level of safety.**

CO_2 / N_2 Inerting Theory And Guidelines Dust (VDI 2263-2 / CEN/TR 15281)

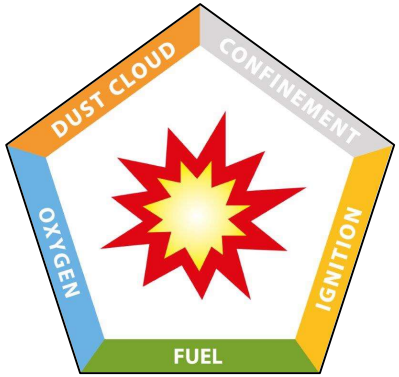
Fire Triangle



"To start a fire **3 pre-requisites** are necessary:

- A **Flammable material** has to be brought together with an
- **Oxidizer** (in most cases the oxygen contained in the ambient air)
- **Ignition source** has to act on the mixture."

Explosion Pentagon



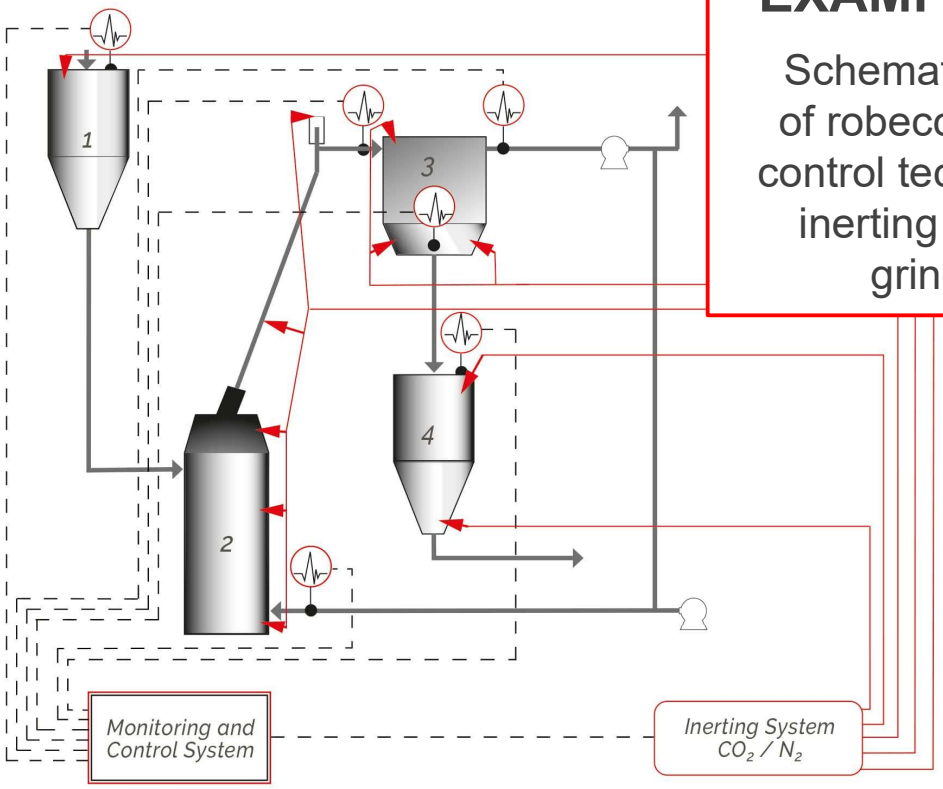
The prevention of dust explosions consists in eliminating one or more of the conditions included in the "**Pentagon of Explosions**". Preventive action can be taken on the following:

- the **combustible element**
- the **source of ignition**
- the **oxidizer**: the oxygen of air (O_2 reduction basis of inerting theory)
- **Confinement**
- **Dust Cloud**

Monitoring, Control & Inerting Concept

EXAMPLE CONCEPT

Schematic representation of robecco monitoring and control technology, including inerting to secure a coal grinding system.



1. Raw coal silo
2. Mill
3. Bag filter
4. Coal dust silo

CO/O_2-Measurement
Injection point CO_2 / N_2

AREAS OF APPLICATION:

- Coal grinding / storage
- Sewage sludge processing
- Biomass
- Power plants
- Minerals
- Cement industry
- Chemistry
- Food industry

WHAT DOES INERTING MEAN?

The target of inerting is the reduction of O_2 in explosive atmospheres. Inert gases like CO_2 / N_2 have a low level of reactivity and reduce the Oxygen below the Limiting Oxygen Concentration (LOC).

robecco GAS ANALYSER SYSTEM

Technical characteristics:

- Measurement systems, monitoring and control units for different gases (e.g. O_2, CO, CH4, etc.)
- Extractive gas sample systems with sample probes and sample lines
- Measurement of process safety related parameters
- Flexible sample lines
  - lengths
  - power
  - heated and non heated version
- ATEX certified equipment for explosive areas

Gas Analyser Cabinet, robecco GAS

robecco GAS ANALYSER SYSTEM

Gas Analyser RGA CGM-5

Sample Line RSL

GAS Sample Probe

robecco SECURE CENTER

robecco secure center is a **central fully-automatic control system**, which guarantees the inert atmosphere during chemical and physical processes.

Sensors and actuators are connected to the system which prevents effectively dangerous process situations.

robecco secure center controls and regulates the following components:

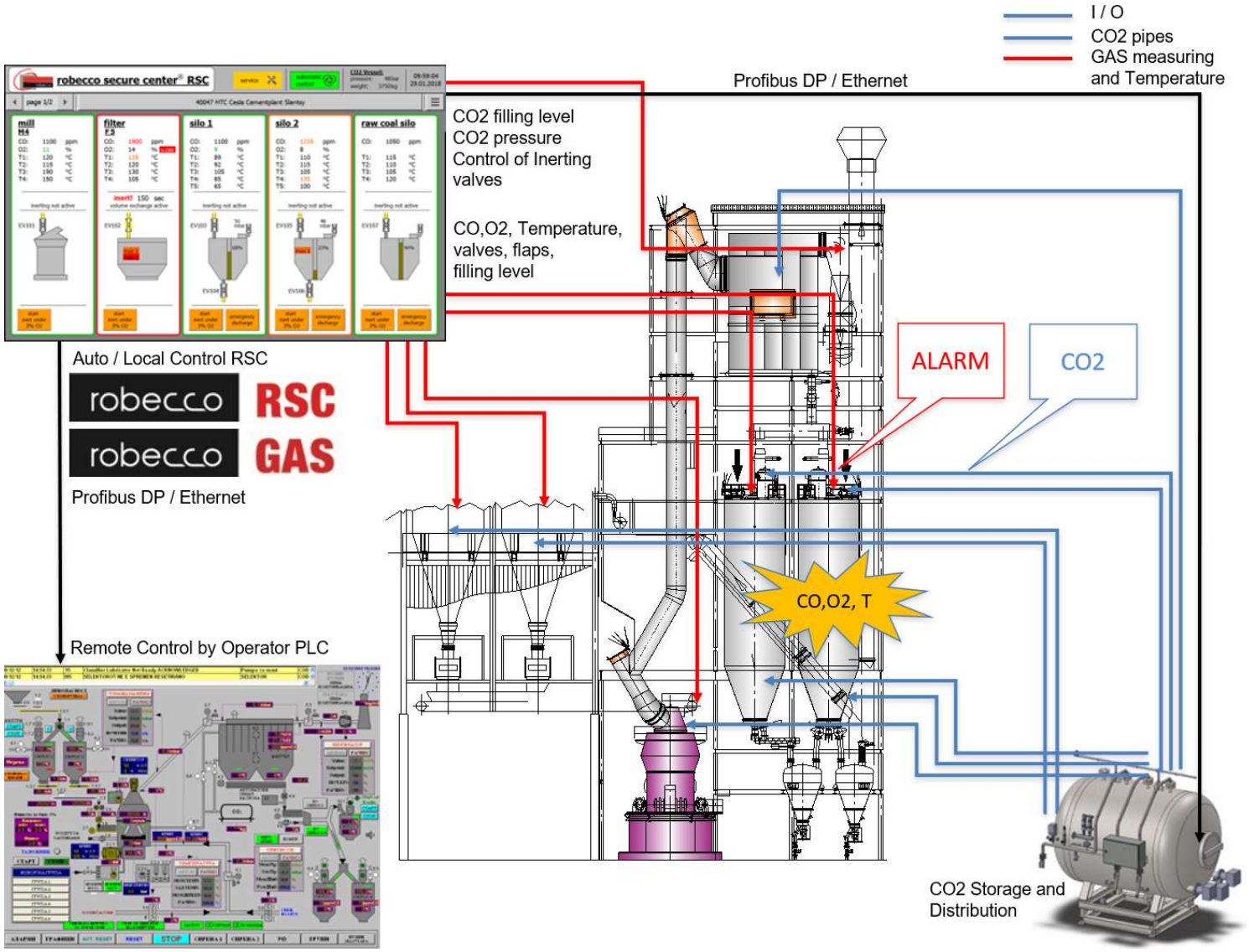
- **Gas Analyser System**
- **Temperature Sensors**
- **Inerting Systems**
- **Valves and Flaps**

robecco SECURE CENTER

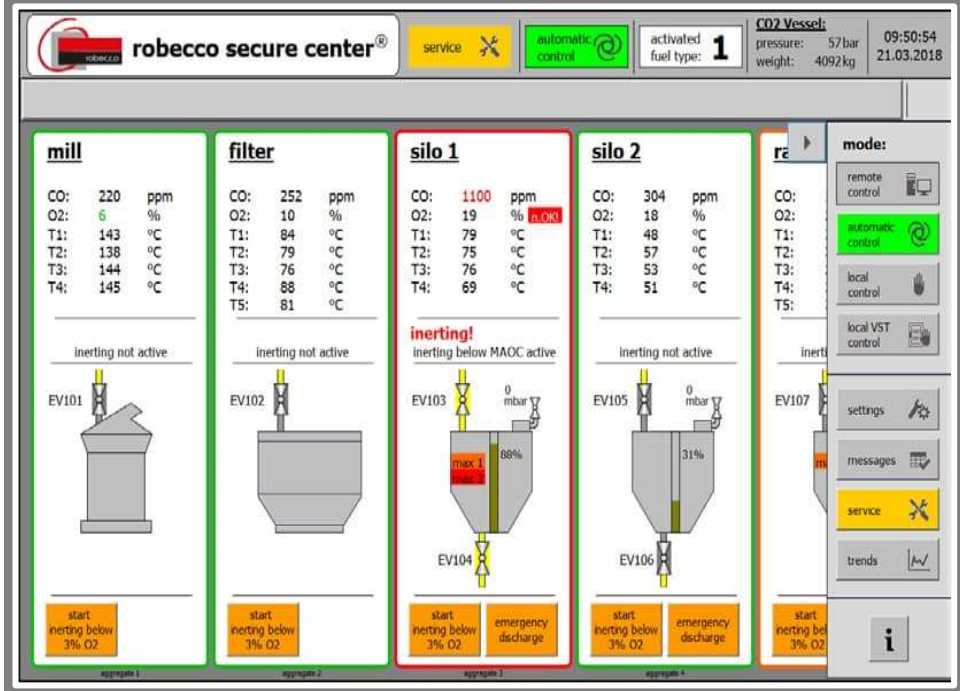
Technical characteristics:

- Visualisation of the complete inerting process
- Fully adaptable at CCR operator
- Service and Maintenance monitoring
- Remote maintenance available
- Failure indication in plain text messages
- Trend view and data memory
- Self-sufficient system functions without upper PLC control
- Exact CO_2- or N_2- dosing regarding effectiveness and environment
- Monitoring of CO_2- or N_2- storage guarantees the procurement and stock on time
- Monitoring of system-relevant functionalities of the inerting system, gas analyser systems and temperature sensors
- Automatic determination of maintenance intervals of single components independent from operation duration or malfunctions

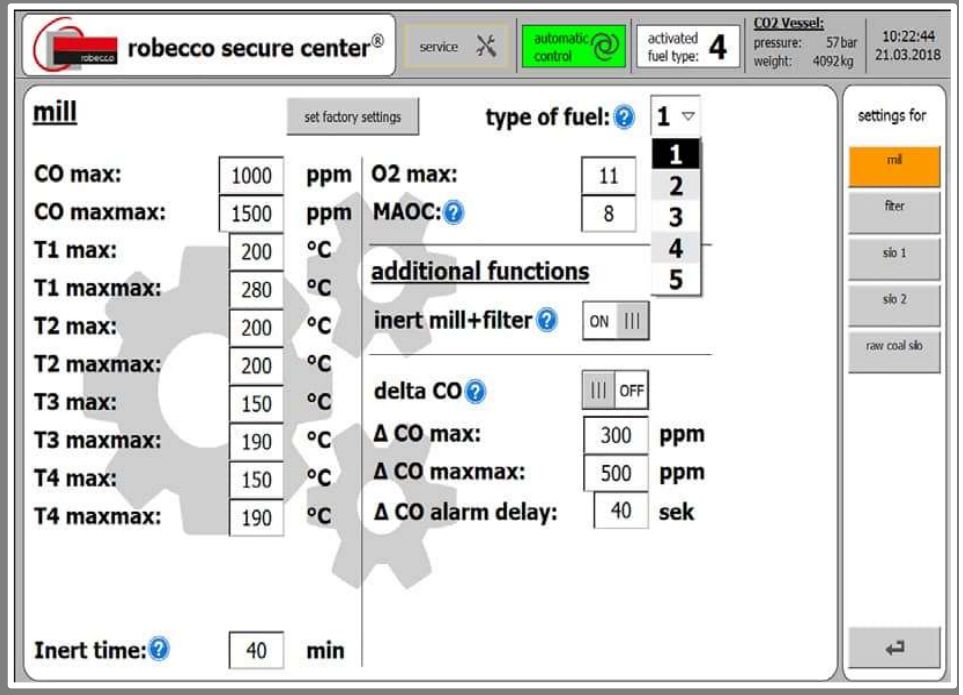
robecco SECURE CENTER



robecco SECURE CENTER



Main Operation Screen



Setting Table

CO_2 / N_2 Inerting Theory

Calculation of capacity + storage volume guidelines dust (VDI 2263-2/CEN/TR 15281)

Storage capacity:

- The maximum gas volume will be stored min. 2 / 3 x geometrical volume of all aggregates and an additional minimum reserve capacity of 25%
- The maximum gas volume has to be discharged within 30 - 60 min
- Extinguishing Smoldering or Glowing Fires is only possible at O_2 concentration max. 2 - 3 % hard coal, lignite / < 2 % biomass pellets

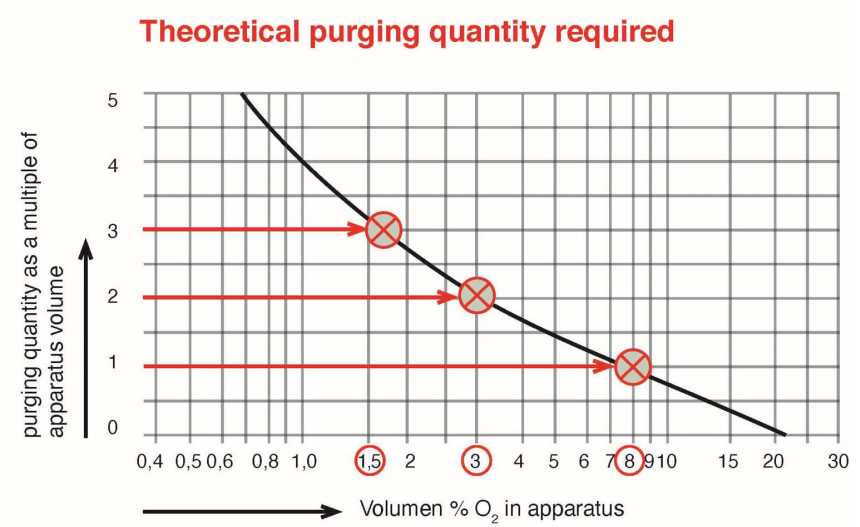


Figure 7:
ESCIS Expert Commission for the Safety in the Swiss Chemical Industry
Inerting – Method and Measures for the Avoidance of Ignitable Substances-Air Mixtures in Chemical Production Equipment and Plants

CO_2/N_2 Inerting Theory + Guidelines Dust (VDI 2263-2 / CEN/TR 15281)

To guarantee safe operation in case of CO-, O_2-, or temperature alarm it is necessary to inject inert gas.

Operation of inerting system is automatically started at **robecco Secure Center or PLC system**, additionally **LOCAL OPERATION** and **EMERGENCY OPERATION** at valve station is possible.

RECOMMENDATION

Necessary inert gas quantity has been reached when **geometrical volume in m³** of single aggregates (**coal mill, filter, silos…**) are purged.

Explosive atmosphere = Inert gas (1 : 1)

2 kg liquid CO_2 = 1 m³ inert gas

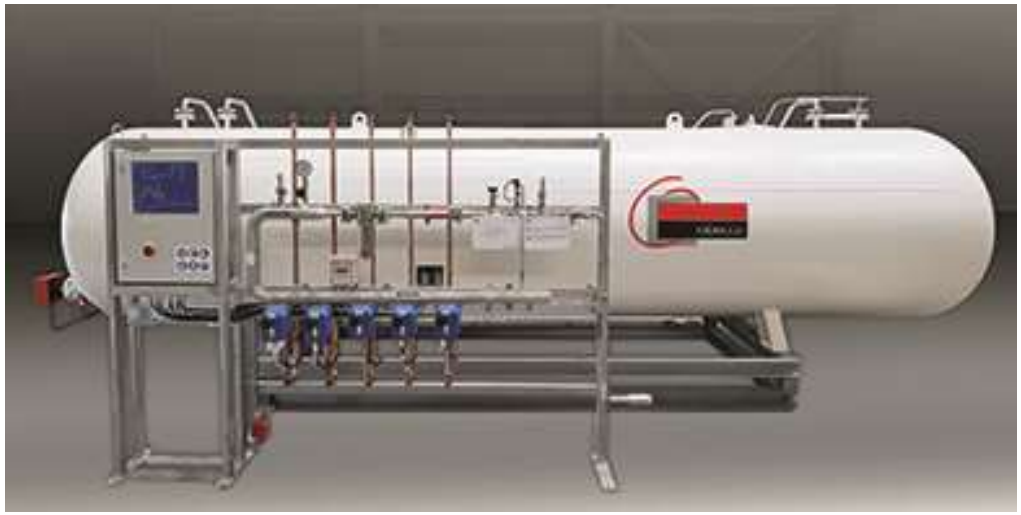
Adequate inerting to be under LOC (Limiting Oxygen Concentration) is ensured:

1 m³ inert gas (CO_2 or N_2) **as per m³ empty volume for avoiding dust explosions**

Higher inert gas rates are necessary for extinguishing smoldering fires

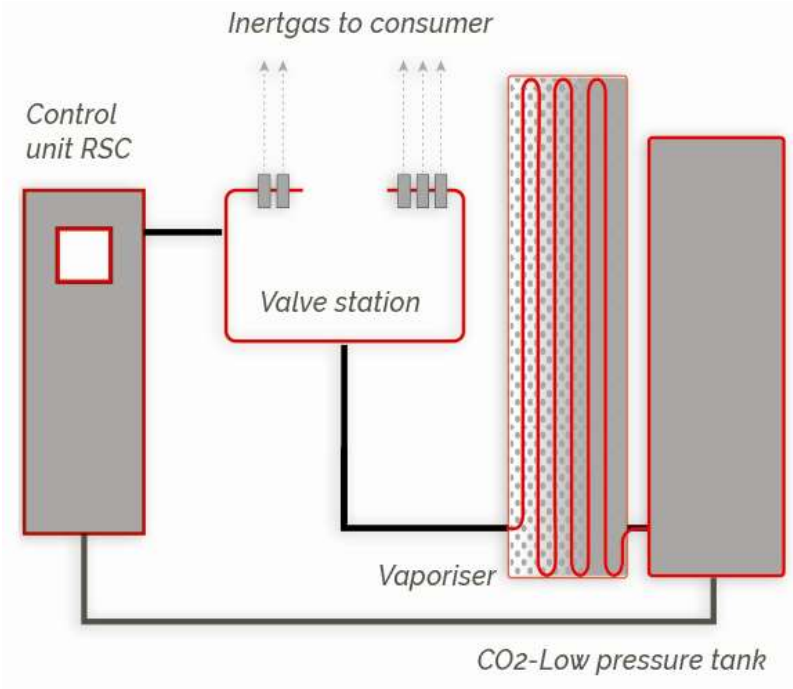
CO_2 High And Low Pressure System

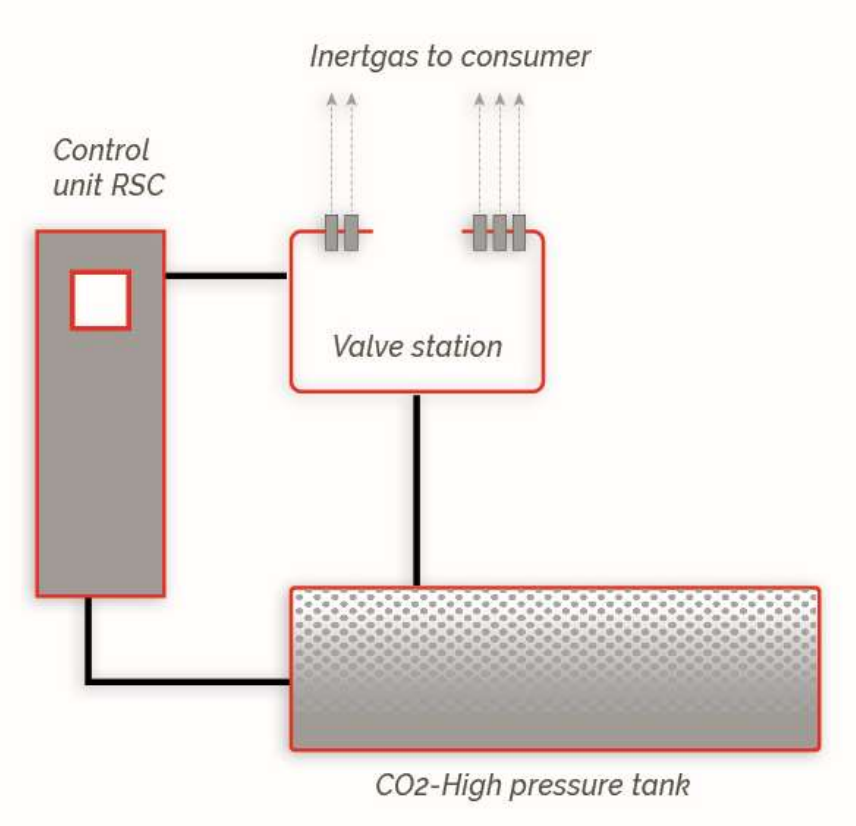
CO_2 Low pressure Inerting system



CO_2 High pressure Inerting system

CO_2 LP system vs. CO_2 HP System

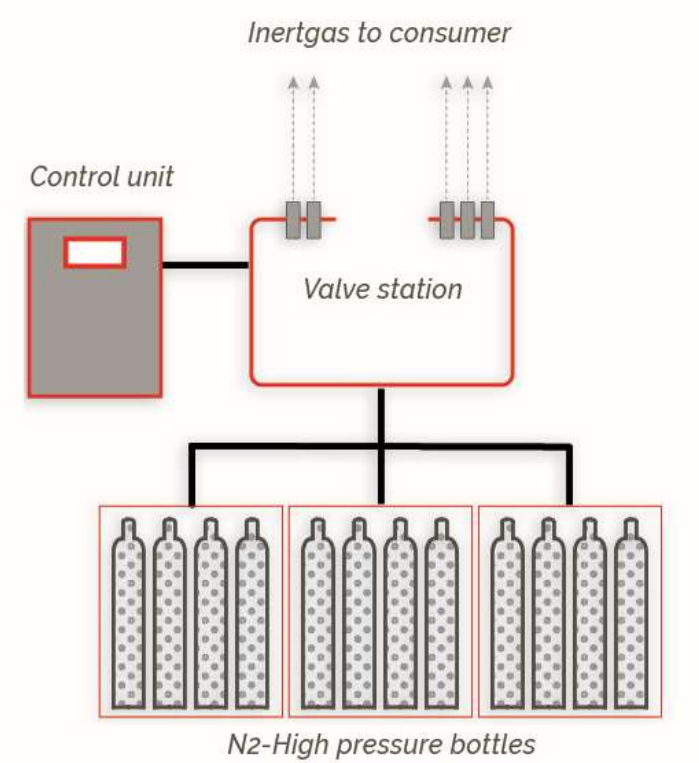




Schematic CO_2 Low Pressure

Schematic CO_2 High Pressure

CO_2 / N_2 -Batteries And / -Packs



CO_2 BATTERIES or **N_2 PACKS** are used for small coal grinding workshops, silos or similar installations in countries with infrastructural disadvantages.

N_2 packs solution are preferred - no need of weighing devices and simple pressure controlled inerting trips.

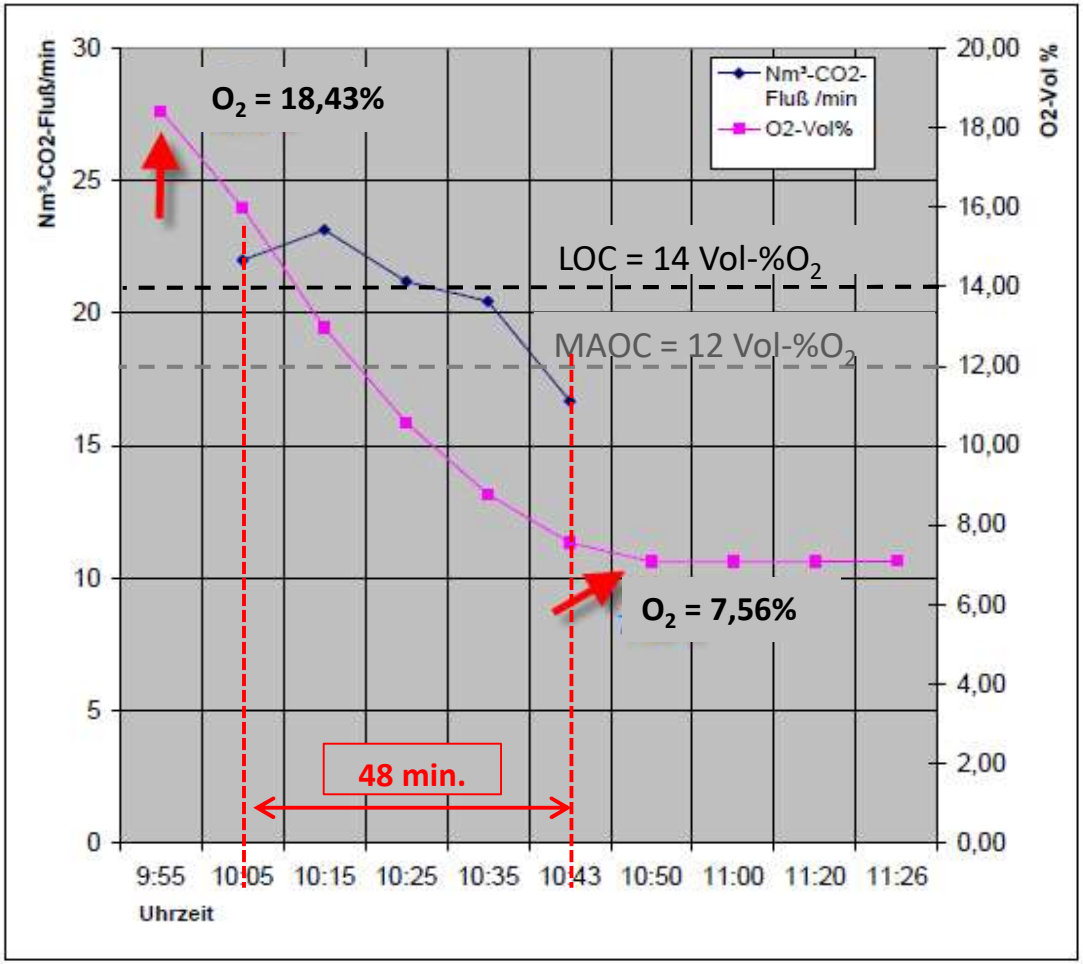
CO_2 / N_2 Inerting In Operation

Practical Inerting-Test at RWE Power in 2012

1.100m3 lignite silo

Reduction of O_2 level by injection of 2.000 kg

Comment	Time	Tank pressure	Tank weight (kg)	O_2 –Vol %
Start	9:55	62	10.035	18,43
	10:05		9.595	16,00
	10:15	52	9.132	12,97
	10:25	48	8.708	10,58
	10:35	44	8.299	8,78
Stop	10:43	42	8.032	7,56
	10:50			7,08
	11:00			7,08
	11:20			7,08

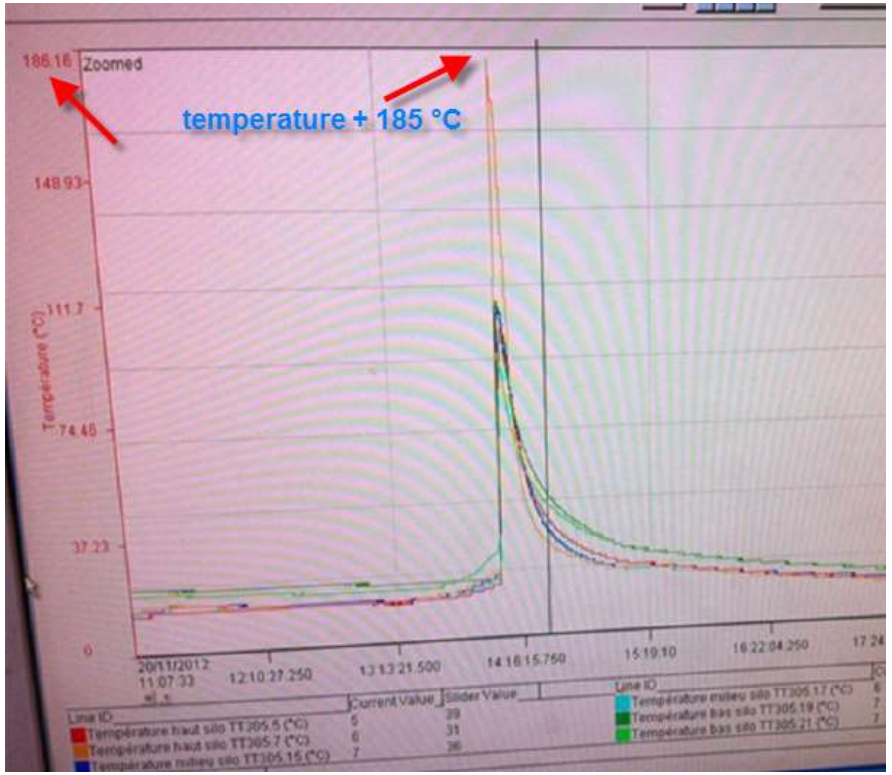


CO_2 Inerting Systems 500m3 Lignite Silo

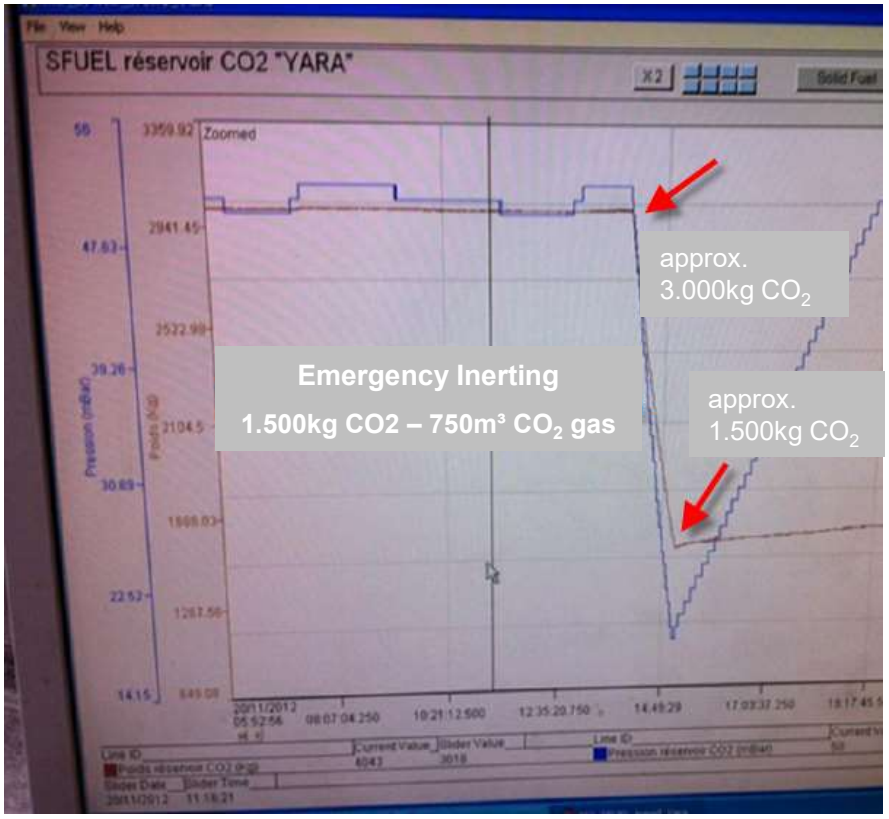
Glowing fire detected by gas and temperature monitoring system.

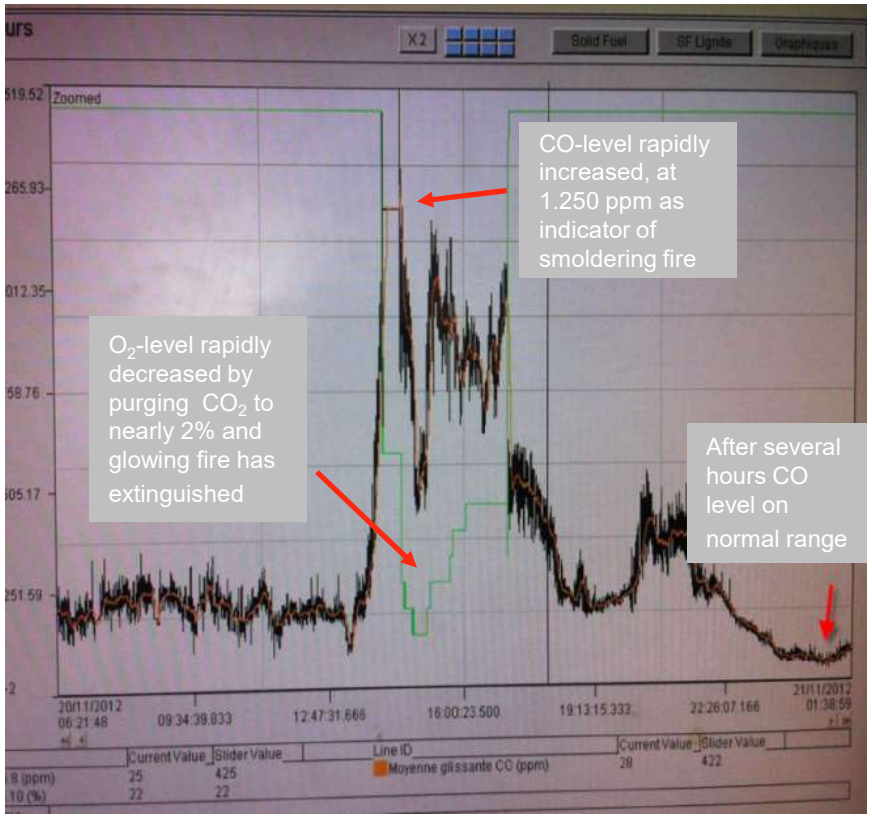
Successfully suffocated by CO_2 inert gas injection

Fully burnt dedusting filter



CO_2 Inerting Systems 500m3 Lignite Silo

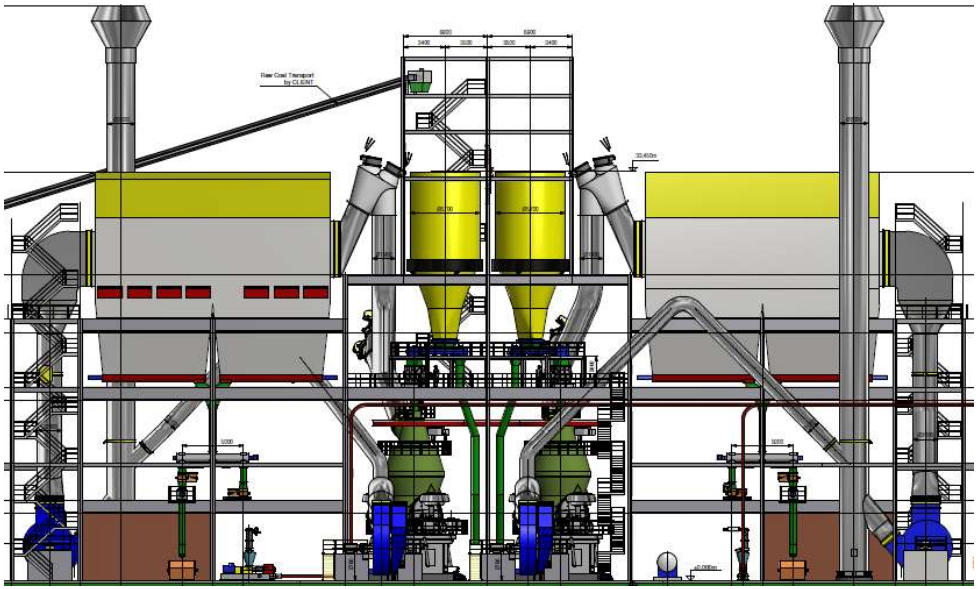




Coal Grinding P.T. Indocement Citeureup

Installation of Inerting systems at P14 line in 2016 by Sinoma TCDRI. Replacement and Retrofit of all inerting systems + robecco secure center for P1 – P4 / P6 - P11 in 2018. Coordination Indocement Technical Management.

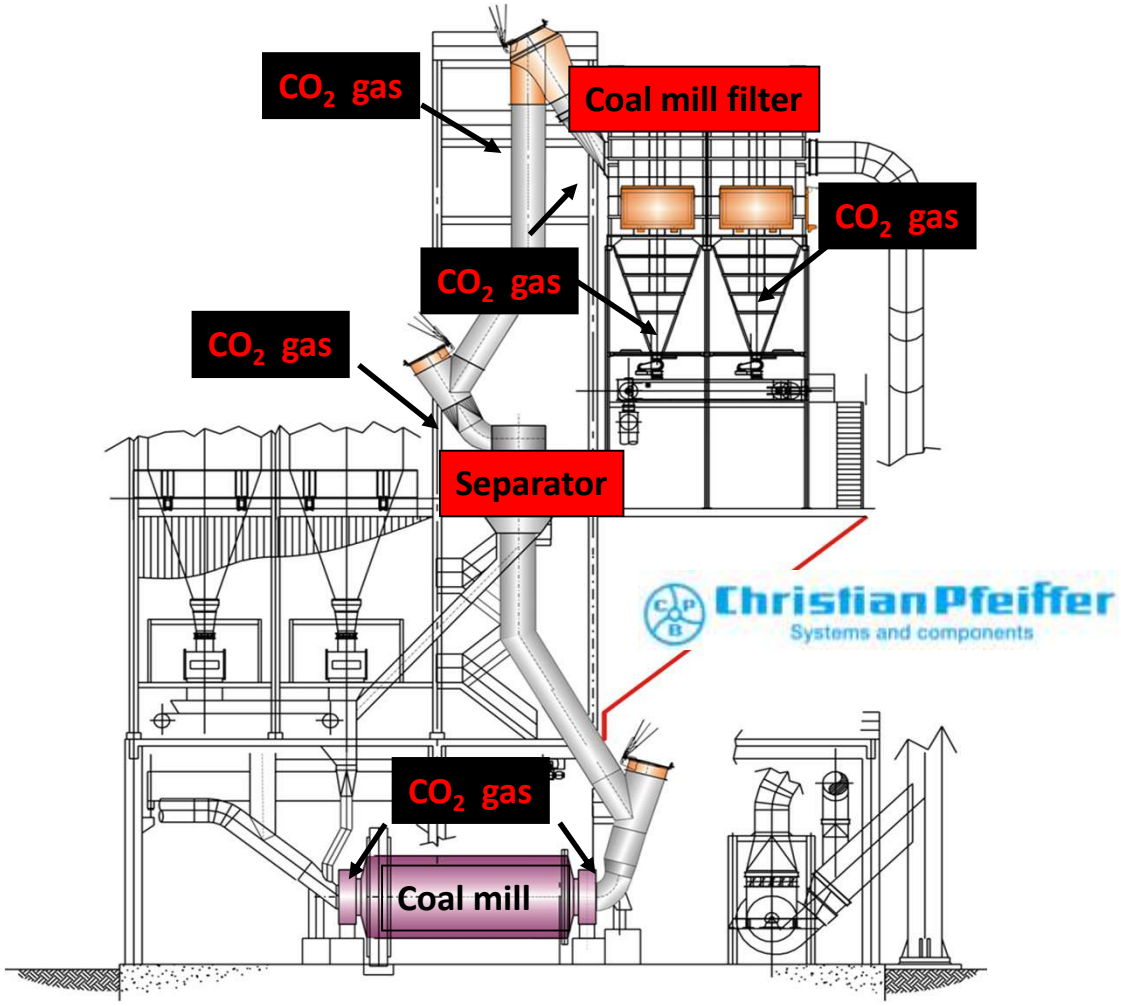
Design of inert system acc. to Heidelberg Cement standard safety specifications



Explosion Protection Horizontal Ball Mill

Safe operation of coal grinding plants requires several independent safety systems. PREVENTIVE EXPLOSION PROTECTION as well as CONSTRUCTIVE EXPLOSION PROTECTION.

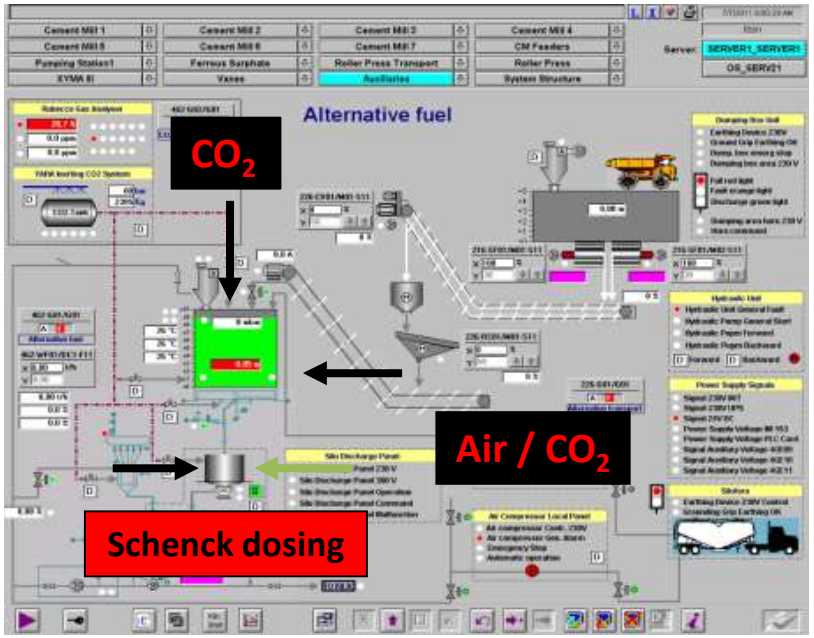
HC OJSC Slantsy Cesla, Russia
Intercement Amreyah, Egypt



Dried sewage sludge silo 365m³

Since 2010 a lot of alternative fuel projects with **Schenck Process Multiflex MTF technology.**

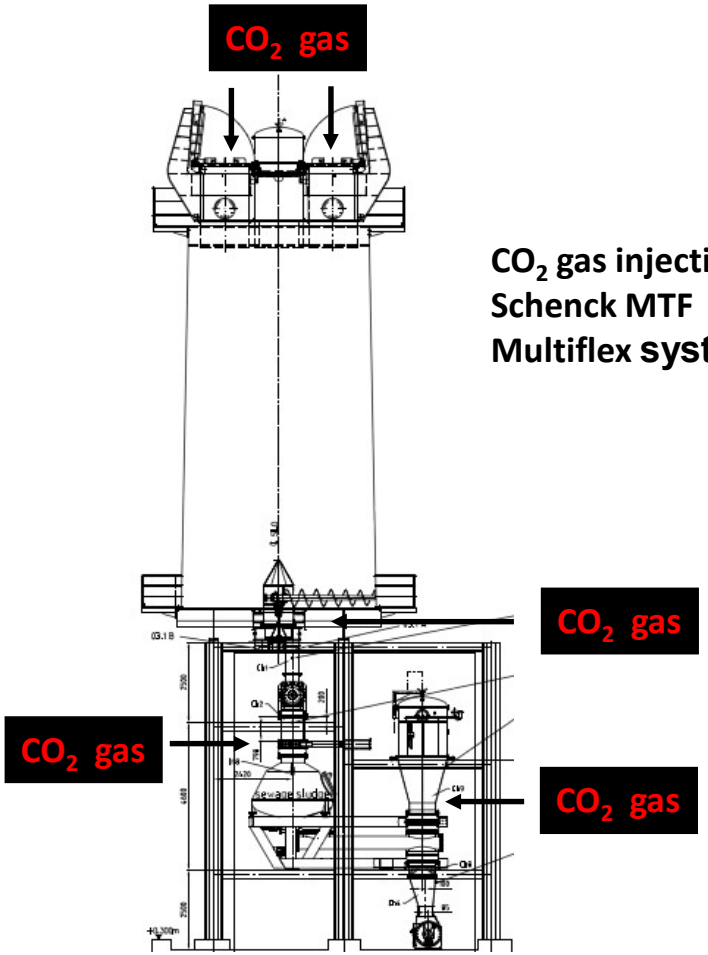
The substition of coal, anthracite, lignite, waste coal by alternative fossil fuels like **dried sewage sludge, biomass pellets, wood powder, animal powder** etc. more and more plays an important role in cement industry.



Inerting alternative fuels dosing system

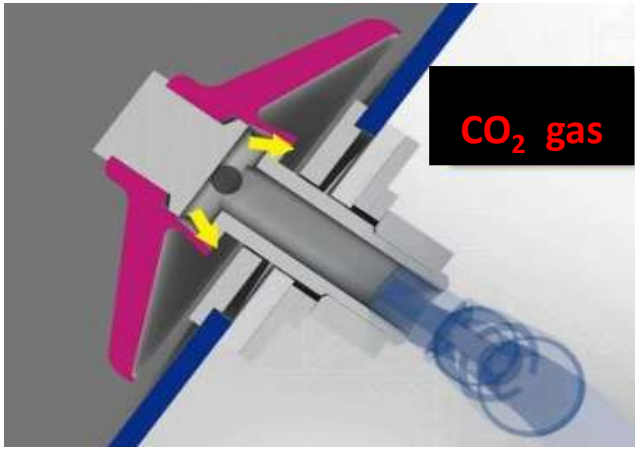
Silo for alternative fuels e.g. sewage sludge or wood powder with Schenck MTF Multiflex dosing system.

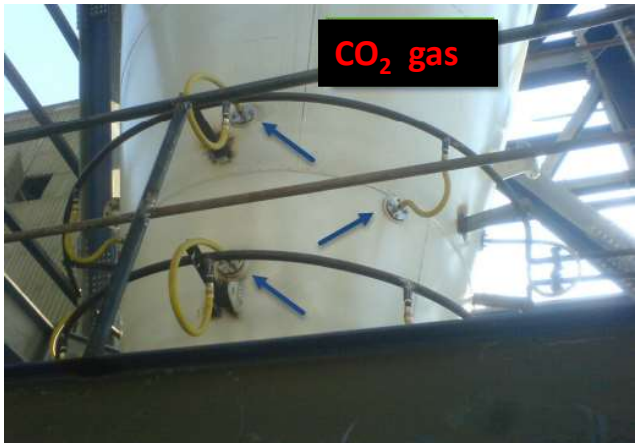
SCHENCK



CO_2 gas injection Schenck MTF Multiflex system

Sewage sludge silo Akcansa Turkey (HC)





Dried sewage sludge silos are operated by geometrical volumes 100m3 - 1000m3.

Erection in conventional cone or flat bottom silo design.

Also here dedicated inerting technologies will be installed at silo cone or flat bottom in order to be able to extinguish smoldering fires.

YOUR BENEFITS

Advantages by using
robecco Monitoring / Control / Inerting Systems
for preventive explosion protection:

- less production stops
- less drop in sales
- operator friendly use
- local / remote control
- systematic monitoring
- optimized maintenance
- Prevention of explosions and fires
- maximum safety

safety = high productivity