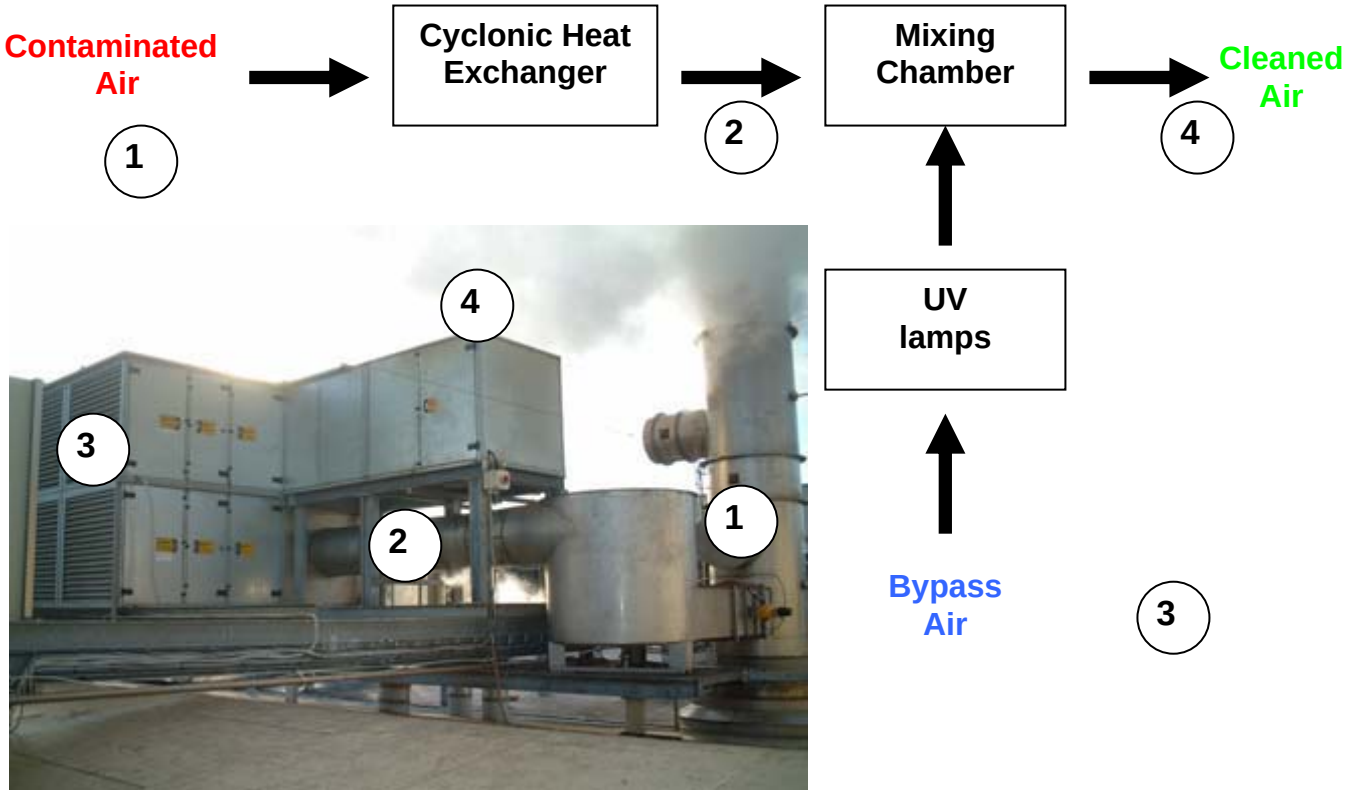
*bio*climatic GmbH
Im Niedernfeld 4
31542 Bad Nenndorf, GERMANY
Tel.: +49-5723-9440-0
FAX: +49-5723-9440-30
E-Mail: info@bioclimatic.de

Chips frying line: emission treatment: Odour abatement via Cyclo-Photo-Oxidation

1. Concept description:

The Cyclo-Photo-Oxidation odour abatement concept has been especially designed for odour removal from hot emissions with high humidity content, like emissions from frying & cooking processes, with possible heat recovery.
This concept combines the “cyclonic heat exchanger” with the “PHOENIX photooxidation in bypass”; The “heat exchanger” first separates the particulate contaminants (oil droplets, soot particles,…) and recover, if requested, a part of the heat in order to produce hot fluids; Afterwards, the “PHOENIX photo-oxidation in bypass” system abates the resting volatile organic molecules by injecting oxygen radicals produced by treating fresh air with UV-C lamps.
Since the flow of photo-oxidised air is much lower than the emission flow (around 15-20% of the emission flow), this system is financially interesting for high flow emissions. The efficiency of this oxidation process increases with the temperature.



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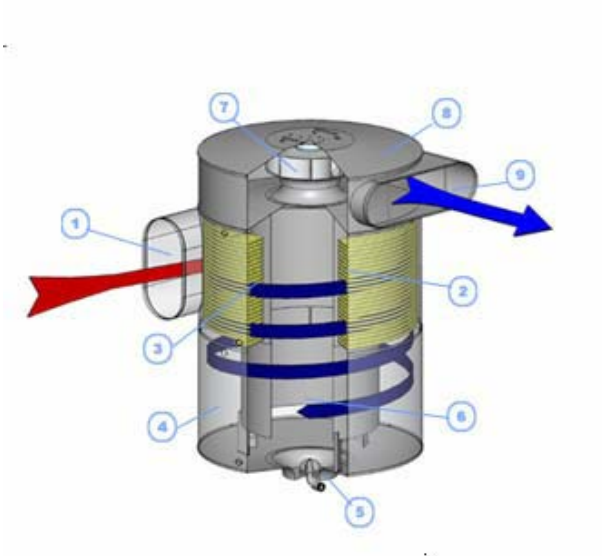
1.1 Cyclonic Heat Exchanger

The Cyclonic Heat Exchanger, integrates cooling coils in a cyclone.
Hot emission, contaminated with solid particles, fibres, oil mist, aerosols, micro-organisms, water dropplets,…can be simultaneously centrifuged and cooled down. Thanks to the very high centrifugal force created by the low slope of the coils, particles as small as 0.5µm can be removed without any mechanical filters and risk of clogging.
The heat from the emission can be transferred to heating or process fluids, like heating water and thermal oil.
Thanks to the high shear force, the Cyclonic Heat Exchanger is a kind of "self-cleaning process".
Water condensation creates a water film on the wall of the cyclone, that continuously evacuates the other contaminants to the drain.



1.2 Phoenix Photo-Oxidation in bypass

- Photo-Oxidation in bypass consists in injecting in the contaminated emission oxygen radicals (O*, OH-,…) produced by treating ambient air with lamps emitting short UV-C waves (100 to 280nm). This bypass flow is approx. 20 % of the emission flow.
- Short UV-C waves, from 100 to 280 nm, can dissociate oxygen molecules and water molecules:

$$O_2 + hv\ (185\ nm) \longrightarrow 2\ O^{\cdot}$$

$$H_2O + hv\ (185\ nm) \longrightarrow OH^{\cdot} + H^{\cdot}$$

This conversion is the first step of a chain reaction process that generates highly reactive oxygen species like atomic oxygen, hydroxyl ions, peroxide, etc with an increased electron energy state.

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For example:

$$O_3 + hv\ (254\ nm) \longrightarrow O_2 + O^{\cdot}$$

$$O^{\cdot} + H_2O \longrightarrow 2\ OH^{\cdot}$$

This highly reactive air mixed in a hot emission quickly oxidizes the odorous components.

- Advantages of cyclo-photo- oxidation:
  - ✓ Harmless gaseous reaction products
  - ✓ Very low energy consumption
  - ✓ No fluid & reagents supply
  - ✓ Little condensates
  - ✓ No start-up time and high flexibility
  - ✓ Almost no maintenance (lamps must be changed after 8.000 oh)
  - ✓ Outdoor location possible

2. Installation parameters:

Customer:	Veurne Snack Foods / Belgium
Contaminants:	odours and fat from potato chips frying lines
Flow rate:	2 x 15.000 Bm³/h
Temperature:	max. 140 °C
Rel. humidity:	max. 100 %
Power consumption:	2 x 8 kW
Measurements:	olfactometric measurements conducted by EPAS Belgium
Efficiency:	> 90 %
Result:	BAT installation (***B***est ***A***vailable ***T***echnology)

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