#05

EPOS TECHNOLOGY FOCUS

Technologies for industrial processes

May 2018

FLUE AND PROCESS GASES

Recovery and abatement of volatile organic and inorganic compounds (part 2)

EPOS

SYMBIOSIS IN INDUSTRY

About the EPOS Technology Focus

Within the scope of the EPOS project, extensive literature and market research reviews were performed in order to identify different technological, organisational, service and management solutions that could be applied to different industrial sites and clusters. The collected information will aid in establishing on-site and/or cross-sectorial industrial symbiosis opportunities; additionally, to enhance overall sustainability, performance and resource efficiency of different process industry sectors. Through the cooperation of project partners, a longlist of different technological options was created. Resource material for this list included: scientific articles, project reports, manufacturer's documentation and datasheets.

FLUE AND PROCESS GASES

The emission of flue gas is one of the most significant issues that process industries must deal with. Flue gas is a result of combustion, taking place in ovens, furnaces, boilers, etc. The composition of the flue gas relates to the type of source that is burned; mainly consisting of water vapour, carbon monoxide, carbon dioxide, particulates, nitrogen oxides and sulphur oxides.

Flue gas emissions have a significant impact on the environment, as such, there were many incentives in recent decades from regulatory bodies and national governments in order to reduce emissions and enhance sustainability of the critical industry sectors. Numerous measures and environmental standards were established. Industries were encouraged to invest and develop new technologies for emissions reduction and utilise the remaining emissions for other activities on industrial sites (e.g. lime production from desulphurisation, liquefaction of CO_2, etc.). This resulted in the establishment of several IS options that are now commonly used.

Treatment of flue gas and utilisation of the opportunities that are offered by different technological options contributes not only to reduced emissions and consequently, reduced costs from penalisation fees, but also offers new options for industries to generate additional revenue, i.e. from re-using or selling products obtained from flue and process gases (lime, liquid CO_2, etc.).

RECOVERY AND ABATEMENT OF VOLATILE ORGANIC AND INORGANIC COMPOUNDS

The techniques identified here are for the treatment of flue and process gases. The focus is on recovery and abatement of volatile organic and inorganic compounds; recovery and abatement of particulates; carbon capture, storage and utilisation techniques; utilisation of waste fuel/methane and flue gas monitoring.

- Bio-trickling
- Moving-bed trickling filter
- Thermal oxidation
- Catalytic oxidation
- Ionisation
- Photo/UV oxidation

TECHNOLOGIES FOR THE RECOVERY AND ABATEMENT OF VOLATILE ORGANIC AND INORGANIC COMPOUNDS

Technology 1: Bio-trickling

Bio-trickling filters are a combination of a bio-filter and a bio-scrubber. The bacteria responsible for decomposition are immobilised on a carrier or filter material. The filter material consists of a synthetic foam, lava or a structured plastic packing. The surface must have a structure that allows biomass to bond to it effectively. [1]

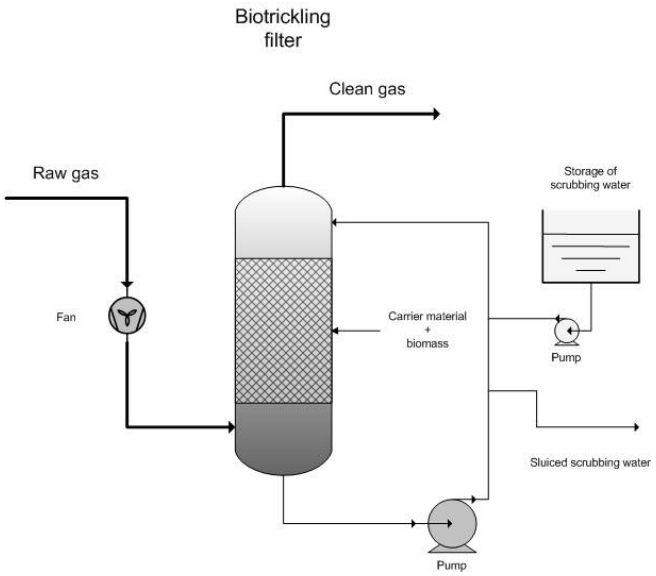

Figure 1 Bio-trickling filter [2]

Applicability

For the abatement of low concentrations of pollutants that are easily soluble in water and readily biodegradable. It is widely used in various industry sectors, especially in the chemical industry.

Maturity

Commercial.

Envirogen bio-trickling filters.

Technology 2: Moving-bed trickling filter

Moving-bed trickling filters are biological filters used to treat both air and water simultaneously, and are similar to the bio-trickling filter. The moving-bed trickling filter consists of a large number of synthetic balls contained in a tank. The synthetic balls are grooved so that microorganisms can grow on them. It is these microorganisms that breakdown the incoming pollutants. [1]

Figure 2 Trickling filter [3]

Applicability

For the combined cleaning of air and water streams, mainly contaminated with organic substances that are soluble in water. It is used in various industry sectors, especially in the chemical and petrochemical industries and waste processing.

Maturity

Commercial.

Project/product reference

MBTF in Lucite Diakon plant.

Technology 3: Thermal oxidation

Thermal oxidation is a process through which hazardous air pollutants and/or volatile organic compounds found in waste gas streams are decomposed through an oxidation process, using air or oxygen as a carrier gas and the resulting products of the reaction are CO_2 and H_2O. The three factors for thermal oxidation are: the temperature for heating above the auto-ignition point, the ability to maintain a high temperature to ensure complete combustion, and the turbulence of the reactions. [1]

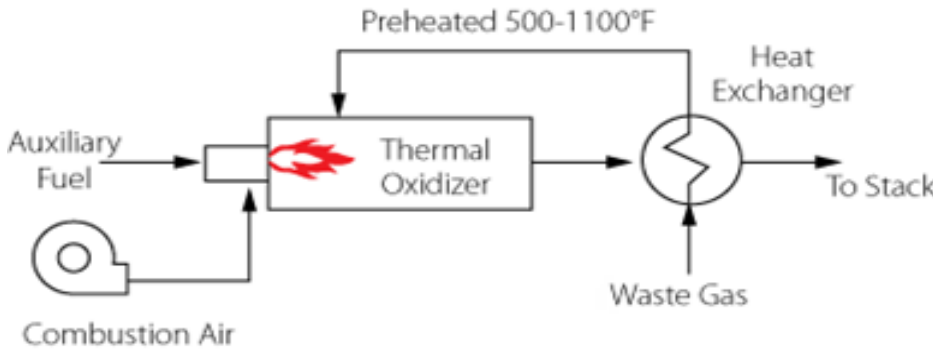

Figure 3 Thermal oxidation [4]

Applicability

For the reduction of emissions from almost all VOC sources with moderate to high VOC loadings, when there are minor fluctuations in flow. It is used to abate odour and total organic compounds in practically all industrial sectors.

Maturity

Commercial.

Project/product reference

Pollution Systems' Thermal oxidizer used by Feed Products Manufacturer: case study.

Technology 4: Catalytic oxidation

Catalytic oxidation is similar to thermal oxidation. The difference between the two is that after passing through the flame area in catalytic oxidation, it then passes through a catalyst bed. The oxidation rate reaction is increased by the catalyst, which, unlike in normal thermal oxidation units, allows for lower reaction temperatures. Using catalytic oxidation can result in lower costs. As a result of faster reaction times and reduced reaction temperatures, there is a reduced fuel requirement; additionally, it is typical that smaller units can be used. [1]

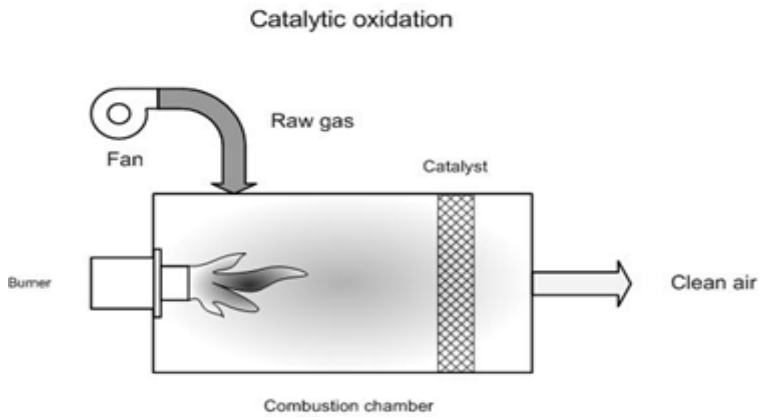

Figure 4 Catalytic oxidation [1]

Applicability
For the reduction of emissions from a variety of stationary sources.

Maturity
Commercial.

Project/product reference
Anguil's Catalytic oxidizer used in automotive industry - case study.

Technology 5: Ionisation

In the ionisation process, electrodes are used to generate a very strong electrical field within a reaction chamber; as the incoming gas flows through, ions, free electrons, radicals and other highly reactive particles are formed. During the decomposition and oxidation of the pollutants, the gas stream is considered to be in a state of cold plasma, as there is no significant increase in temperature. [1]

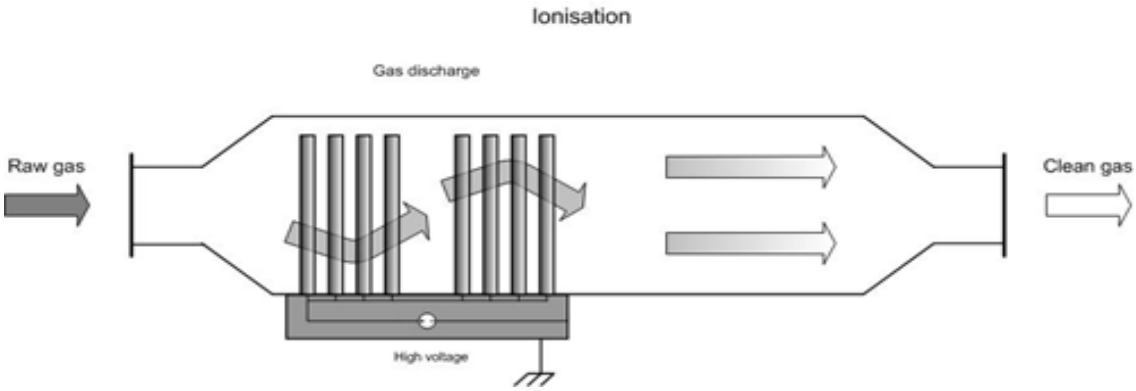

Figure 5 Ionisation [2]

Applicability

For the treatment of waste gases with low concentrations of VOCs and in cases where thermal/ catalytic oxidation is not effective.

Maturity

Commercial.

Project/product reference

Uniqair plasma injector.

Technology 6: Photo/UV oxidation

Photo-oxidation is the degradation of a polymer surface in the presence of oxygen or ozone. The effect is facilitated by radiant energy such as UV or artificial light. This process is the most significant factor in the weathering of polymers. [1]

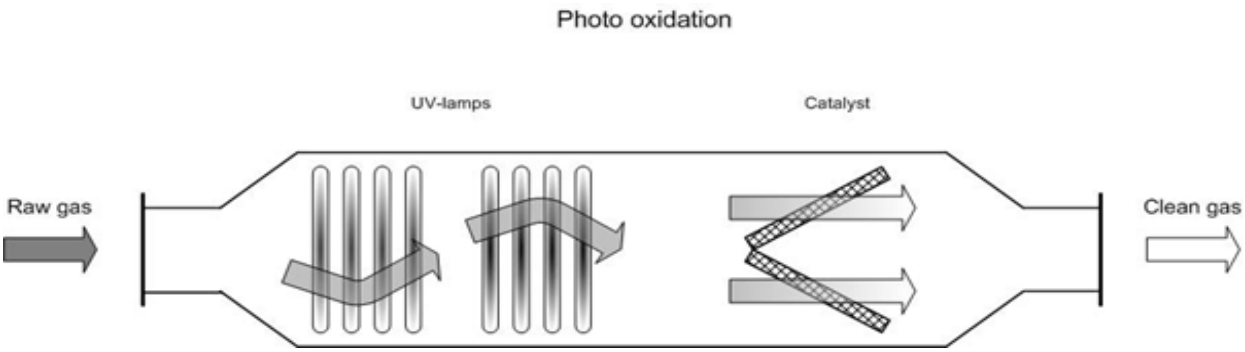

Figure 6 Photo/UV oxidation [2]

Applicability

For the treatment of flue gas. It is used in coating installations, waste treatment installations, fermentation processes, etc.

Maturity

Commercial.

Project/product reference

Enviolet UV oxidation units.

REFERENCES

1. "Best Available Techniques (BAT) reference documents (BREFs): "Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector," [Online].
2. "LUSS tool," [Online].
3. "RCL Moving bed trickling filter," [Online].
4. "What are thermal oxidizers?," [Online].

All the EPOS TECHNOLOGY FOCUS Acts could be found on www.spire2030.eu/epos (Section Outcomes/Publications)

CREDITS

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