PLASMACAT®

Waste Gas Treatment

Additional Information

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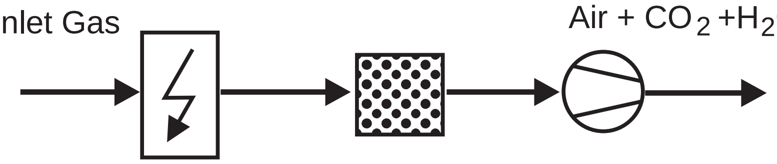
PLASMACAT® - Clean air at low cost

1 Description of the PLASMACAT Process

PLASMACAT is a new, high energy-saving technology for the treatment of gaseous pollutants. The standard process consists of 2 stages, as shown in the following flow-diagram:



In the excitation stage, the molecules of the waste gas are excited by an alternating electrical field of several thousand volts. The gas molecules at departure from the excitation stage are in a condition of vibration which is theoretically equivalent to heating to several thousand degrees centigrade, without the gas itself changing in temperature to any significant degree (so-called cold plasma).

Next the gas is fed over a contact catalyst, which also operates at ambient temperature, where the contaminant molecules are completely oxidised. The contaminants are then converted into harmless compounds (e.g. hydrocarbons in CO_2 and H_2O), without the creation of any by-products.

The theory behind the process has been known for some time. To date, however, nowhere in the world has it been economically viable to apply it in practice in industry. The reasons for this are chiefly the design and method of operation of the excitation stage (problems with condensation, electrical breakdown and materials).

The PLASMACAT process is protected by patents both in Switzerland and internationally.

1.1 Fields of Application

- **Odour elimination** (e.g. in the food industry, sewage treatment plants, composting plants, tobacco industry, sludge treatment, etc.).
- Inlet air purification (e.g. for air-conditioning or special applications).
- Removal of **solvents** in low concentrations from exhaust air (varnish, paint, and printing industries, etc.).
- **Decontamination** of toxic substances.

1.2 Decontamination Efficiency

It is not possible to give the attainable purity of the gas in general terms. In many cases, air treated by PLASMACAT may even be used as plant or factory ambient air. This leads to *considerable additional energy savings* during the period when heating is required.

Example 1:

Odour from a municipal waste waster treatment system containing H_2S, mercaptens and other stinking products.

Input:	80’000 odour units
Output:	c. 200 odour units

Example 2:

Odour from the food processing industry

Input:	c. 80 ppm (extremely pervasive odour)
Output:	odourless

Example 3:

Odour from the production of animal food

Input:	c. 7,000 - 35,000 odour units
Output:	c. 100 – 200 odour units

Example 4:

Odour Treatment after a Burley dryer in the tobacco industry.

Input:	17’000 odour units
Output:	500 odour units
Power requirement for excitation	6 kW for 12’000 m^3/h

Example 5:

Toluene (and similar solvents)

Input:	c. 100 mg/m^3
Output:	c. 10 mg/m^3

1.3 Investment Costs

Since a PLASMACAT plant has to be individually designed for each application (degree of excitation, catalyst), it is difficult to provide general, reliable figures concerning investment costs. We would be happy to provide an estimate for specific applications.

1.4 Energy Consumption

The energy consumed in the excitation stage, depending on the application, is about

0.5 - 3 Wh per m^3 of exhaust air. For odour problems, the lower end of this range is more applicable.

A PLASMACAT system, therefore, for a volumetric flow of 1000 m^3 / hr consumes in the excitation stage c. 0.5 - 2.5 kWh of energy per hour. The exact value depends on the type of contaminant, its concentration, and the air humidity.

In addition, there are the power requirements of the fan.

1.5 Innovative Technology

The PLASMACAT process is a *new* process and not a further development of an existing technology. Its uniqueness lies in the production of a cold plasma: it is generated in the excitation stage, not through heating, but rather by the transfer of energy from an electrical field.

Thanks to the very efficient, selective excitation of the contaminant molecules, the requirements of energy are lower by some multiples than, for example, those of incineration. This becomes a very important consideration when the concentration and/or the energy content of the waste gas is low, which in the case of incineration requires a great deal of some secondary energy source (oil, gas).

2 Competitive Processes

In the following, only the major and most commonly applied competitive processes are listed, along with a brief outline of their advantages and disadvantages. For certain specific applications, however, some of the processes listed here are either out of the question, or additional custom-designed processes would have to be included in the evaluation.

2.1 Processes for the Elimination of Contaminants

Thermal Incineration (TI)

The waste gas is heated to temperatures between 600 - 1000 °C, and the contaminant molecules oxidised in the ignition point range.

Advantages

- Tried and tested technology

Disadvantages

- High energy consumption
- Creation of additional emissions through the burning of secondary energy sources (gas, oil).
- Danger of the formation of nitrogen oxide from the atmospheric nitrogen
- High capital outlay

Catalytic Incineration (CI)

In order to avoid high-temperature incineration (TI), which is rarely economical, the reaction temperature is lowered with the help of contact catalysts. An oxidation decomposition of the contaminants occurs between c. 300 - 600 °C.

Advantages

- Proven technology

Disadvantages

- High energy consumption (particularly when the heat content of the waste air is low)
- High capital outlay (noble metal catalysts)
- Creation of additional emissions through the burning of secondary energy sources (gas, oil).
- In some cases, low serviceable life of the catalysts.

Biological Processes (earth filters, biofilters, etc.)

The decomposition of organic compounds through the agency of micro-organisms has been known for a long time, and is used successfully in the field of sewage purification. With the so-called biofilters, the waste air is fed through a peat-like biomass and decomposed at least partially.

Advantages

- Low energy consumption
- If a constant volume of waste gas, without fluctuations in concentration or composition of the contaminant, can be guaranteed, investment costs are relatively low.

Disadvantages

- Concentration fluctuations have to be evened out or they make the process ineffective.
- Continuous operation necessary
- Large amount of space required
- Heavy equipment and materials
- Certain toxic materials need to be avoided
- Disposal of toxic biomass problematic
- Low flexibility of the system.

2.2 Processes for the Reclamation of Contaminants

All recovery processes (e.g. condensation, adsorption, etc.) involve high investment and operating costs, which make the application of this process economically viable only for very expensive solvents and high concentrations. The purity which can be achieved in this process to maintain economical viability is often relatively poor, so a waste air plant (e.g. PLASMACAT) needs to be used afterwards in order to keep within the legal limits.

Advantages

- Ecologically beneficial.

Disadvantages

- High initial capital outlay
- High operating costs

👎 Reclaimed materials usually have to be treated further or safely disposed of.

3 How PLASMACAT Rates Against Competitive Processes

PLASMACAT is a combination process, which, if at all, may best be compared with catalytic incineration. The biggest difference lies in the manner by which the contaminant molecules are made reactive.

The heating of the entire gas flow to temperatures of c. 350 °C or higher is replaced in the PLASMACAT process by an excitation in an alternating electrical field. Since the PLASMACAT process requires no heating of the gas, there are *very great energy savings*. The exact amount of energy saved depends on the heat content of the waste gas undergoing treatment. The lower the energy content, the more secondary energy (e.g. oil, natural gas) needs to be used in the thermal process. The incineration of the secondary energy leads, in addition, to undesirable emissions in the form of CO_2, CO, NO_x, etc.

Since with a *constant* supply of high concentrations (at least several g/m^3, depending on the contaminant), little secondary energy is required for catalytic incineration, PLASMACAT is particularly suitable for small concentrations of contaminants. PLASMACAT will not be subject to taxation should a CO_2 tax be introduced in Switzerland, since no additional CO_2 is produced through the burning of secondary energy sources.

From a *theoretical* point of view, PLASMACAT may be applied for the treatment of organic and inorganic contaminants in concentrations up to the lower explosive limit (LEL). However, from an *economical* point of view, PLASMACAT may be applied in any case where at least one of the following conditions are fulfilled:

- The heat content of the gas is low (in particular for odour problems).
- High temperatures would be necessary if thermal processes were to be used (Example: chlorinated hydrocarbon, fluorocarbon, highly toxic substances, etc.).

Advantages offered by PLASMACAT

👍 Low energy consumption
👍 High purity of the treated gas
👍 Ease of use
👍 No generation of additional emissions
👍 Economical in particular for odour problems and low solvent concentrations
👍 Mobile plants are available for tests
👍 Modular design so that any air volume can be treated
👍 High reliability

4 Procedure for the Installation of a PLASMACAT Plant

4.1 Offer Phase

1. A potential customer provides Up-To-Date Environmental Engineering AG with the analysis data of its waste gas. On the basis of the composition of the gas, Up-To-Date makes a preliminary offer. Where necessary, Up-To-Date carries out preliminary tests with a small plant in its own laboratory.
2. If the customer is interested in a purchase, Up-To-Date demonstrates the applicability of the PLASMACAT process for his particular waste gas problem at its laboratory in Oberurnen.
3. If the customer requests it or if the waste gas problem can't be simulated in the laboratory, Up-To-Date can also carry out tests with a mobile plant on site. During such tests, air samples may be taken and analysed by an independent testing organisation. This demonstration is charged to the customer.
4. Clarification of technical questions and finalisation of the offer.

4.2 Implementation Phase

Development of a project plan with the customer. Up-To-Date Environmental Engineering AG takes over the planning and implementation of the plant, and is the sole contact with the customer.

4.3 Operational Phase

Either the customer himself or Up-To-Date Environmental Engineering AG or in some cases a local partner will be responsible for the care and maintenance of the plant during the operational phase.

5 Awards

Up-To-Date Environmental Engineering AG was founded in August, 1994. In the following year, through the "Technologiestandort Schweiz" competition, the PLASMACAT technology was chosen to participate in the Hannover Trade Show, and received the 1995 Environment Prize from the Foundation for Nature and the Environment of Switzerland.

In addition, PLASMACAT was awarded with the environmental award of M.U.T. (European fare for Environmental technology in Basel).

In 1999 Up-To-Date Environmental Engineering AG was awarded with the SME Oscar for innovative achievements from FDP Switzerland.

6 List of references

Since March, 1995, PLASMACAT waste air purification plants have been offered on the market. To date, the following plants have been sold:

Year	Plant/ Location
1985	Community sewage treatment plant, St. Moritz-Staz. Treatment of the expansion gases from the drying of sewage sludge with the ZIMPRO process. Prototype plant erected by Dr. E. Rohrer AG.
1989	Maggi AG, Kempthal (Nestlé). Odour elimination in the buffer tanks of the biological sewage treatment plant. Prototype plant erected by Dr. E. Rohrer AG. It has now been replaced by an industrial plant from Up-To-Date Environmental Engineering AG.
1995	Maggi AG, Kempthal (Nestlé). Odour elimination in the buffer tanks of the biological sewage treatment plant as replacement for the prototype plant. 1500 m^3/hr.
1995	Nestlé R&D Centre (2nd system for Nestlé). In operation since November 1995.
1996	Philip Morris AG, Neuenburg. Odour elimination for the treatment of tobacco, 12’000 m^3/hr.
1997	ETH Zurich, system for research purposes.
1997	Nestlé R&D Centre (3rd system for Nestlé). System put into operation in March 1998.
1997	Water corporation Melide / Vico Morcote / Carona. Odour treatment for the municipal waste water treatment plant. System put into operation in autumn 1997.
1998	Maggi AG (Nestlé) Kemptthal, Switzerland. Two Systems for the odour treatment of exhaust air after a production process. These systems were put into operation in October 1998. (4th and 5th system for Nestlé).

1998 Maggi AG (Nestlé) Kemptthal, Switzerland. Two Systems for the odour treatment of indoor air of a production building. These systems were put into operation in October 1998. (6th and 7th system for Nestlé).

1998 Schmidt-Feldbach GmbH, Feldbach, Austria. Leather industry. 2 systems for the odour treatment of the sludge processing and the waste water treatment, respectively. System was put into operation in November 1998.

1999 Schmidt-Feldbach GmbH, Feldbach, Austria. Leather industry. 2 additional systems for the odour treatment at the sludge processing plant. Systems were put into operation in February 1999.

1999 Unichema Italia, Cremona, Italy. Odour treatment in the oil industry. System was put into operation in April 1999.

2000 UFA AG, Lenzburg, Switzerland. Treatment of odour after the production of animal food. 22'000 m^3/h. In operation since August 2000.

2000 Delipet AG, Switzerland. Treatment of odour after the production of pet food. 2 units for 3000 m^3/h each. In operation since September 2000.

2001 Ciba Fine Chemicals AG, Germany. Treatment of odours at the company owned waste water treatment facility. Mobile unit built in a container.

2001 SGL Carbon, Germany. Treatment of odours at the production of brake-drums for automobiles.

2001 Philip Morris Kazakhstan. Treatment of odours of the tobacco processing. 2nd PLASMACAT unit for Philip Morris. Project realised together with an external partner as the general contractor.

Up-To-Date Environmental Engineering AG currently have 4 mobile plants available for tests in the laboratory, on-site and for hiring, with volumetric flows from 30 to 60 m^3/hr.

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