

Cold Plasma

The Smart Way of Odor Control in Pet Food Processing

The COPLAS [clean](#) system is a sustainable cold plasma oxidizer controlling odors without any chemicals, water or waste.





Why Reducing Odors During Pet Food Processing?

Due to the shortage of living space, more residential areas will be developed nearby production plants. This creates mixed building areas. Residents are therefore increasingly affected by noise and unpleasant smells. In the past, the need for odor control was often driven by legal compliance. Now, due to urbanization and environmental awareness, as well as quickly adapting social media tools,

pet food plants are increasingly looking for sustainable and economical solutions to prevent their surrounding community from complaining about their odor emissions. In addition, the local authorities are now taking complaints more seriously. In some cases authorities forced companies to stop production lines due to ongoing odor complaints by nearby residents.

What does the market need?

The need for odor control is growing. Above all, the market needs an effective and sustainable technology that does not require any chemicals, water or generate waste. Therefore, the cold plasma technology COPLAS **clean** was developed that precisely meets these requirements.

COPLAS **clean** at a glance

COPLAS **clean** utilizes the effect of cold plasma for creating reactive oxygen species that can eliminate odor emissions simply through the application of energy. These oxygen species are injected into the exhaust forcing a high-speed oxidation process without a direct contact of the dirty exhaust gas with the plasma system.

- High odor reduction up to 95%
- No use of water or chemicals, no generation of waste
- Space-saving system design
- Easy integration and maintenance (modular design)
- Adjustable power between 20 - 100 % in 1 % steps

Understanding the Pet Food Processing Regarding Odor Sources and Contaminants

The pet food industry comprises of wet and dry food. Dry pet food accounts for most of the pet food sales.² There are different ways to produce dry pet food; however, extrusion is the most used process.³ Especially, the processes of extrusion, drying and cooling tend to release highly odorous contaminants

with the exhaust air, which inevitably has to be let out through the chimney. These odors typically result of the physical processing of ingredients like heating, drying and cooling of foods in general. These emissions can influence the image of the companies, if surrounding neighbors register these smells.²

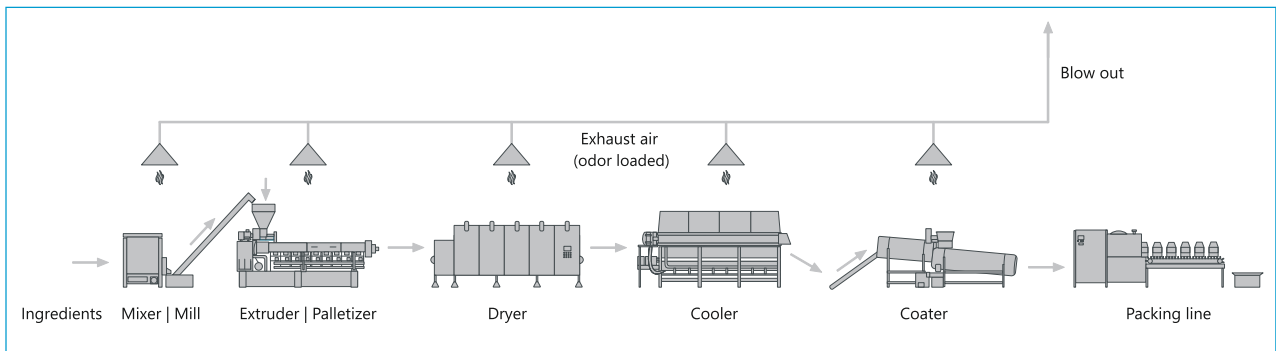


Figure 1: Pet food processing of dry pet food

Primary odor sources

Process Step	Airflow [m ³ /h]	Temperature [°C]	Odor Concentration (depending on recipe) [OU/m ³]
Extruder	8,000 - 15,000	45 - 50	Up to 50,000
Dryer	16,000 - 26,000	75 - 80	Up to 45,000
Cooler	20,000 - 32,000	40 - 45	Up to 25,000

* Data based on experience from executed projects and conducted measurements in the pet-food industry

Table 1: Odor sources of pet food processing



Comparison of Various Possible Techniques to Control Odors

Various techniques are available to control odors in the pet food production process. A comparison of these solutions is useful as they have different advantages and disadvantages. However, at the center of the equation is the fact that odor is a complex beast. Not only can odors not be measured analytically, but controlling them also requires a completely different approach. All odor control technologies need to be customized and tested first in order to determine the odor reduction

performance directly at the customer site. Based on the results of such small-scale tests odor control technologies can be compared according to below criteria. Taking our experience and the feedback from our customers into consideration the following comparison between technologies can be provided. Based on this comparison, it can be stated that, all validation criteria for cold plasma (footprint, waste, cost, etc.) are at least equal or better than alternatives.

Technology Criteria	Odor Reduction	Handling	Ecological footprint (Waste, Water, Energy)	Space requirement	Operational cost
Activated Carbon	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Bio Filter	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Scrubber (w & w/o. chemicals)	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Cold Plasma	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★

Table 2: Comparison of odor control techniques via relevant criteria

For choosing the smart way of odor control the exhaust data of the primary odor sources from pet-food processing must be taken into consideration. Typically, the odor concentration is high but the VOC load is low, which is especially challenging for traditional technologies. For example, mercaptans can be present at a concentration of only 0.1ppm that are very difficult to treat with water scrubbers or bio filters due to poor water solubility. However, the odor detection threshold (DT) can be even lower (0.00001ppm) resulting in an odor concentration of 10,000 OU/m³ and more.

Additionally, air from pet food processing contains a cocktail of countless different odor contaminants, also present in extreme low concentrations creating a very specific and unique odor character. Unlike scrubbers or bio filters, the proprietary cold plasma technology can treat exactly those exhausts by oxidizing the odors like nature, only faster: this will result in abatement efficiency up to 95%.

Instead of filtering, separating or adsorbing the odors, COPLAS clean is an energy efficient technology without producing waste and without the use of water or chemicals.

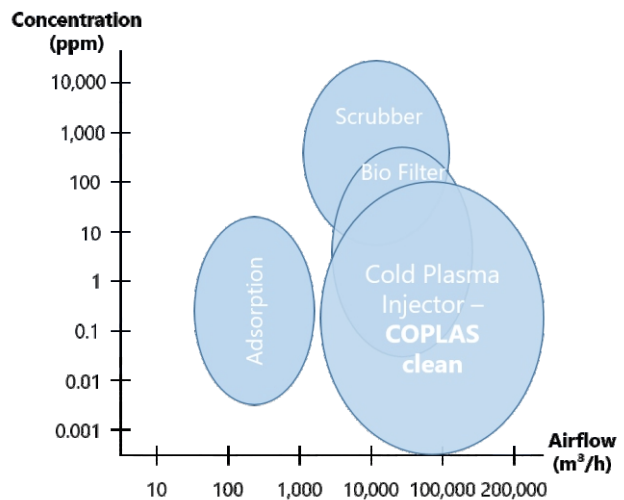


Figure 2: Cold Plasma - treats low ppm odor emission



COPLAS clean

How Does it Work

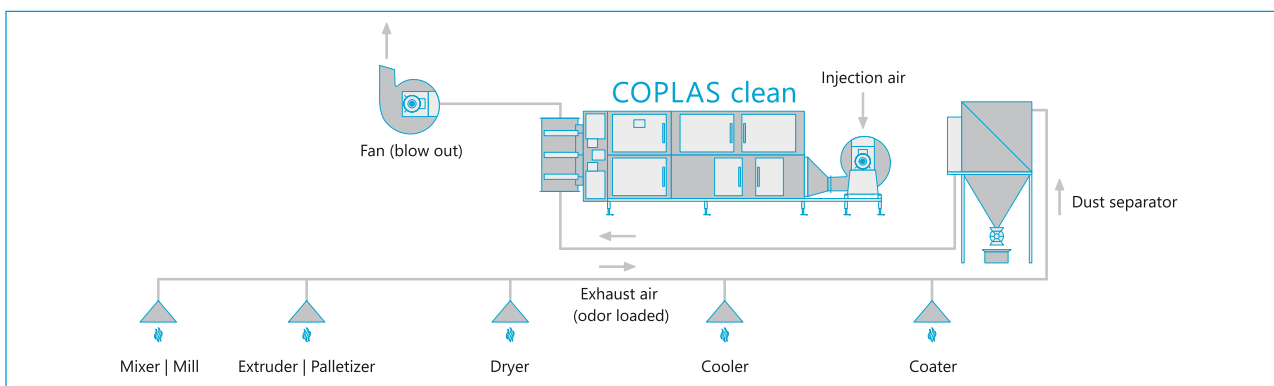


Figure 3: COPLAS clean system integrated in the production process

COPLAS clean utilizes the effect of cold plasma for creating reactive oxygen species that can eliminate odor emissions simply through the application of energy. It is not directly installed in the exhaust airstream, but in a bypass, which is connected to the ducting with a custom-designed T-adapter. Essentially, the exhaust air is then treated with plasma-enriched air so that organic pollutants are oxidized. Ambient air, which consists of oxygen, enters the Plasma Reactor Cylinders (PRCs) whereby highly Reactive Oxygen Species (ROS) are formed. These radicals are injected into the exhaust air stream for high-speed oxidation and odor abatement without the use of any water, chemicals or waste. This process has also been visualized in the above graphic.

The system has been designed with flexibility in mind, providing not only for easy integration at existing plants, but also for adaptability to production-related fluctuations in the airflow that needs to be treated. Depending on the airflow to be treated and the required energy for oxidation, the number of installed PRCs can be defined accordingly.

Additionally, the plasma power can be adjusted from 20 – 100 %, in 1 % increments. This exclusive feature provides full flexibility to the operator and enables energy savings; especially in situations where different exhaust lines are combined and airflows might change due to shut-downs of single processes.

Technological Advantages

- Systems will be connected to the normal ducting
- COPLAS clean units are prepared for an easy upgrade if required (modular design)
- Linear power control in 1% steps
- Electrically driven flaps in the T-adapter to prevent backflow of process gas into the system
- Uninterruptible power supply
- No heating element required
- No activated carbon cartridges
- Energy efficiency close to 100 %
- No starting sequence required



Approaching the Solution by Determining the Design Parameters

Odor control has many factors that come into consideration for design. There are parameters that are given on the part of the operating environment, local as well as process conditions that must be determined before starting customizing processes. For example, the plant location parameters provide information about the given situation and the requirements to be met.

Operating site parameters

Some important design parameters relate to the installation site. These include space availability to consider the various installation options. This also might determine an installation inside or outside the production building. In addition, the installation in negative pressure (before the last fan) or in positive pressure (after the fan) also determines the need for additional measures. For example, in the case of positive pressure injection tubes might be required to ensure the necessary mixing of the radicals with the odor molecules.

Exhaust air parameters

The exhaust air parameters are critical to the functionality and efficiency of the cold plasma technology. In addition to the energy input, the airflow is required for calculating the customized size of the system. Important factors for the efficiency of odor reduction are air temperature, humidity and dust concentration. Relative humidity e.g. enhances the performance. However, any kind of condensation must be prevented as the odor molecules would capsule inside the water drops and could hardly be oxidized. A similar process occurs, if the concentration of solid particles in the exhaust air is too high. The solid particles would prevent the radicals to properly oxidize with the odor molecules. Therefore, the dust concentration should be within regulatory limits.



Chimney types/size/dimensions



Proximity to residential area



Limitations by authorities



Production hours per year



Space availability



Indoor/outdoor installation



Positive/negative pressure



Climatic conditions



Airflow



Air temperature



Air humidity



Odor concentration



Dust concentration



VOC concentration



Approaching the Solution by Customizing On Site

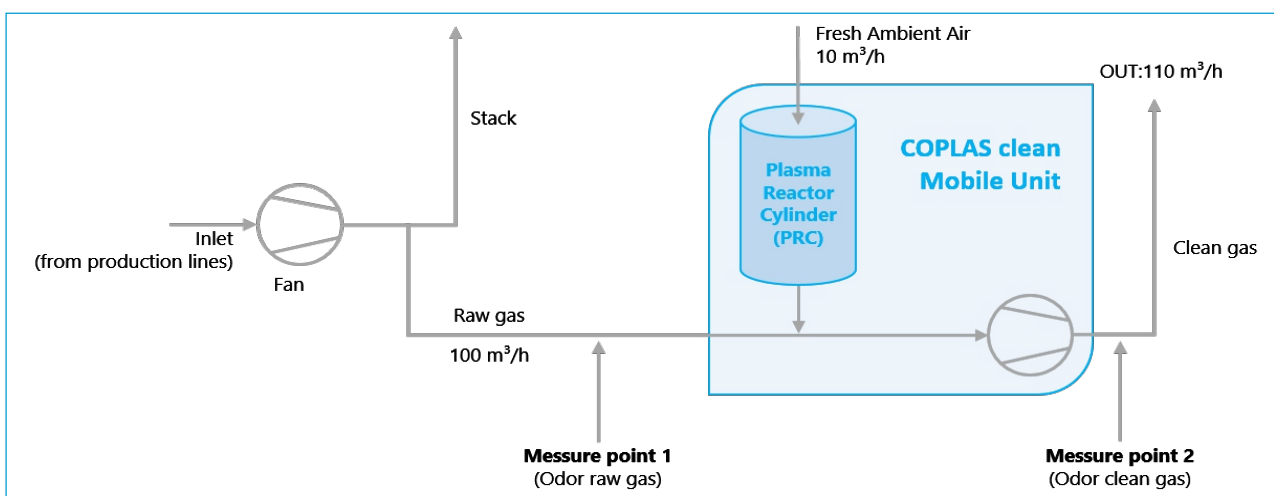


Figure 4: Customizing Set Up

Taking the project content and the design parameter into account the customizing with the COPLAS [clean](#) mobile unit can be arranged at the customer's site. Setting up the unit is only a matter of a few hours and only few arrangements have to be made by the customer. With the fully set up system 100 m³/h of the exhaust air are extracted and treated it with 10 m³/h of plasma-induced air (see Figure 5). Different power settings are tested to determine the energy amount needed to reduce the odors and to eliminate

the typical raw gas smell. Samples are then taken at measure point 1 with the raw gas before the treatment as well as at measure point 2 with the clean gas after the treatment by a certified and independent odor laboratory. In order to get more reliable results, 2 or 3 samples are taken with each power setting. The samples can then be analyzed and evaluated by a trained team of panelists on site or at the laboratory by dynamic olfactometry.



Figure 5: COPLAS [clean](#) Mobile Unit

Odor Measurement

Dynamic Olfactometry

The determination of the mostly odorous emissions is carried out via the human nose or olfactory sense. Dynamic olfactometry is used to determine the odor concentration. In this process, odorous air samples are taken in an odorless bag at the sampling points by a certified laboratory. These are then presented to a trained team of four panelists in a controlled manner via an olfactometer. The actual measuring device in the olfactometer is the human nose. The olfactometer itself consists of a calibrated mixing device in which the odorous samples can be mixed in a defined manner with odorless air. This odorless air is synthetic air from gas cylinders. The odor evaluation by the individual panelists is carried out

simultaneously. If a panelist is now offered synthetic air (via nose mask), no odor will be detectable. In this case, the odor threshold is not exceeded.



Figure 6: Sampling Bag Device⁴

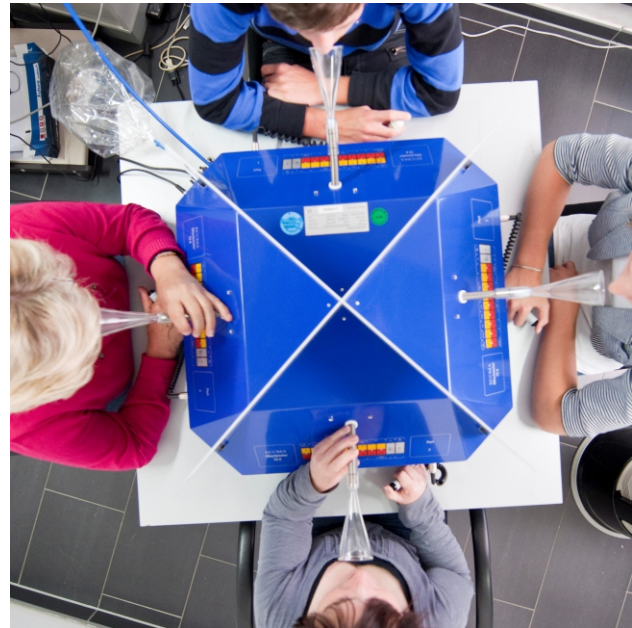


Figure 7: Olfactometer⁴

If at the same time the proportion of odorous air is gradually increased, there will be a dilution level, at which an odor perception will occur in one or more of the panelists. This level is called the odor threshold and by definition is assigned the unit $1 \text{ OU}/\text{m}^3 = 1 \text{ DT}$. With an average of the odor perception of all panelists, an odor concentration can be assigned to the odorous air. After carrying out all inspections with sampling, the source concentration is obtained as an input value for the stack dispersion calculation, in which the exceedance frequency of the odor threshold in the area to be assessed is determined as a percentage of the annual hours.^{1,5}



Project Example of Installed Cold Plasma System for Pet Food Manufacturer Rupp Food

Our customer, a global player, specialized in the production of dry food for cats and dogs, operates five production lines at its factory in Hörbranz, Austria. As a specialist in exhaust air purification, Riedel was selected to implement a system reducing these odor emissions. Three production lines with a total airflow of 48,000 m³/h were chosen by the

customer with the goal to reduce the odor concentration below 500 OU/m³. Additionally to the limited space for installation, our challenge was to prevent the occurrence of the typical raw gas smell. Further, the design complexity of the systems was increased due to fluctuating process conditions caused by different recipes and odor compositions.

Challenges



reducing odors below 500 OU/m³



designing systems for fluctuating process conditions



preventing the occurrence of the typical raw gas smell



adapting to a very limited space

Approach by On-site Customizing

After defining the project scope, the customizing with COPLAS [clean](#) mobile unit took place at the customer's site. 100 m³/h of the exhaust air were treated with different power settings, in order to confirm the applicability and efficiency of the technology and to determine the required energy consumption of a potential full-scale system. Samples were taken before and after the treatment by a certified and independent odor laboratory. These were analyzed and evaluated by trained panelists on site.

Installation of COPLAS [clean](#)

Based on the results of the customizing, three single systems were designed and installed at Rupp. Due to the compact and modular design as well as the injection principle of COPLAS [clean](#) system, the customer's existing infrastructure could remain in place. Acceptance measurements confirmed that Rupp now fulfills the official requirements. Additionally, a cleanable bag filter is being installed and another COPLAS [clean](#) system will be delivered.

Practical Application of Cold Plasma Technology



- 1 Injection Fan (AmbientAir)
- 2 Pre Filter Cabinet
- 3 Switch Cabinet
- 4 Plasma Reactor Cabinet
- 5 T-Adapter
- 6 Exhaust Air



Figure 8: COPLAS clean - Full scale System

| Conclusion

Pet food processing odors can be oxidized economically and sustainably with cold plasma technology, without the use of any chemicals, water or waste. The COPLAS [clean](#) systems are the most advanced systems available that have the unique ability to adapt with 1% accuracy to the required pet food process conditions with energy efficient self-cleaning venturi plasma reactors and high frequency power supply technology. Total solutions, including

additional air purification systems as dust-filters, venturi scrubbers, etc. are designed by our engineers, fabricated in our modern shop in Germany and installed/serviced by our team of hardware-/software-specialists. For your odor control projects we are able to brainstorm, develop and test customized solutions in our state-of-the-art R&D center in Bielefeld Germany.

**If you would like us to COPLAS your process,
we are pleased to advise you according to your individual and specific needs.**





References

- [1] Hauschildt H. & Mannebeck B. (2016) Messung, Analyse und Beurteilung von Umweltgerüchen. In: ReSource, Rhombos, Berlin
- [2] Made How (2021) How to make pet food. <http://www.madehow.com/Volume-2/Pet-Food.html>
- [3] Rokey G.J. (1994) Petfood and fishfood extrusion. In: Frame N.D. (eds) The Technology of Extrusion Cooking. Springer, Boston, MA. https://doi.org/10.1007/978-1-4615-2135-8_5
- [4] Uppenkamp+Partner GmbH (2021), Ahaus
- [5] Verein Deutscher Ingenieure (2015) VDI 3884 Blatt 1: Olfaktometrie – Bestimmung der Geruchsstoffkonzentration mit dynamischer Olfaktometrie – Ausführungshinweise zur Norm DIN EN 13725, Düsseldorf



| About Riedel Group

Riedel exists for over 100 years and originates from the field of dust removal/handling, pneumatic conveying and silo conditioning. The main customer industries are tobacco and sugar, in which Riedel belongs to the hidden champions by continuously developing process optimizing solutions for the customer. The customer requirements and demands are always in the focus at Riedel when developing new products and solutions. With the same approach the COPLAS **clean** system was developed. Several years ago, a key customer faced a problem with odor emissions and wanted to implement an odor control system that overcomes the disadvantages of the traditional technologies. The customer request

prompted Riedel to look into and evaluate the area of odor emissions and odor control. Soon, it was realized that there is demand from a wide range of industries for innovative, environmentally friendly solutions for those systems. A project team with experts from different disciplines was formed for developing the proprietary and patented COPLAS **clean** system. In addition to the engineers at Riedel, the team was joined by an internationally recognized expert from Uniqair with over 20 years' experience in the field of cold plasma. Since 2019, Uniqair belongs to Riedel and the system has continuously been further improved and developed.

Headquarters

Riedel Filtertechnik GmbH

Westring 83 | 33818 Leopoldshöhe

Germany

phone +49 5202 992 - 0 | riedel-filtertechnik.com

Contact us at sales@riedel-filtertechnik.com

Division North America

Uniqair Technologies Ltd.

305- 43881 Progress Way | Vancouver-Chilliwack

Canada

phone +1 604 854 5628 | uniqair.com

Contact us at sales@uniqair.com