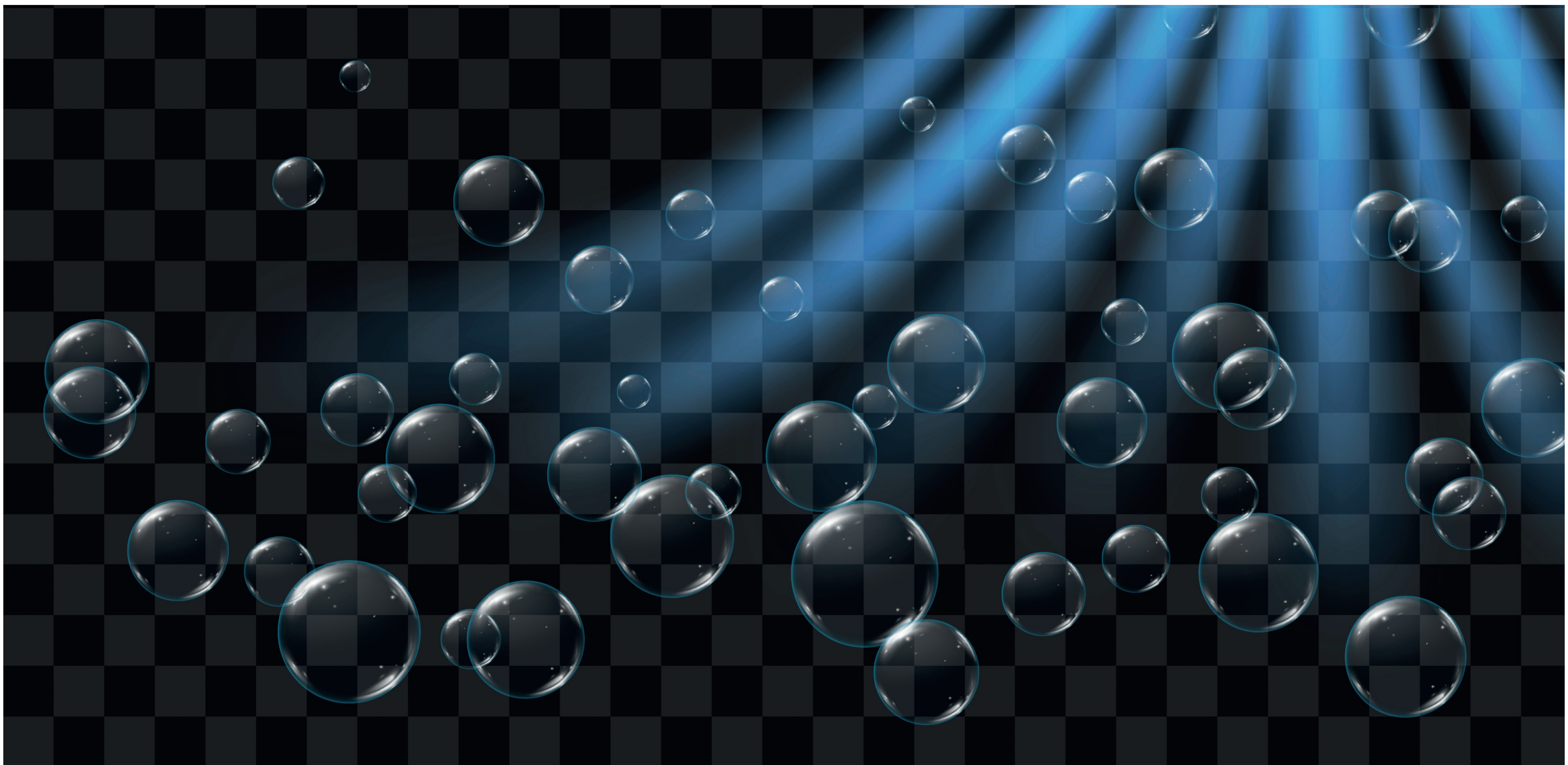


# IONISATION SYSTEMS FOR ODOUR CONTROL: A REVIEW OF EFFECTIVENESS AND LIMITATIONS

## Introduction

**Ionisation is an emerging technology for odour control that has been implemented under various names, depending on the mechanism used to generate ions. These mechanisms include ozone generator units, cold (non-thermal) plasma units, and photo/UV light units. The primary purpose of these systems is to generate ions—negative ions, or both negative, radical, and positive ions—which are designed to neutralise or oxidise odorous compounds in the air.**

**This technology is widely employed in sectors such as food processing, waste management, and wastewater treatment, where odorous emissions are a persistent issue. By breaking down the chemical structure of odorous compounds, ionisation systems aim to reduce odour levels and minimise impacts on employees, visitors, and nearby communities. However, results vary significantly depending on the system's design, its implementation, and the specific odorous compounds involved.**

## Aim of the Article

This article provides a comprehensive overview of ionisation technology, outlining its principles, effectiveness, and limitations. It highlights challenges associated with its application and examines three main design configurations commonly used in industrial settings. This review is intended to inform operators, regulators, and industry professionals about the practicalities and potential pitfalls of using ionisation for odour management.

This article explores what ionisation entails, its limitations in treating odours, and the three main design configurations for ionisation systems.

## How Ionisation Works

Ionisation generates charged particles (ions) to interact with odorous compounds in the air. Typically, these ions are oxygen ions or hydroxide radicals, designed to break down or neutralise odour molecules by altering their chemical structure. Ideally, this results in reduced odour intensity or the conversion of harmful substances into less problematic forms.

While ionisation has clear theoretical advantages, its real-world application is often complex. Factors such as system design, compound variability, and the absence of adequate monitoring can significantly affect performance.

## Why Ionisation May Be Ineffective

Despite its promise, ionisation technology is afflicted with vulnerabilities that affect its reliability. One challenge is unpredictable reactions where ion contacts with odour compounds may cause them to become incompletely oxidised, producing odour compounds with a larger odour intensity and toxicity level than the starting compounds. Additionally, sulphur and ammonia-based compounds, common in industrial emissions, require longer reaction times or higher ion concentrations than typical ionisation systems can provide.

Another issue is inadequate monitoring—without proper air stream monitoring before and after treatment, secondary pollutants or increased odour levels may go undetected. Energy threshold restrictions also play a role; each odorous compound requires a specific energy level for molecular bond breakage. High-energy volatile organic compounds (VOCs) like indole and skatole require sufficient reactive species for oxidation. However, most commercial ionisers have constant energy output, meaning such compounds cannot be oxidised effectively, particularly with low-intensity UV or cold plasma technology.

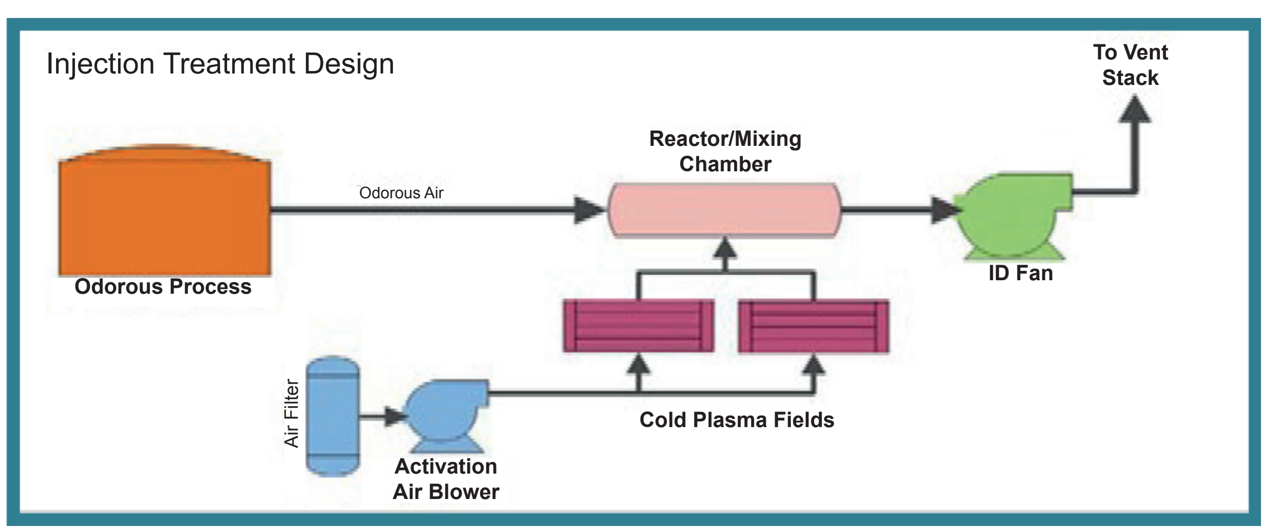
## Main Designs of Ionisation Systems

### Ionisation systems generally fall into one of three designs:

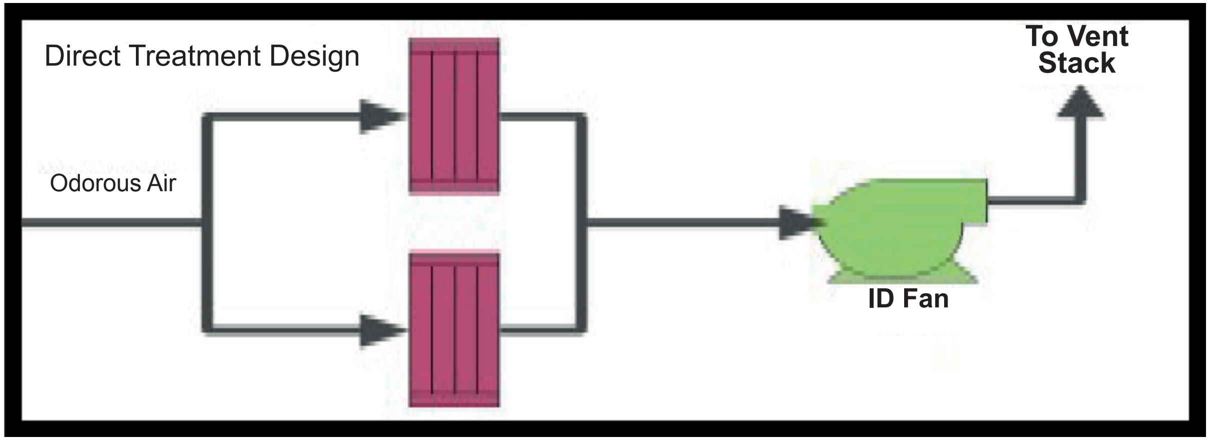
**Direct Treatment Design:** In this setup, odorous air is passed directly through a generator that produces ionised particles (such as oxygen ions or hydroxide radicals). The goal is for these ions to neutralise or oxidise the odorous compounds in the air stream. However, this approach presents several challenges, including unpredictable outcomes, where odour compounds may undergo cracking or partial oxidation, leading to the formation of more odorous or hazardous chemicals. Field data suggests that in some cases, treated air is more odorous than untreated air, making this design often unreliable and less likely to meet Best Available Techniques (BAT) standards.

**Injection Treatment Design:** This method introduces ionised particles into a designated mixing chamber, such as a gas duct or stack, where they interact with odorous air streams. Air sampling before and after treatment can assess the system's performance. The injection treatment design allows for measurable outcomes, making it easier to validate the system against BAT criteria. When implemented correctly, it is more likely to gain regulatory acceptance.

**Spraying Design in Reception Areas:** This approach involves spraying ionised oxidising agents through nozzles positioned in reception or processing buildings where odorous materials



are handled. The aim is for these agents to neutralise odours emitted from the materials. However, there are several challenges associated with this design, such as poor mixing of odorous compounds with ionised agents, limiting its effectiveness. Additionally, since there is no defined airflow to measure results, performance validation is impossible. Furthermore, increased ozone levels—a toxic by-product—pose safety risks to workers. For these reasons, spraying is often regarded as ineffective and unsafe.




## Key Considerations for Effective Ionisation Systems

To optimise ionisation performance, certain factors should be considered. Systems must be well-engineered, certified, and validated for proper operation. Removing larger particles from the gas stream before ionisation improves effectiveness and reduces maintenance. Sufficient interaction time between ions and odorous compounds is crucial for neutralisation. Additionally, optimising variables like ion levels, power, airflow, humidity, air quality, and ozone production is important for the effectiveness of injection system designs.

Combining ionisation with other abatement methods significantly boosts odour control, making it more reliable and effective.

## Conclusion

The success of ionisation systems depends on system design, monitoring, and application context. Direct treatment systems are often unreliable, producing unpredictable by-products and struggling with scalability. Ionisation may be suitable for niche applications in small, controlled environments—such as airport restrooms or restaurant kitchens—where airflow is limited, and odour intensity is low. However, these systems lack the capacity to handle high-volume, variable emissions typical of industrial sites like wastewater plants or waste management facilities. Their inability to degrade high-energy-demand compounds or adapt to fluctuating pollutant loads makes them unsuitable as standalone solutions for large-scale odour abatement.

For operators seeking effective odour control, careful evaluation of ionisation system suitability is essential. Validating performance, addressing system limitations, and integrating complementary technologies can ensure a more effective and reliable approach. By considering these factors, ionisation systems can contribute to emissions reduction and help meet regulatory requirements.

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**Sam Hantoosh,**
**Technical Advisor (Odour),**
**Environment Agency for England**
Tel: 07795603726
**Email:** sam.hantoosh@environment-agency.gov.uk