

Purification

by catalytic oxidation



Johnson Matthey Inspiring science, enhancing life

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Catalysing the net zero transition for our customers

Johnson Matthey's 200+ year pedigree in Platinum Group Metal catalysis – the safe option in a changing world

What we offer

Most industrial and power applications produce off gases that are harmful to health, the environment or have global warming potential, such as CO₂, CO, hydrocarbons etc. As the world is pledging to reduce global warming to below 1.5° C compared to pre-industrial levels, removing or re-using these gases is crucial to achieve this target.

Catalytic oxidation is a facile and economic process to remove a wide range of impurities from industrial gas streams as part of feedstock, in-process or effluent purification. The versatility of the chemistry and its application, combined with the Johnson Matthey's long-standing experience in precious group metal (PGM) catalysis, places catalytic oxidation at the heart of the purification needs in a decarbonising world. Johnson Matthey's **PURAVOC**[™] technology provides catalytic oxidation solutions to remove volatile organic compounds (VOCs), oxygen, hydrogen and carbon monoxide.

PURAVOC alumina-supported PGM fixed bed catalysts are specially designed to oxidise individual or complex gas impurities to very low levels, at temperatures lower than thermal processing and with minimal intervention.

As a result, **PURAVOC** catalysts can achieve long and dependable bed life at reduced OPEX, making this a very economical solution.

Capitalising on the **PURAVOC** brand's long history, we have extended our portfolio with dedicated and improved catalysts for emerging applications.



Comfort, confidence and cost management through careful consideration

Johnson Matthey has over 25 years of experience and over a hundred installations with guaranteed performance worldwide

Process design considerations

Catalytic oxidation requires an oxidant and at least one oxidisable component. In order to maximise the efficiency of the process and performance of the catalyst, it is important to consider:

- Oxidisable components concentration considering the feed stream as a whole is important to avoid runaway reactions and damage to catalyst and reactor
- **Stoichiometry** the complete removal of target components requires excess of the co-reactant
- **Process temperature** achieving best catalyst performance requires gas phase operation and at temperature reflective of the reactivity of target reactants
- **Process pressure** defines the form of the catalyst; for fixed bed applications, positive pressure is required to overcome pressure drop along the bed of the catalyst.



PURAVOC catalyst features

Family of platinum and palladium catalysts supported on alumina shaped carriers for fixed bed operation



The main features of these catalysts are:

- **PURAVOC** catalysts are designed to operate effectively at temperatures lower than thermal processes, contributing to OPEX savings
- PGM content is tailored through proprietary methods to give the optimal cost to performance balance
- Various size and shapes offered to ensure efficient catalyst utilisation whilst minimising the pressure drop in the reactor
- **PURAVOC** catalysts are non-hazardous and thus, no special storage conditions required. The catalysts can be handled safely in air
- **PURAVOC** catalysts are supplied in activated form – starting the catalyst requires simple procedure and no in-situ activation is required
- **PURAVOC** catalysts have long and dependable life they can be operated continuously with little intervention
- **PURAVOC** catalysts can be operated in intermittent mode specific advice will be given to each customer.



PGM circularity

Johnson Matthey offer a fully circular PGM management service to our customers:

- Sourcing and PGM management global team of experts that support our customers in effectively sourcing and managing of PGMs, enabling their sustainable and circular use
- PGM chemicals and catalyst manufacture highly skilled technical teams that have many years of experience in synthesis, formulation and advanced characterisation
- PGM refining of spent catalysts advanced processes for extracting and separating PGMs from products – so advanced that we can refine PGMs to a purity of 99.95%
- Market research annual PGM market report gives an insight into PGMs demand and supply developments helping customers to understand likely market trends.



Next generation **PURAVOC** catalysts



PURAVOC GREEN family

PURAVOC GREEN[™] catalysts are specially designed to remove trace contaminants from hydrogen and oxygen produced by water electrolysis.

Deoxygenation is an essential step in the production of green hydrogen and requires a flexible and robust catalyst that can operate under a variety of pressures, relatively low temperatures, and intermittent feed flows.



Catalysts features

PURAVOC GREEN catalysts are highly efficient within a broad operation envelope and maintain performance over many operation cycles making this a reliable, easy to operate and economic solution.

- **PURAVOC GREEN** catalysts can be operated in presence of water providing the stream is single gas phase. This allows for a single dehydration step downstream of the catalytic oxidation bed
- **PURAVOC GREEN** catalysts can be operated in intermittent mode in line with renewable energy availability. Specific advice will be given to customers regarding the best ways to manage the catalyst during the downtime periods
- **PURAVOC GREEN** catalysts have long and reliable life if operated correctly. Johnson Matthey is happy to provide advice on possible catalyst poisons and inhibitors, which are the most likely causes of premature deactivation

PURAVOC GREEN purification catalysts enable green hydrogen to be used as a building block for decarbonising industry











PURAVOC BLUE family

PURAVOC BLUE[™] catalysts are carefully formulated to remove trace oxygen and/or VOCs from CO₂ streams prior to sequestration or downstream utilisation.

The **PURAVOC BLUE** offering can be combined with Johnson Matthey's **PURASPEC**[™] purification technologies to achieve transportation and feed specifications.

PURASPEC technology utilises metal oxides engineered into robust granules to remove traces of mercury and a range of sulphur compounds – most frequently hydrogen sulphide (H₂S) and carbonyl sulphide (COS).



Catalysts features

PURAVOC BLUE catalysts have retained all features that have made the parent **PURAVOC** range successful. However, the variability in CO₂ compositions from a wide range of sources brings additional challenges for the catalyst design. Considering the feed composition as a whole and positioning the catalytic oxidation bed at an appropriate location in the flowsheet is critical to maximise the efficiency and life of the catalyst.

Johnson Matthey is investing effort in understanding the interlinks between different impurities and widening the purification offer to other impurities such as SOx and NOx. These are likely to be poisons or at least inhibitors for catalysts in CO₂ to chemical processes.



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