JM

Purification solutions

For the Gas Processing industry

Johnson Matthey
Inspiring science, enhancing life

We deliver so you can deliver

With 40+ years of experience, technical expertise and understanding of the science, Johnson Matthey stand by our performance guarantees

Johnson Matthey's **PURASPEC™** absorbents are the industry choice for longest bed life and toughest duties.

PURASPEC technology utilises metal oxides specially engineered into robust granules to remove traces of contaminants from hydrocarbon gases and liquids. In particular, the absorbents are designed to remove mercury and a range of sulphur compounds – most frequently hydrogen sulphide (H_2S) and carbonyl sulphide (COS). They are widely used for natural gas sweetening to meet pipeline or liquification specifications and polishing to feedstock requirements.

PURASPEC absorbents are 'made-to-measure' solutions that fit right, feel great and last the distance

- **PURASPEC** absorbents' high capacities lead to less change-outs and waste, minimising the cost of mercury and sulphur removal over time
- Fixed-bed processes that are simple to operate and require low capital outlay. Latest generation products can reduce bed volumes and space requirements for the vessel
- Effective and fast impurity removal to very low levels:
  - Sulphur: ppbv for H_2S from natural, associated and, shale gas, and copper strip 1A quality for propane/LPG.
  - Mercury: <10ng/Nm^3 from natural and associated gas and <1ppb wt from NGLs, LPGs and hydrocarbon condensates
- No feedstock losses; only the impurities are reacted and absorbed.
- **PURASPEC** processes are flexible and withstand process up-sets. Robust granules maintain stable pressure drop throughout the life of the absorbent allowing for minimal operators' intervention.
- Energy use and CO_2 emissions during operation are effectively zero. Used absorbents can be reprocessed and disposed of in an environmentally responsible way.
- Effective low temperature operation from 0-200°C (32-400°F) for sulphur removal and 0-95°C (32-200°F) for mercury applications
- Easy operation for dry or water saturated gas, and in high or low CO_2 - containing gases. End of life discharge is free flowing under gravity.
- Easy retrofitting for existing onshore and offshore installations.

Comfort, confidence and cost management through careful consideration

Our customers can depend upon **PURASPEC** absorbents' performance to provide effective removal of sulphur compounds and mercury. This has already been proven with hundreds of installations world-wide at both onshore and offshore locations.

PURASPEC Hydrogen sulphide (H_2S) removal

PURASPEC H_2S removal technology is ideally suited for polishing and it is targeted at applications where the required sulphur removal capacity is no greater than 950kg/day H_2S.

It can also be used in conjunction with other bulk sulphur removal technologies, allowing installation of the most cost-effective solution.

Applications include:

- Sales and fuel gas
- Reboiler vent gas
- Carbon dioxide
- Tank vapours
- Amine off-gas

PURASPEC H_2S removal processes operate effectively in the temperature range of 0-200°C (32-400°F), pressures from atmospheric up to 120bar (1750psi) and flow rates exceeding 2.0million Nm^3/hr (1.8Bscfd).

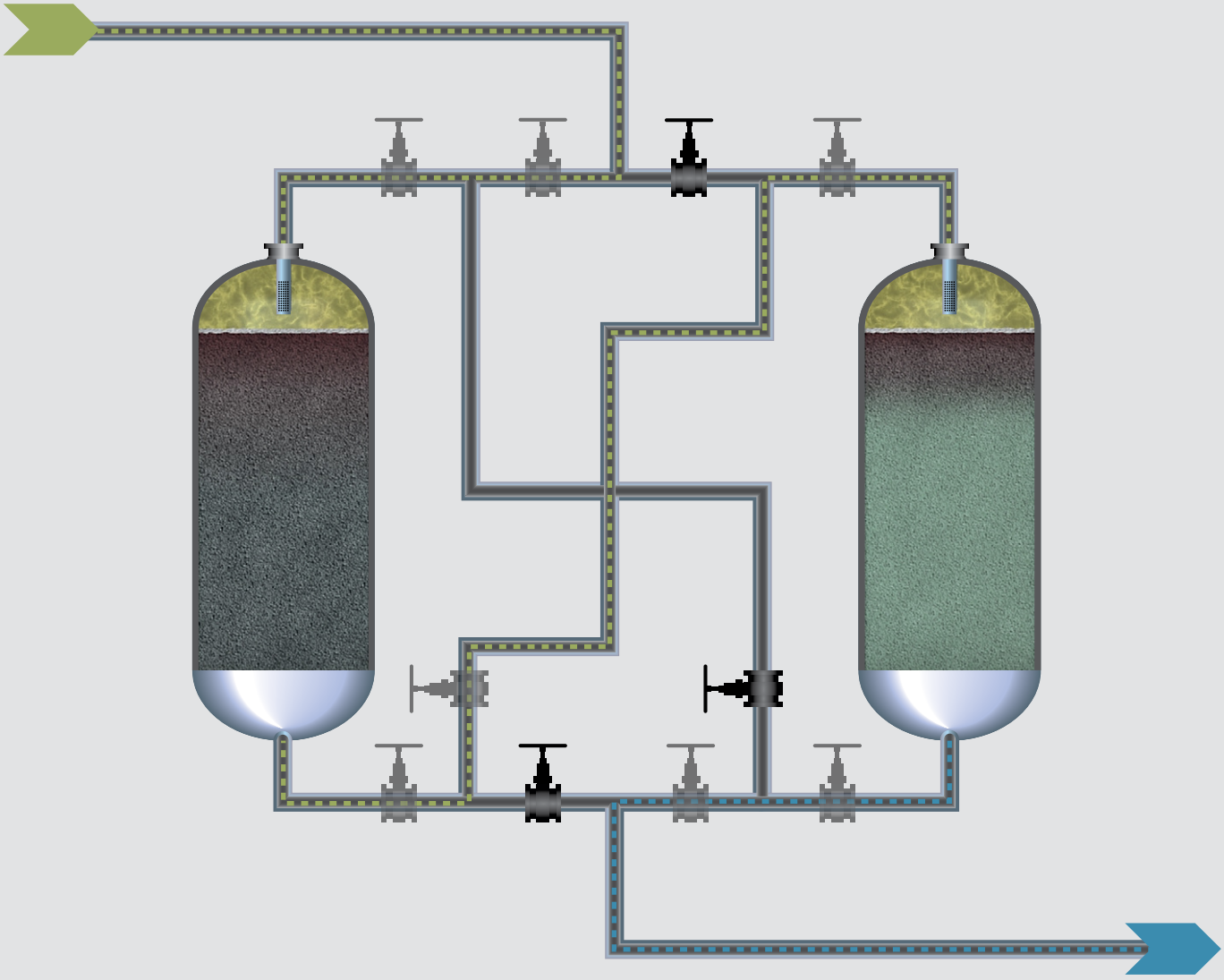


Figure 1: Typical lead-lag process flow diagram

How it works

PURASPEC absorbents are the market leading product for H_2S removal from hydrocarbon streams. It is a well-proven and robust product for complete removal of H_2S via an irreversible chemical reaction.

Once the H_2S has reacted with the metal oxide present in the absorbent, it is permanently bound into the material and will not be released back into the environment even when the absorbent is fully saturated.

Vessels can be single, parallel, lead-lag or in a series configuration. A typical lead-lag process flow diagram is shown in Figure 1.

Quick and efficient start-ups with reduced operational risks or damage to the absorbent can be achieved through on- and off-site expert technical support.

The spent material can be shipped to a smelting plant that can remove the sulphur before the metals are extracted and recycled into industrial applications. These smelting plants are designed to handle both mercury and sulphur, allowing a comprehensive audit of the entire recycling route.

PURASPEC
Mercury removal

PURASPEC mercury removal technology is specially designed for a range of hydrocarbon steams. Typically, mercury in natural gas and natural gas liquids will be present in elemental form. The concentration of mercury in natural gas varies widely depending on the geographical location and on the geology of the well formation. Mercury levels can range from < 0.01µg/Nm^3 to >5000µg/Nm^3.

PURASPEC mercury absorbents operate effectively in the temperature range of 0°C - 95°C (32°F - 200°F), pressures from atmospheric up to 200bar (2900psi) and flow rates exceeding 2.0million Nm^3/hr (1.8Bscfd).

The main concerns associated with mercury are:

- Corrosion of process equipment
- Emissions to the environment
- Exposure of workers to high levels of mercury during maintenance operations
- Difficulty in disposal of mercury contaminated equipment
- Potential liabilities resulting from mercury contaminated product streams

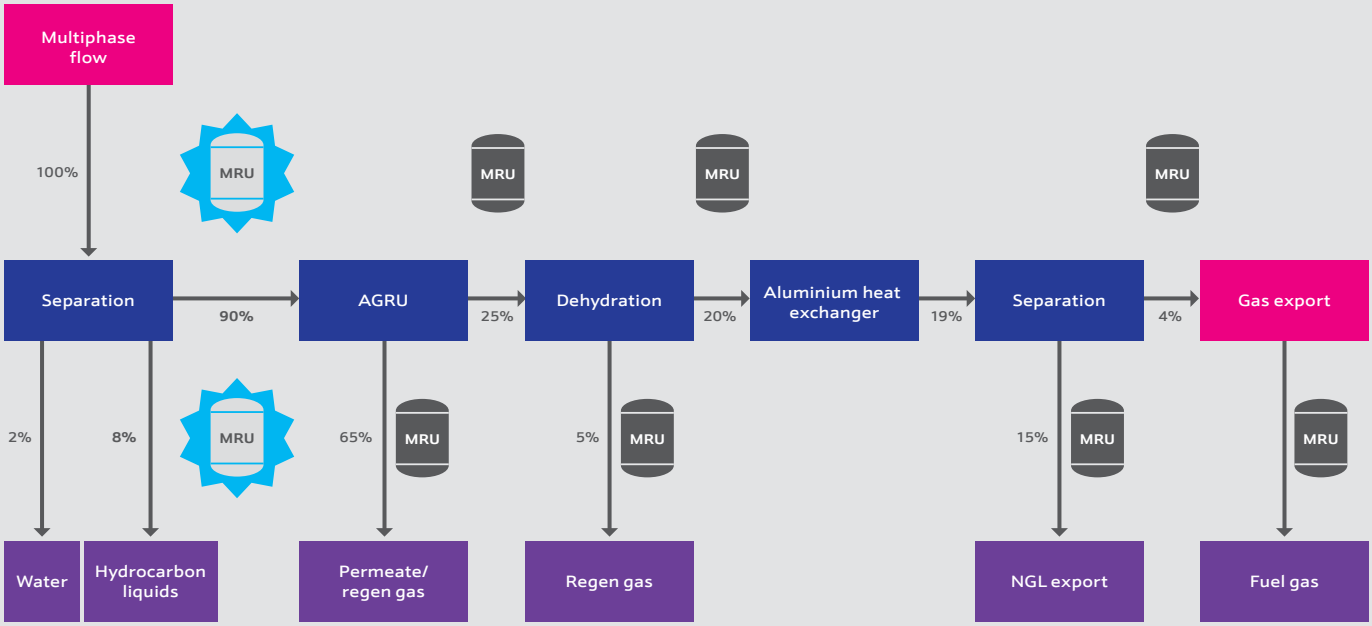


Figure 2: Possible locations of mercury removal unit (MRU) in a typical process flow sheet

How it works

PURASPEC absorbents are the market leading solution for mercury removal. Our granules, containing an active mixed metal sulphide, are engineered to provide effective and irreversible removal of mercury from hydrocarbon gases and liquid to meet customer feedstock requirements. Mercury will not be released back into the environment even when the absorbent is fully saturated.

The absorbent is typically offered in its active (pre-sulphided) form so it removes mercury as soon as hydrocarbon flow is passed over it. If loading under nitrogen is a concern, JM can offer specially designed air-stable grade or a range of oxidic absorbents which can be activated in-situ by reaction with H_2S.

The location of the mercury removal unit (MRU) is critical to ensure that the mercury coming into the plant is removed as far upstream as possible (Figure 2). This avoids emissions of mercury to the atmosphere and contamination of process streams and equipment.

The spent material can be shipped to a smelting plant in airtight UN approved metal drums that can separate the mercury before the other metals are extracted and recycled into industrial applications. Recycling of the spent material is a fully auditable process with 'Certificate of destruction' sent to the customer.

Collaborate with confidence to drive process optimisation with JM trusted technical experts

Reactor design

Fixed bed removal reactors have typically been axial flow designs. They are simple, low cost and well-proven technology.

Axial beds can be constrained when designing for large flow rates, resulting in high bed pressure drops. Increasing vessel diameters can usually reduce bed pressure drop but other issues arise:

- Vessel fabrication limits
- Larger diameter vessels require thicker walls adding weight to the vessel
- Escalation of transportation and fabrication costs
- Flow maldistribution due to increased bed diameter over length (D:L) ratio

Johnson Matthey have developed an alternative radial bed design for high flow applications. Radial flow reactors have >5 times lower pressure drop (i.e. wider D:L ratio design range) and are less susceptible to fouling. These vessels require more complex interiors (Figure 3).

The pressure drop savings possible with these designs are shown in Figure 4, where the comparison has been made for a light natural gas at 25°C (77°F) and 60bara (870psia).

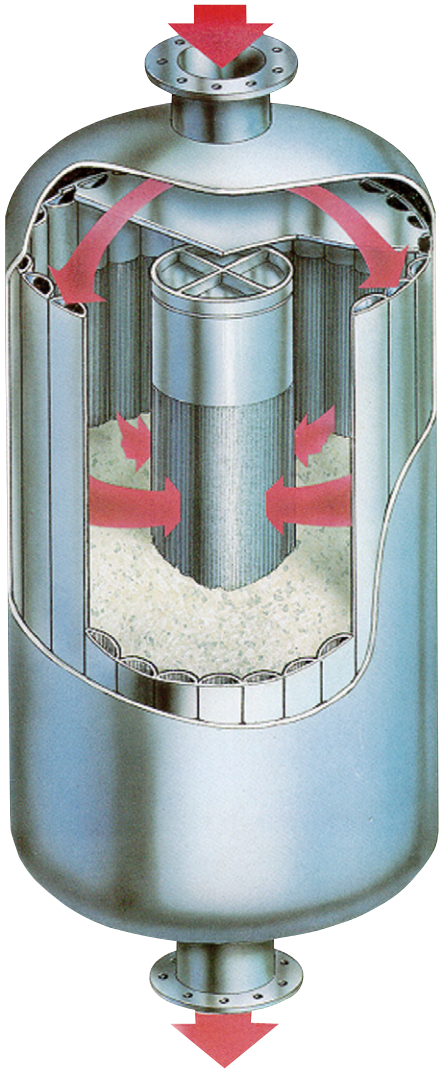


Figure 3: Typical radial bed

Radial vs. axial Vessel volume = 50m^3

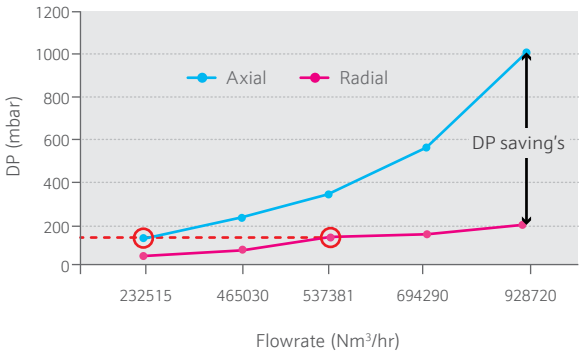


Figure 4: Possible pressure drop savings

Reactor modelling

Computational fluid dynamics (CFD) plays an important role in the design of purification systems, from details of the vessel such as inlet distributors and outlet collectors through to optimisation of the catalyst bed and support materials.

With the help of CFD Johnson Matthey has been able to work with and help customers diagnose and eliminate problems in existing systems.

Typical CFD applications include distributor redesign to reduce gas velocities at the bed surface and minimise the risk of catalyst movement, and pressure drop and flow distribution studies to eliminate bypassing and optimise catalyst utilisation. Depending on the application the modelling work may include effects such as reaction and heat transfer, and require the use of proprietary data and correlations for JM products. Project timescales vary from a single day to several weeks, depending on the complexity of the geometry and necessary level of detail in the model.

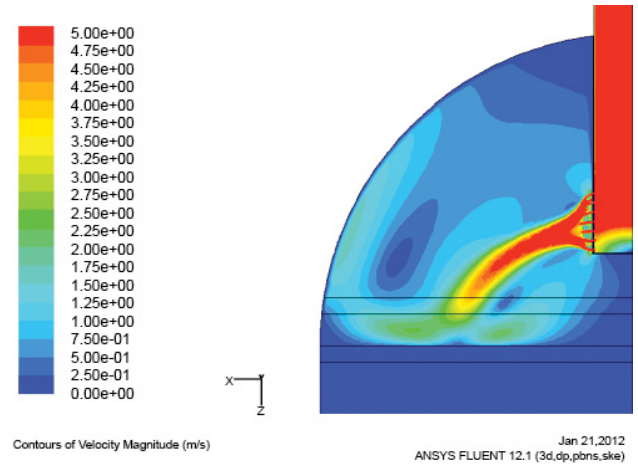
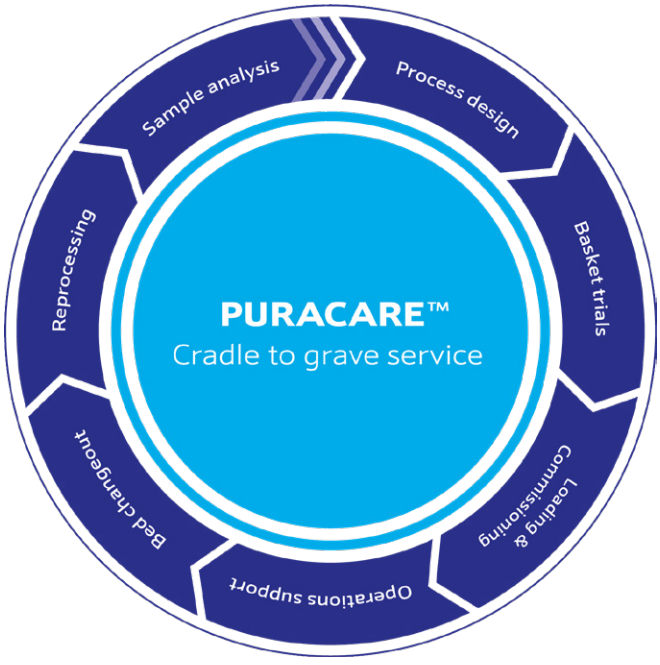


Figure 5: CFD output

PURACARE service is guaranteed peace of mind



We support our customers to lower EHS risks, lessen workload and maximise value through long-term thinking and channeling what really matters

There is no such thing as a standard **PURASPEC** process. The choice of absorbent, catalyst and the design of the reactor vessel will vary according to the type of feedstock, the level of contaminants, pressure and temperature conditions, and purity specification.

Our experienced engineers will ensure optimum design tailored to the customer's conditions and targets. They will select from the family of **PURASPEC** processes or, where necessary, develop a variation to meet operational needs precisely, regardless of the size of the application. At its simplest, a **PURASPEC** package can be the supply of the requisite absorbents/ catalysts together with operating instructions.

Johnson Matthey can offer the end user guidance related to vessel dimensions and internal designs. Our flexible approach also enables us to work with engineering companies or a customer's own design team to deliver the ideal package.

JM's cradle-to-grave service looks beyond the operational life cycle of the absorbent through regionalised support and our experienced personnel

PURACARE tailored service is designed to take care of all aspects of operation, maintenance and absorbent/catalyst recycling for our global customers in the Gas Processing industry. Under the expert direction of the Johnson Matthey team, this hands-on service enables customers to save time and manpower, and also to comply with all current and anticipated environmental legislation.

- **Design considerations**
  We will provide specialist consultancy to ensure that change-out considerations are addressed at the design stage. This includes consideration of access to vessel and sufficient laydown for media and change out equipment.

- **Delivery and loading**
  We will manage the delivery of the agreed quantities and grades of materials to your plant, followed by loading using the most appropriate technique for the type of reactor vessel and site conditions. Our experienced on-site consultants can be at hand to provide advice and assistance during the loading. We focus on quality and reliability in every detail, from review of method statements to road haulage and fork-lift handling on site.

- **Optimum operation**
  We will advise you on how to make the most cost-effective use of our process in your plant. Our experienced and dedicated team will monitor and support your operation to ensure optimised performance to maximise bed lives. Towards the end of life we will provide recommendations on the timing for absorbent replacement.

- **Material discharge**
  Prior to discharge, we can provide consultation on the safe and best discharge operation for the particular unit. We can provide trained people and suitable equipment to facilitate the clean and safe discharge of the used absorbents and catalysts.

- **Environmental disposal**
  Sustainable behaviour is a leading principle for Johnson Matthey and it is our policy to ensure an environmentally responsible disposal and/or recycling of all our spent products. We regularly audit our reprocessing partners to ensure full compliance with environmental and corporate standards. We can manage the whole process from unloading, through transportation to the issue of a 'certificate of destruction', the final step in the life of a charge of absorbent.

Designed and produced by www.houseoftype.co.uk

For further information on Johnson Matthey, please contact your local sales representative or visit our website.
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Billingham, UK
Tel +44 (0) 1642 553601
www.matthey.com

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