Technical Data Sheet (TDS)

High Surface Area Manganese Dioxide for Gas Phase Catalysis

1. Product Information

Field	Details
Product Name	High Surface Area Manganese Dioxide for Gas Phase Catalysis
Chemical Name	Manganese Dioxide
Chemical Formula	MnO_2
CAS Number	1313-13-9
Molecular Weight	86.94 g/mol
Manufacturer	BTLnewmaterial
Email	lixifirm@outlook.com
Phone/WhatsApp	+8618273793022
Website	manganesesupply.com
Address	Room 706, No. 154, Wuyi East Road, Niezhou Residential Committee, Caizichi Sub-district Office, Leiyang City, Hengyang City, Hunan Province, China

2. Product Description

High Surface Area Manganese Dioxide for Gas Phase Catalysis is a highly active MnO_2 material specifically engineered for heterogeneous catalytic reactions in gas-phase systems. This advanced catalyst material combines high specific surface area with strong oxidation capability, making it ideal for environmental catalysis, air purification, and industrial gas treatment applications. The product is manufactured with controlled purity levels and optimized crystal phase composition to ensure consistent and reliable catalytic performance across a wide range of operating conditions.

The material's exceptional surface properties enable efficient adsorption and activation of reactant gases, while its stable crystal structure supports prolonged catalyst life in continuous industrial processes. Whether used in laboratory research or large-scale industrial applications, this MnO_2 catalyst delivers reproducible results and superior pollutant conversion efficiency.

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3. Key Features & Advantages

3.1 High Specific Surface Area

The material exhibits a BET surface area of 120–220 m^2/g, providing an extensive network of active sites for catalytic reactions. This high surface area significantly enhances gas–solid contact efficiency and improves overall reaction kinetics compared to conventional MnO_2 powders.

3.2 Strong Oxidation Capability

The material demonstrates powerful oxidative properties, enabling efficient catalytic conversion of carbon monoxide (CO), volatile organic compounds (VOCs), formaldehyde, and other pollutants at relatively low temperatures. This capability reduces energy requirements and improves process economics in industrial applications.

3.3 Controlled Purity & Composition

With MnO_2 purity levels of 90–95%, the material maintains consistent chemical composition and predictable catalytic behavior. The controlled impurity profile ensures stable performance in continuous industrial processes and reproducible results in research applications.

3.4 Optimized Crystal Phase

The material features a γ-MnO_2 and amorphous composite crystal phase structure, which combines the benefits of crystalline order with the enhanced reactivity of amorphous phases. This composite structure maximizes catalytic activity while maintaining structural stability.

3.5 Porous Structure Design

The engineered porous architecture reduces mass transfer resistance during catalytic reactions, facilitating rapid diffusion of reactant gases into the catalyst matrix and efficient removal of product species. This design feature significantly improves reaction rates and overall catalyst efficiency.

3.6 Mechanical Stability

The material exhibits good mechanical strength and durability, allowing for easy integration into catalyst supports, coating systems, and fixed-bed reactors without degradation or attrition losses during operation.

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4. Technical Specifications

Parameter	Specification	Unit
MnO_2 Purity	90–95	%
Particle Size	1–10	μm
Surface Area (BET)	120–220	m^2/g
Moisture Content	≤2.0	%
Bulk Density	0.45–0.65	g/cm^3
Crystal Phase	γ-MnO_2 / amorphous composite	—
Color	Black powder	—
Appearance	Fine, uniform powder	—
Odor	Odorless	—
pH (aqueous suspension, 10% w/v)	3–5	—
Solubility	Insoluble in water and common organic solvents	—

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5. Physical & Chemical Properties

5.1 Appearance & Physical State

The product is supplied as a fine, uniform black powder with excellent flowability. The controlled particle size distribution (1–10 μm) ensures consistent packing density and uniform contact in catalytic reactors.

5.2 Density

- **True Density:** Approximately 4.8–5.0 g/cm^3 (theoretical density of MnO_2)

- **Bulk Density:** 0.45–0.65 g/cm^3 (varies with particle packing and moisture content)

5.3 Surface Area

The BET (Brunauer–Emmett–Teller) surface area of 120–220 m^2/g is significantly higher than conventional MnO_2 materials, providing enhanced catalytic performance. This high surface area is achieved through controlled synthesis methods that create a porous microstructure.

5.4 Thermal Stability

The material exhibits good thermal stability up to approximately 400–500°C under inert atmosphere. Above this temperature range, MnO_2 may undergo thermal decomposition to lower manganese oxides (e.g., Mn_2O_3, Mn_3O_4). Thermal stability in oxidizing atmospheres is typically maintained to higher temperatures.

5.5 Chemical Reactivity

- **Oxidizing Agent:** MnO_2 acts as a strong oxidizing agent, particularly in acidic or neutral environments. It readily oxidizes organic compounds, CO, and other reducing substances.
- **Redox Behavior:** The material exhibits reversible redox cycling between Mn^{4+} and Mn^{3+}/Mn^{2+} oxidation states, which is fundamental to its catalytic mechanism.
- **pH Sensitivity:** Catalytic activity is pH-dependent, with optimal performance typically observed in neutral to slightly acidic conditions (pH 3–7).

5.6 Moisture Absorption

The material may absorb moisture from humid environments. Moisture content should be maintained at $\leq$2.0% to ensure optimal catalytic performance. Storage in sealed containers with desiccants is recommended.

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6. Applications

6.1 VOC Catalytic Oxidation

MnO_2 catalysts efficiently convert volatile organic compounds (VOCs) such as benzene, toluene, xylene, and other organic pollutants into CO_2 and water in exhaust gas treatment systems. This application is critical for environmental compliance in industrial facilities, printing operations, and chemical manufacturing plants.

6.2 Carbon Monoxide (CO) Oxidation

The material promotes low-temperature CO oxidation, converting toxic carbon monoxide to harmless CO_2. This application is essential in indoor air purification systems, automotive exhaust treatment, and industrial gas cleanup processes.

6.3 Formaldehyde Decomposition

High Surface Area MnO_2 is highly effective for formaldehyde (HCHO) removal in air purification devices, indoor air quality systems, and catalytic air treatment applications. The catalyst efficiently decomposes formaldehyde at room temperature or with mild heating.

6.4 Ozone Decomposition

The active manganese dioxide surface rapidly decomposes ozone (O_3) in environmental control systems, air purification units, and water treatment applications. This capability is particularly valuable for removing residual ozone from ozone-based disinfection systems.

6.5 Environmental Catalysis Research

The material is widely used in laboratory catalyst development, academic research, and pilot-scale studies investigating gas-phase catalytic reactions, reaction mechanisms, and catalyst optimization strategies.

6.6 Industrial Gas Treatment

The catalyst is suitable for treating various industrial exhaust streams containing pollutants such as hydrogen sulfide (H_2S), nitrogen oxides (NO_x), and other harmful gases in chemical plants, refineries, and manufacturing facilities.

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7. Packaging & Supply

7.1 Standard Packaging

- **Container Type:** 25 kg fiber drums with double polyethylene (PE) liners
- **Purpose:** Double PE liners prevent moisture contamination during storage and transport
- **Palletization:** Export packaging is suitable for international shipping with standard palletized loading configurations

7.2 Laboratory Samples

Smaller sample quantities (typically 100 g – 1 kg) are available for catalyst screening, process testing, and research applications. Custom packaging sizes can be arranged upon request.

7.3 Bulk Supply

For large-scale industrial applications, bulk supply options are available with customized packaging and logistics arrangements. Contact the manufacturer for specific bulk pricing and delivery schedules.

7.4 Storage Conditions

- **Environment:** Store in sealed containers in a dry, well-ventilated location
- **Temperature:** Room temperature (15–25°C) is preferred
- **Humidity:** Maintain relative humidity below 60% to minimize moisture absorption

- **Shelf Life:** Under proper storage conditions, the material maintains stable catalytic performance for 24 months or longer

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8. Customization & Technical Support

8.1 Particle Size Customization

The manufacturer can provide customized particle size distributions tailored to specific reactor configurations and catalytic applications. Available particle size ranges can be adjusted from submicron to several micrometers.

8.2 Purity Level Adjustment

MnO_2 purity levels can be adjusted to meet specific application requirements. Higher purity grades (>95%) are available for demanding applications, while cost-optimized grades with lower purity may be suitable for certain industrial processes.

8.3 Bulk Production

The manufacturer offers bulk production capabilities for large-scale industrial catalyst manufacturing. Custom synthesis parameters can be optimized to meet specific performance requirements.

8.4 Technical Consultation

Professional technical support is available to assist with:

- Catalyst formulation and optimization
- Coating processes and integration into support materials
- Reaction performance testing and characterization
- Process scale-up from laboratory to industrial scale
- Troubleshooting and performance optimization

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9. Handling & Safety Information

9.1 General Handling

- Handle the material in well-ventilated areas to minimize dust inhalation
- Use appropriate personal protective equipment (PPE) including safety glasses, gloves, and respiratory protection when handling powder
- Avoid prolonged contact with skin and eyes

9.2 Storage Precautions

- Store in sealed, moisture-proof containers
- Keep away from strong reducing agents and incompatible materials
- Maintain storage temperature between 15–25°C
- Keep away from direct sunlight and heat sources

9.3 Disposal

Dispose of the material in accordance with local environmental regulations and waste management guidelines. The material is not classified as hazardous waste in most jurisdictions, but local regulations should be consulted.

9.4 First Aid

- **Eye Contact:** Rinse immediately with copious amounts of water for at least 15 minutes
- **Skin Contact:** Wash with soap and water; seek medical attention if irritation persists
- **Inhalation:** Move to fresh air; seek medical attention if respiratory symptoms develop
- **Ingestion:** Seek immediate medical attention

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10. Quality Assurance

10.1 Testing & Certification

All batches of High Surface Area Manganese Dioxide are subjected to rigorous quality control testing, including:

- Chemical composition analysis (XRF, ICP-OES)
- Surface area determination (BET method)
- Particle size distribution analysis (laser diffraction)
- Moisture content determination (Karl Fischer titration)
- Purity verification (gravimetric analysis)

10.2 Batch Documentation

Each shipment includes comprehensive batch documentation with:

- Certificate of Analysis (CoA) with test results
- Batch identification and traceability information
- Manufacturing date and expiration date
- Storage and handling recommendations

10.3 Consistency & Reproducibility

The manufacturer maintains strict process controls to ensure batch-to-batch consistency, enabling reproducible catalytic performance and reliable results in both research and industrial applications.

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11. Ordering & Contact Information

Contact Method	Details
Email	lixifirm@outlook.com
Phone/WhatsApp	+8618273793022
Website	manganesesupply.com
Company	BTLnewmaterial
Address	Room 706, No. 154, Wuyi East Road, Niezhou Residential Committee, Caizichi Sub-district Office, Leiyang City, Hengyang City, Hunan Province, China

For product inquiries, technical specifications, sample requests, or bulk ordering, please contact the manufacturer using the information provided above.

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12. Frequently Asked Questions (FAQ)

Q: What is the typical MnO_2 purity of this catalyst?

A: The material typically contains 90–95% MnO_2 purity with controlled impurity levels. This purity range provides an optimal balance between catalytic activity, structural stability, and cost efficiency for industrial applications.

Q: Why is high surface area important for catalytic performance?

A: High surface area increases the number of accessible active sites on the MnO_2 surface, improving adsorption of reactant gases and enhancing overall catalytic reaction rates. The 120–220 m^2/g surface area of this material is significantly higher than conventional MnO_2, resulting in superior catalytic efficiency.

Q: How should this material be stored?

A: Store in sealed containers in a dry, well-ventilated environment at room temperature (15–25°C). Maintain relative humidity below 60% to prevent moisture absorption. Avoid exposure to excessive moisture or contamination to maintain catalytic activity and shelf life.

Q: Is this MnO_2 suitable for low-temperature catalytic oxidation?

A: Yes. High-surface-area MnO_2 materials are specifically designed for low-temperature oxidation processes involving CO, VOCs, and formaldehyde. The strong redox properties and high surface area enable efficient catalytic conversion at relatively low temperatures, reducing energy requirements.

Q: What is the typical shelf life?

A: When stored under dry conditions in sealed packaging, the material generally maintains stable catalytic performance for 24 months or longer. Shelf life may be extended with proper storage conditions and moisture control.

Q: Can the particle size or purity be customized?

A: Yes. The manufacturer offers customized particle size distributions and adjusted MnO_2 purity levels to meet specific application requirements. Contact the manufacturer for details on available customization options.

Q: What crystal phases are present in this material?

A: The material features a composite structure of γ-MnO_2 (gamma-phase manganese dioxide) and amorphous MnO_2. This combination provides enhanced catalytic activity while maintaining structural stability and durability.

Document Information

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End of Technical Data Sheet