

The Complete Book on Industrial Gases

Author: P. K. Chattopadhyay

Format: Paperback

ISBN: 9788195830473

Code: NI361

Pages: 544

Price: Rs. 2,495.00 **US\$** 63.00

Publisher: NIIR PROJECT CONSULTANCY SERVICES

Usually ships within **5** days

The Complete Book on Industrial Gases (Acetylene, Argon, Butane, Butene, Carbon Dioxide, Carbon Monoxide, Ethane, Ethene, Helium, Hydrogen Chloride, Hydrogen, Krypton, Liquefied Natural Gas (LNG), Methane, Neon, Nitrogen, Nitrogen Trifluoride Gas, Nitrous Oxide, Oxygen, Ozone, Propane, Propene, Refrigerant Gases, Sulphur Dioxide Gas, Sulphur Hexafluoride Gas, Xenon, Gas Mixtures with Machinery Equipment Details and Factory Layout)

Industrial gases are gases that are produced for use in industrial processes. These gases are used in a wide range of industries, including manufacturing, healthcare, electronics, food and beverage, and many more. They are utilized in different forms, such as pure gases, gas mixtures, and liquid gases, depending on the specific application. Industrial gases can be classified into several categories based on their properties and applications. One of the most common types is atmospheric gases, which are gases that exist naturally in the Earth's atmosphere. This category includes gases such as nitrogen, oxygen, and argon, which are widely used in various industries.

The global industrial gases market size was valued at USD 99.99 billion and is expected to grow at a compound annual growth rate (CAGR) of 7.42%. The growing demand for industrial gases from food & beverages, electronics, and healthcare sectors is driving the global market growth. There are untapped opportunities for market players operating in the industrial gases market due to surging demand for industrial gases in emergency medical conditions. Moreover, due to the rapid spread of manufacturing and processing industries across the globe, market players are expected to invest towards production expansion to expand the market share, hence providing growth opportunities in the upcoming years. Steel, glass, oil, and fiber optics segments demand intensive usage of industrial gases. Growth and advancement in these sectors in developing countries is contributing to the rapid expansion of the industrial gases market.

This book is dedicated to the Gases Industry, the details of gases properties, methods and applications are given. The book sheds light on the materials required for the same and the various processes involved. This popular book has been organized to provide readers with a firmer grasp of how gas technologies are revolutionizing the industry.

The major content of the book are Acetylene, Ammonia, Argon, Butane, Butene, Carbon Dioxide, Carbon Monoxide, Ethane, Ethene, Helium, Hydrogen Chloride, Hydrogen, Krypton, Liquefied Natural Gas (LNG), Methane, Neon, Nitrogen, Nitrogen Trifluoride Gas, Nitrous Oxide, Oxygen, Ozone, Propane, Propene, Refrigerant Gases, Sulphur Dioxide Gas, Sulphur Hexafluoride Gas, Xenon, Gas Mixtures (Breathing, Forming, Penning, Shielding) photographs of machinery with suppliers contact details.

A total guide to manufacturing and entrepreneurial success in one of today's most Industrial Gases industry. This book is a one-stop guide to one of the fastest growing sectors of the Industrial Gases industry, where opportunities abound for manufacturers, retailers, and entrepreneurs. This is the only complete book on the commercial production of Industrial Gases. It serves up a feast of how-to information, from concept to

purchasing equipment.

Contents

1. INTRODUCTION
 - 1.1 History of Gases
 - 1.2 Application and Use of Gases
 - 1.3 Major Industrial Gases
 - 1.4 How Industrial Gases are Used to Innovate in Manufacturing
 - 1.4.1 Automotive Industry
 - 1.4.2 Food Processing
 - 1.4.3 Manufacturing
 - 1.4.4 Semiconductors
 - 1.4.5 Steel Manufacturing and Metal Fabrication
 - 1.5 Gas Production Technology
 - 1.6 Gas Distribution
 - 1.6.1 Mode of Gas Supply
 - 1.6.2 Gas Delivery
 - 1.7 Industrial Gas Market
2. AIR GASES SEPARATION
 - 2.1 Introduction
 - 2.2 Gas Plant Building Blocks
 - 2.3 Compressors
 - 2.4 Thermal Transfer in Gases: Heat Exchangers
 - 2.5 Distillation of Air
 - 2.6 Pressure-Swing Absorption
 - 2.7 Membrane Separation of Gases
3. HANDLING AND TRANSPORTATION OF GASES
 - 3.1 Understanding Industrial Gases
 - 3.2 Handling Precautions
 - 3.3 Transporting Industrial Gases
 - 3.4 Emergency Response
 - 3.5 Legal and Regulatory Compliance
 - 3.6 References
 - 3.7 Best Practices for Specific Gases
 - 3.8 Leak Detection and Mitigation
 - 3.9 Cylinder Maintenance and Inspection
 - 3.10 Special Considerations for International Transportation
 - 3.11 End of Life - Cylinder Disposal
 - 3.12 Glossary
 - 3.13 Hazard Communication
 - 3.14 Special Handling Equipment
 - 3.15 Safety in Extreme Conditions
 - 3.16 Transporting Multiple Gas Types
 - 3.17 Training Refreshers and Updates
 - 3.18 Risk Assessment
 - 3.19 Technology in Gas Handling and Transport
 - 3.20 Conclusion
4. GAS SAFETY MEASURES AND EQUIPMENT
 - 4.1 Understanding Gas Hazards

- 4.2 Safety Measures
 - 4.2.1 Procedural Safety Measures
 - 4.2.2 Operational Safety Measures
- 4.3 Safety Equipment
 - 4.3.1 Personal Protective Equipment (PPE)
 - 4.3.2 Gas Detectors
 - 4.3.3 Firefighting Equipment
 - 4.3.4 Gas Cylinder Equipment
- 4.4 Advanced Safety Equipment
 - 4.4.1 Automated Monitoring Systems
 - 4.4.2 Smart PPE
 - 4.4.3 Robotics and Drones
- 4.5 Incorporating Safety Culture
- 4.6 Regulatory Compliance
- 4.7 Conclusion
- 5. HOW TO START MANUFACTURING UNIT OF INDUSTRIAL GASES
 - 5.1 Detailed Business Plan
 - 5.2 Identify the Type of Industrial Gas to Manufacture
 - 5.3 Licenses and Permits
 - 5.4 Location
 - 5.5 Purchase Necessary Equipment
 - 5.6 Build Your Facility
 - 5.7 Hiring Staff
 - 5.8 Safety Measures
 - 5.9 Quality Control
 - 5.10 Marketing and Sales
 - 5.11 Production and Operation Management
 - 5.12 Distribution Strategy
 - 5.13 Customer Service
 - 5.14 Business Expansion
 - 5.15 Sustainability and Environmental Responsibility
 - 5.16 Regular Audits and Reviews
 - 5.17 Innovation and Technology
 - 5.18 Risk Management
 - 5.19 Regulatory Compliance
 - 5.20 Continuous Improvement
- 6. INDUSTRIAL GAS PURIFICATION CONSIDERATIONS
 - 6.1 Physical Gas Separation
 - 6.1.1 Membrane Separation
 - 6.1.2 Pressure-Swing Adsorption
 - 6.1.3 Cryogenic Distillation
 - 6.2 H₂ and He Generation
 - 6.3 Gas Storage
 - 6.4 Gas Purification Media
 - 6.5 Capacity and Efficiency
 - 6.6 Impurity Concentrations
- 7. THE LAWS OF GASES
 - 7.1 Gas Laws
 - 7.2 Boyle's Law
 - 7.3 Charles's Law

- 7.4 Gay-Lussac Law
- 7.5 Avogadro's Law
- 7.6 Combined Gas Law
- 7.7 Ideal Gas Law
- 7.8 Ideal Gas
- 7.9 Ideal Gas Properties and Characteristics
- 7.10 Application of Gas Law
- 8. HOW VALVES ARE MADE AND USED IN GAS INDUSTRY
 - 8.1 Applications
 - 8.2 Variation
 - 8.3 Valve Operating Positions
 - 8.3.1 Two-Port Valves
 - 8.3.2 Three-Port Valves
 - 8.3.3 Four-Port Valves
 - 8.4 Types of Gas Valves
 - 8.4.1 Gate Valves
 - 8.4.2 Globe Valves
 - 8.4.3 Check Valves
 - 8.4.4 Plug Valves
 - 8.4.5 Ball Valves
 - 8.4.6 Butterfly Valves
 - 8.4.7 Slam-Shut Valves
 - 8.5 Components of Valve
 - 8.5.1 Body
 - 8.5.2 Bonnet
 - 8.5.3 Ports
 - 8.5.4 Actuator
 - 8.5.5 Disc
 - 8.5.6 Seat
 - 8.5.7 Stem
 - 8.5.8 Spring
 - 8.5.9 Trim
 - 8.6 The Requirements for Operating Various Valves
 - 8.6.1 Temperature
 - 8.6.2 Pressure
 - 8.6.3 Pressure Relief
 - 8.6.4 Corrosive Conditions
 - 8.7 Resources Used in Construction
 - 8.8 Valve Manufacturing
 - 8.8.1 Cast Method
 - 8.8.2 Forged Method
 - 8.9 Valve Assembly Phase
 - 8.10 Pressure Test
 - 8.11 Inspection and Quality Control
- 9. OXYGEN GAS MANUFACTURING PROCESS
 - 9.1 Industrial Benefits of Oxygen Gas
 - 9.2 Other Uses of Oxygen Gas
 - 9.3 Medical Oxygen
 - 9.4 The Manufacturing Process
 - 9.4.1 Pretreating
 - 9.4.2 Separating
 - 9.4.3 Purifying
 - 9.4.4 Distributing

- 9.4.5 Quality Control
- 10. HYDROGEN GAS
 - 10.1 Introduction
 - 10.2 Properties
 - 10.2.1 Combustion
 - 10.3 Hydrogen Applications
 - 10.4 Hydrogen Production Process
 - 10.4.1 Hydrogen Production from Fossil Fuels
 - 10.4.2 Hydrogen Production from Renewable Resources
- 11. CARBON DIOXIDE GAS GENERATION
 - 11.1 Increased Concentration of Carbon Dioxide
 - 11.2 Carbon Dioxide as a Greenhouse Gas
 - 11.3 Properties of Carbon Dioxide
 - 11.4 Carbon Dioxide Uses
 - 11.4.1 Carbonation
 - 11.4.2 Food and Beverage Industry
 - 11.4.3 Fire Suppression
 - 11.4.4 Welding and Metal Fabrication
 - 11.4.5 Oil and Gas Industry
 - 11.4.6 Chemical Processes
 - 11.4.7 pH Control
 - 11.5 Harmful Effects of Carbon Dioxide
 - 11.6 Manufacturing Process
 - 11.6.1 Source Identification
 - 11.6.2 Extraction or Generation
 - 11.6.3 Purification and Refinement
 - 11.6.4 Storage and Distribution
 - 11.6.5 Utilization
 - 11.7 Carbon Dioxide Capture
 - 11.7.1 Postconversion Capture
 - 11.7.2 Preconversion Capture
 - 11.7.3 Oxy-Fuel Combustion Capture
 - 11.8 Carbon Dioxide Storage
- 12. NITROGEN GAS
 - 12.1 Chemical Properties
 - 12.2 Industrial Applications of Nitrogen
 - 12.2.1 Food Packaging
 - 12.2.2 Chemical Blanketing
 - 12.2.3 Electronics
 - 12.2.4 Laboratory
 - 12.2.5 Laser Cutting
 - 12.2.6 Beer Manufacturing
 - 12.3 Use of Nitrogen in the Oil and Gas Industry
 - 12.3.1 Nitrogen Injection in Oil and Gas Wells
 - 12.3.2 Pipeline Drying
 - 12.3.3 Nitrogen Purging
 - 12.3.4 Pressure Testing
 - 12.3.5 Nitrogen Blanketing
 - 12.4 Common Types of Nitrogen Gas Production
 - 12.4.1 Pressure Swing Adsorption (PSA) Nitrogen Production
 - 12.4.2 Membrane Nitrogen Production
 - 12.4.3 Fractional Distillation Nitrogen Production
 - 12.5 Production Process

- 12.5.1 Purification
- 12.5.2 Refrigeration
- 12.5.3 Rectification
- 12.6 What Is Nitrogen Gas Purity?
- 12.7 High-Purity vs. Low-Purity Nitrogen
 - 12.7.1 High-Purity Nitrogen Gas
 - 12.7.2 Low-Purity Nitrogen Gas
- 12.8 How to Check Purity of Nitrogen Gas
- 12.9 Nitrogen Gas Purity Classification
- 12.10 What Is Ultra High Purity (UHP) Nitrogen Gas?
- 12.11 What Is Oxygen-free Nitrogen (OFN)?
- 13. ACETYLENE GAS MANUFACTURING PROCESS
 - 13.1 Introduction
 - 13.2 Discovery of Acetylene Gas
 - 13.3 Applications of Acetylene Gas
 - 13.3.1 Welding, Cutting, and Heat Treating
 - 13.3.2 Portable Lighting
 - 13.3.3 Production of Chemicals
 - 13.3.4 Making of Polyethylene Plastics
 - 13.3.5 Importance of Purity of Acetylene
 - 13.4 Raw Material
 - 13.5 The Manufacturing Process
 - 13.5.1 Chemical Reaction Process
 - 13.5.2 Thermal Cracking Process
 - 13.6 Storage and Handling
 - 13.7 Quality Control
 - 13.8 How an Acetylene Gas Plant Works
 - 13.9 Detailed Technical Process for Acetylene Production
- 14. ETHANE GAS MANUFACTURING PROCESS
 - 14.1 History
 - 14.2 Structure of Ethane
 - 14.3 Preparation of Ethane
 - 14.4 Physical Properties of Ethane
 - 14.5 Chemical Properties of Ethane
 - 14.6 Use/Applications
 - 14.7 Manufacturing Process
 - 14.7.1 Exploration and Drilling
 - 14.7.2 Extraction
 - 14.7.3 Separation
 - 14.7.4 Ethane Recovery
 - 14.7.5 Compression and Storage
- 15. ETHENE GAS
 - 15.1 Ethene Gas Chemical Properties
 - 15.1.1 Molecular Formula and Structure
 - 15.1.2 Double Bond Reactivity
 - 15.1.3 Combustibility
 - 15.1.4 Polymerization
 - 15.1.5 Addition Reactions
 - 15.1.6 Oxidation
 - 15.1.7 Acidic Nature
 - 15.1.8 Stability and Reactivity
 - 15.2 Ethene Gas Industrial Uses and Application
 - 15.2.1 Production of Plastics

- 15.2.2 Synthetic Rubber Production
- 15.2.3 Solvent
- 15.2.4 Ripening Agent
- 15.2.5 Fuel
- 15.2.6 Production of Ethylene Oxide
- 15.2.7 Agrochemicals
- 15.2.8 Pharmaceuticals
- 15.3 Manufacturing Process of Ethene Gas
 - 15.3.1 Feedstock Selection
 - 15.3.2 Preheating
 - 15.3.3 Mixing With Steam
 - 15.3.4 Cracking Reaction
 - 15.3.5 Quenching
 - 15.3.6 Separation and Purification
 - 15.3.7 Compression and Storage
- 16. HELIUM GAS GENERATION
 - 16.1 Physical Properties
 - 16.1.1 Atomic Structure and State of Matter
 - 16.1.2 Density and Buoyancy
 - 16.1.3 Boiling and Melting Points
 - 16.1.4 Thermal Conductivity and Superfluidity
 - 16.1.5 Solubility and Interaction with Other Elements
 - 16.2 Industrial Applications and Uses
 - 16.2.1 Healthcare and Medical
 - 16.2.2 Manufacturing and Industrial Processes
 - 16.2.3 Aerospace and Ballooning
 - 16.2.4 Nuclear and Energy
 - 16.2.5 Miscellaneous Applications
 - 16.3 Helium Manufacturing Process
 - 16.3.1 Natural Reserves and Extraction
 - 16.3.2 Preprocessing and Purification
 - 16.3.3 Storage and Distribution
 - 16.3.4 Recycling and Conservation
 - 16.4 Challenges and Future Prospects
 - 16.4.1 Helium Reserves and Supply Concerns
 - 16.4.2 Alternative Helium Sources
 - 16.4.3 Advanced Manufacturing Technologies
 - 16.4.4 Global Cooperation and Policy Initiatives
- 17. BUTANE GAS
 - 17.1 Chemical Properties
 - 17.1.1 Combustion
 - 17.1.2 Halogenation
 - 17.1.3 Inertness
 - 17.1.4 Isomerization
 - 17.2 What are Isomers?
 - 17.2.1 Butane
 - 17.2.2 Iso-Butane
 - 17.3 Butane Structure
 - 17.4 Uses
 - 17.5 How Butane is Produced?
 - 17.5.1 Extraction from Crude Oil
 - 17.5.2 Natural Gas Processing
 - 17.5.3 Further Processing and Safety Measures

- 17.5.4 Storage and Transport
- 18. BUTENE GAS
 - 18.1 Isomers
 - 18.2 Properties
 - 18.3 Industrial Applications of Butene Gas
 - 18.3.1 Polymer Production
 - 18.3.2 Fuel Blending
 - 18.3.3 Chemical Synthesis
 - 18.3.4 Synthetic Rubber Production
 - 18.3.5 Butene Isomerization
 - 18.3.6 Solvents and Extraction Processes
 - 18.3.7 Adhesives and Sealants
 - 18.4 Butene Gas Manufacturing Process
 - 18.4.1 Steam Cracking of Hydrocarbons
 - 18.4.2 Catalytic Dehydrogenation
- 19. PROPANE GAS GENERATION PROCESS
 - 19.1 Ways Propane Is Produced
 - 19.1.1 Propane from Natural Gas Production
 - 19.1.2 Propane from Crude Oil Refining
 - 19.2 Industrial Uses of Propane
 - 19.3 Chemical Preparation of Propane
 - 19.4 Raw Materials
 - 19.5 The Manufacturing Process
 - 19.6 Quality Control
 - 19.7 Byproducts/Waste
 - 19.8 The Future
- 20. PROPENE GAS
 - 20.1 Chemical Reactions of Propane
 - 20.2 Uses and Application
 - 20.2.1 Polypropylene Production
 - 20.2.2 Chemical Manufacturing
 - 20.2.3 Fuel and Energy
 - 20.2.4 Refrigeration and Air Conditioning
 - 20.2.5 Pharmaceuticals and Cosmetics
 - 20.2.6 Other Applications
 - 20.3 Manufacture of Propene (Propylene)
 - 20.3.1 Catalytic Cracking of Propane
 - 20.3.2 The MTO (Methanol to Olefins) Process
 - 20.3.3 The Reaction Between Ethene and Butenes
- 21. METHANE GAS
 - 21.1 Importance of Methane
 - 21.2 Methane Impacts
 - 21.2.1 Climate Impacts
 - 21.2.2 Health Impacts
 - 21.3 Properties and Bonding
 - 21.4 Chemical Reactions
 - 21.4.1 Selective Oxidation
 - 21.4.2 Acid–Base Reactions
 - 21.4.3 Combustion
 - 21.5 Methane Generation
 - 21.5.1 Geological Routes
 - 21.5.2 Biological Routes
 - 21.5.3 Industrial Routes

22. ARGON GAS

22.1 The Discovery of Argon

22.1.1 Unraveling a Hidden Element

22.1.2 The Birth of a New Field

22.2 Chemical Inertness and Stability

22.3 Properties of Argon

22.3.1 A Noble Gas

22.3.2 Colorless, Odorless, and Non-Toxic

22.3.3 High Thermal Stability

22.3.4 Relatively High Density

22.4 Industrial Applications and Uses

22.4.1 Argon Gas in Metal Fabrication

22.4.2 Heat Treatment and Controlled Atmospheres

22.4.3 Argon Gas in Lighting and Electronics

22.4.4 Other Industrial Applications

22.4.5 Future Perspectives and Innovations

22.5 Production Process of Argon Gas

22.5.1 Extraction of Argon from the Atmosphere

22.5.2 Argon Gas Purification

22.5.3 Storage and Distribution

22.5.4 Safety Considerations

22.5.5 Environmental Considerations and Challenges

22.6 Research and Development

22.7 Branding and Marketing

22.7.1 Understanding Branding in the Context of Argon Gas

22.7.2 Crafting an Effective Brand Messaging Strategy

22.7.3 Designing a Visual Identity

22.7.4 Building Brand Awareness and Recognition

22.7.5 Embracing Digital Marketing Strategies

22.7.6 Tracking and Measuring Brand Performance

23. OZONE GAS

23.1 Structure

23.2 Properties and Formation of Ozone

23.2.1 Solar Ultraviolet Radiation

23.2.2 Lightning and Electrical Discharges

23.3 The Ozone Layer

23.4 Ozone Depletion

23.5 Impacts of Ozone Depletion

23.6 Ozone Protection Efforts

23.7 Applications and Uses of Ozone

23.7.1 Ozone in Water Treatment

23.7.2 Ozone in Air Purification

23.7.3 Ozone in Medical

23.7.4 Ozone in Food Preservation

23.7.5 Ozone in Industrial Processes

23.7.6 Ozone in Environmental Remediation

23.8 How Ozone is Made

23.8.1 Ozone Generation by Corona Discharge

23.8.2 Photochemical Ozone Generation

23.8.3 Electrolytic Ozone Generation

23.8.4 Radiochemical Ozone Generation

24. CARBON MONOXIDE GAS

24.1 Structure of Carbon Monoxide or CO

- 24.2 Industrial Applications and Uses
 - 24.2.1 Production of Chemicals and Fuels
 - 24.2.2 Metal Extraction and Metallurgy
 - 24.2.3 Hydrogen Production
 - 24.2.4 Chemical and Petrochemical Industry
 - 24.2.5 Laboratory and Industrial Processes
- 24.3 Production Process
 - 24.3.1 Sources of Carbon Monoxide
- 24.4 In Laboratory
- 24.5 Industrial Processes
 - 24.5.1 Steam Reforming of Natural Gas
 - 24.5.2 Partial Oxidation of Hydrocarbons
 - 24.5.3 Coal Gasification
- 24.6 Safety Measures and Environmental Considerations
 - 24.6.1 Monitoring Systems
 - 24.6.2 Ventilation and Exhaust Systems
 - 24.6.3 Personal Protective Equipment (PPE)
 - 24.6.4 Environmental Impact
- 24.7 Emerging Technologies and Future Prospects
 - 24.7.1 Carbon Capture and Utilization (CCU)
 - 24.7.2 Renewable Energy Integration
 - 24.7.3 Advanced Catalysts and Reaction
 - 24.7.4 Safety and Monitoring Systems
 - 24.7.5 Environmental Regulations and Standards
- 25. HYDROGEN CHLORIDE GAS
 - 25.1 Industrial Applications of Hydrogen Chloride Gas
 - 25.1.1 Chemical Industry
 - 25.1.2 Metal Processing
 - 25.1.3 Water Treatment
 - 25.1.4 Pharmaceuticals and Laboratories
 - 25.2 Preparation of Hydrogen Chloride Gas
 - 25.2.1 General Methods
 - 25.2.2 Laboratory Method
 - 25.3 Drying of the Gas (Purification of Gas)
 - 25.4 Collection
 - 25.5 Physical Properties of Hydrogen Chloride Gas
 - 25.6 Hazards and Precautions
 - 25.6.1 Toxicity
 - 25.6.2 Corrosivity
 - 25.6.3 Reactivity
 - 25.6.4 Environmental Impact
 - 25.7 Safety Measures and Emergency Response
 - 25.7.1 Training
 - 25.7.2 Ventilation and Containment
 - 25.7.3 Personal Protective Equipment
 - 25.7.4 Emergency Response
- 26. SULPHUR HEXAFLUORIDE GAS
 - 26.1 Physical and Chemical Properties
 - 26.2 Industrial Applications and Uses
 - 26.2.1 Electrical Industry
 - 26.2.2 Semiconductor Manufacturing
 - 26.2.3 Medical Applications
 - 26.2.4 Metal Production and Processing

- 26.2.5 Sound Insulation and Acoustics
- 26.2.6 Particle Accelerators
- 26.2.7 Leak Detection and Testing
- 26.3 Environmental Impact and Regulations
 - 26.3.1 Emissions and Leakages
 - 26.3.2 Regulations and Alternatives
 - 26.3.3 Research and Development
- 26.4 Physical Properties of Sulphur Hexafluoride Gas
 - 26.4.1 Molecular Structure and Composition
 - 26.4.2 Density and Phase Transition
 - 26.4.3 Boiling and Melting Points
 - 26.4.4 Solubility
 - 26.4.5 Thermal Conductivity
 - 26.4.6 Dielectric Strength
 - 26.4.7 Chemical Inertness
- 26.5 Production Process of Sulphur Hexafluoride Gas
 - 26.5.1 Sulphur Extraction
 - 26.5.2 Fluorine Generation
 - 26.5.3 Reaction and Synthesis
 - 26.5.4 Purification and Distillation
- 26.6 Environmental Concerns and Alternatives
 - 26.6.1 Emission Reduction
 - 26.6.2 Substitution with Alternative Gases
 - 26.6.3 Advanced Technologies
- 27. XENON GAS
 - 27.1 Chemical Properties
 - 27.1.1 Atomic Structure of Xenon
 - 27.1.2 Reactivity of Xenon
 - 27.1.3 Xenon Compounds
 - 27.2 Applications
 - 27.3 Isotopes
 - 27.4 Precautions
 - 27.5 The Production of Xenon
 - 27.5.1 Sources of Xenon
 - 27.5.2 Extraction Methods
 - 27.5.3 Purification Techniques
- 28. SULPHUR DIOXIDE GAS COMPOUND
 - 28.1 Structure of Sulphur Dioxide
 - 28.2 Characteristics of Sulphur Dioxide
 - 28.3 Sources of Sulphur Dioxide
 - 28.4 Health Effects
 - 28.5 Mitigation Strategies
 - 28.6 pH of Sulphur Dioxide
 - 28.7 Occurrence of Sulphur Dioxide
 - 28.8 Uses and Application
 - 28.8.1 Industrial Processes
 - 28.8.2 Food Preservation
 - 28.8.3 Bleaching Agent
 - 28.8.4 Refrigeration and Cooling
 - 28.8.5 Water Treatment
 - 28.8.6 Metal Extraction
 - 28.8.7 Air Pollution Control
 - 28.9 Chemical Properties of Sulphur Dioxide

- 28.10 Methods of Preparation of Sulphur Dioxide
 - 28.10.1 Combustion of Elemental Sulphur
 - 28.10.2 Roasting of Metal Sulphide Ores
 - 28.10.3 Contact Process
- 28.11 Production of Sulphur Dioxide Gas
 - 28.11.1 Sources of Sulphur Dioxide
 - 28.11.2 Industrial Production Methods
- 28.12 Industrial Applications of Sulphur Dioxide
 - 28.12.1 Sulphuric Acid Production
 - 28.12.2 Food Preservation
 - 28.12.3 Bleaching Agent and Chemical Intermediary
- 28.13 Environmental Impact and Control Measures
 - 28.13.1 Air Pollution
 - 28.13.2 Regulatory Measures
- 28.14 Environmental Considerations
 - 28.14.1 Emissions and Air Pollution Control
 - 28.14.2 Waste Management and Disposal
- 28.15 Safety Considerations
 - 28.15.1 Handling and Storage
 - 28.15.2 Personal Protective Equipment
- 28.16 Quality Control and Monitoring
 - 28.16.1 Purity and Impurities
 - 28.16.2 Continuous Monitoring
- 28.17 Future Trends and Innovations
 - 28.17.1 Conversion into Value-Added Products
 - 28.17.2 Environmental Applications
 - 28.17.3 Sustainable Industrial Practices
 - 28.17.4 Advanced Monitoring and Control Systems
 - 28.17.5 Regulatory Framework and Collaboration
- 29. AMMONIA GAS COMPOUND
 - 29.1 Structure of Ammonia (NH₃)
 - 29.2 Properties of Ammonia (NH₃)
 - 29.3 Preparation of Ammonia
 - 29.4 Applications and Uses of Ammonia Gas
 - 29.4.1 Ammonia in Agriculture
 - 29.4.2 Ammonia in Refrigeration
 - 29.4.3 Ammonia in Manufacturing Processes
 - 29.4.4 Ammonia as a Fuel and Energy Source
 - 29.4.5 Ammonia for Cleaning and Decontamination
 - 29.4.6 Other Applications of Ammonia
 - 29.5 Production Process of Ammonia
 - 29.5.1 Nitrogen Extraction
 - 29.5.2 Hydrogen Production
 - 29.5.3 Ammonia Synthesis
 - 29.5.4 Separation and Purification
 - 29.5.5 Storage and Distribution
 - 29.6 Natural Occurrence of Ammonia
 - 29.7 Future Opportunities of Ammonia Gas
 - 29.7.1 Ammonia as a Green Energy Carrier
 - 29.7.2 Ammonia as a Zero-Emission Fuel
 - 29.7.3 Ammonia as a Sustainable Fertilizer
 - 29.7.4 Ammonia for Hydrogen Storage and Delivery
 - 29.7.5 Challenges and Considerations

29.8 Regulatory Changes and Industry Compliance of Ammonia Gas

29.8.1 The Environmental Impact of Ammonia Gas

29.8.2 Regulatory Changes for Ammonia Gas

29.8.3 Industry Compliance and Best Practices

29.8.4 Collaboration and Knowledge Sharing

29.9 Branding and Marketing Strategies for Ammonia Gas

29.9.1 Understanding Ammonia Gas

29.9.2 Identifying the Target Audience

29.9.3 Establishing Brand Identity

29.9.4 Crafting Brand Messaging

29.9.5 Marketing Channels and Tactics

29.9.6 Building Customer Relationships

30. NITROGEN TRIFLUORIDE GAS

30.1 Chemical Structure and Properties

30.1.1 Stability

30.1.2 Solubility

30.1.3 Chemical Reactivity

30.2 Applications

30.2.1 Semiconductor Manufacturing

30.2.2 Solar Energy Applications

30.2.3 Plasma Etching

30.2.4 Fluorination Reactions

30.2.5 Propellant

30.2.6 Other Applications

30.3 Synthesis and Reactivity

30.4 Manufacturing Process

30.4.1 Synthesis from Ammonium Fluoride (NH₄F) and Sodium Fluoride (NaF)

30.4.2 Purification and Refinement

30.4.3 Storage and Packaging

30.5 Environmental Considerations and Sustainability Efforts

30.5.1 Environmental Impact

30.5.2 Emission Reduction and Recovery Efforts

30.5.3 Industry Collaboration and Regulatory Measures

30.6 Safety Considerations and Handling Practices

30.6.1 Safety Precautions

30.6.2 Storage and Transportation

30.7 Future Perspectives and Research

30.7.1 Improved Production Efficiency

30.7.2 Alternative Cleaning and Etching Agents

30.7.3 Emission Reduction Technologies

30.7.4 Lifecycle Assessment

31. NEON GAS

31.1 The Birth of Neon

31.1.1 Unveiling the Origins

31.1.2 The Discovery of Neon

31.2 Properties of Neon

31.3 Uses and Applications of Neon Gas

31.3.1 Neon Signage

31.3.2 Lighting Applications

31.3.3 Scientific and Medical Research

31.3.4 Liquid Neon

- 31.3.5 Neon in Art and Entertainment
- 31.3.6 Astrophysics and Plasma Studies
- 31.4 Chemical Properties of Neon Gas
 - 31.4.1 Chemical Inertness
- 31.5 The Production of Neon Gas
 - 31.5.1 Raw Materials and Extraction
 - 31.5.2 Neon Extraction from the Atmosphere
 - 31.5.3 Purification of Neon
 - 31.5.4 Fractional Distillation
 - 31.5.5 Storage and Distribution
- 31.6 Manufacturing of Neon Signs
 - 31.6.1 Glass Tube Preparation
 - 31.6.2 Electrode Placement
 - 31.6.3 Vacuuming and Gas Filling
 - 31.6.4 Sealing and Testing
 - 31.6.5 Assembly and Wiring
- 31.7 Branding and Marketing Strategies for Neon Gas
 - 31.7.1 Understanding Neon Gas: A Radiant Opportunity
 - 31.7.2 Developing a Strong Brand Identity
 - 31.7.3 Branding Strategies for Neon Gas
 - 31.7.4 Implementing Effective Marketing Tactics
 - 31.7.5 Leveraging Brand Equity and Customer Loyalty
- 32. KRYPTON GAS PRODUCTION
 - 32.1 Chemical Properties
 - 32.2 Atomic Structure of Krypton
 - 32.3 Isotope of Krypton
 - 32.4 Uses of Krypton
 - 32.4.1 Commercial Applications
 - 32.4.2 Research Applications
 - 32.4.3 Medical Applications
 - 32.4.4 Miscellaneous Applications
 - 32.5 The Production Process of Krypton Gas
 - 32.5.1 Extraction of Krypton from Air
 - 32.5.2 Purification of Krypton Gas
 - 32.5.3 Krypton Gas Storage and Distribution
 - 32.6 Conclusion
- 33. NITROUS OXIDE GAS
 - 33.1 Introduction
 - 33.2 Historical Significance
 - 33.3 Physical Properties
 - 33.3.1 State and Appearance
 - 33.3.2 Density and Solubility
 - 33.3.3 Stability
 - 33.4 Applications and Uses
 - 33.4.1 Medical and Dental
 - 33.4.2 Food and Beverage
 - 33.4.3 Automotive and Racing
 - 33.4.4 Electronics and Semiconductors
 - 33.5 Chemical Properties
 - 33.6 Expansion of Industrial Applications
 - 33.6.1 Aerospace and Rocket Propulsion
 - 33.6.2 Semiconductor Manufacturing
 - 33.6.3 Analytical Chemistry

- 33.6.4 Welding and Metal Fabrication
- 33.6.5 Water Treatment
- 33.7 The Production Process of Nitrous Oxide Gas
 - 33.7.1 Raw Materials and Sourcing
 - 33.7.2 Nitric Oxide Production
 - 33.7.3 Nitrogen Dioxide Formation
 - 33.7.4 Absorption and Purification
 - 33.7.5 Nitrous Oxide Formation
 - 33.7.6 Quality Control
- 33.8 Safety Precautions and Environmental Considerations
 - 33.8.1 Handling of Raw Materials
 - 33.8.2 Catalytic Converter Operation
 - 33.8.3 Ventilation and Containment
 - 33.8.4 Fire and Explosion Prevention
 - 33.8.5 Waste Management
 - 33.8.6 Emissions Control
 - 33.8.7 Energy Efficiency
 - 33.8.8 Environmental Impact Assessments
- 33.9 Future Prospects and Challenges
 - 33.9.1 Environmental Concerns
 - 33.9.2 Regulatory Measures
 - 33.9.3 Advancements in Production
 - 33.9.4 Safety and Occupational Health
 - 33.9.5 Research and Innovation
- 33.10 Exploration of Research and Development
 - 33.10.1 Green Production Methods
 - 33.10.2 Carbon Capture and Utilization
 - 33.10.3 Nitrous Oxide Sensors and Monitoring
 - 33.10.4 Nitrous Oxide Decomposition Catalysts
 - 33.10.5 Nitrous Oxide Emission Reduction Strategies
 - 33.10.6 Nitrous Oxide as an Energy Storage Medium
- 33.11 Branding and Marketing Strategies for Nitrous Oxide Production
 - 33.11.1 Understanding the Nitrous Oxide Market
 - 33.11.2 Developing a Strong Brand Identity
 - 33.11.3 Targeted Marketing Strategies
 - 33.11.4 Building Trust and Credibility
 - 33.11.5 Implementing Effective Communication Channels
 - 33.11.6 Monitoring and Analyzing Performance
- 34. LIQUEFIED NATURAL GAS (LNG)
 - 34.1 Introduction
 - 34.2 Understanding Liquefied Natural Gas
 - 34.3 Significance of Liquefied Natural Gas
 - 34.3.1 Energy Security and Diversification
 - 34.3.2 Environmental Benefits
 - 34.4 What Is Liquefied Natural Gas Used For?
 - 34.5 What are the Differences Between Raw, Compressed, and Liquefied Natural Gas?
 - 34.6 Characteristics of Liquefied Natural Gas
 - 34.7 Applications of Liquefied Natural Gas
 - 34.7.1 Power Generation
 - 34.7.2 Transportation
 - 34.7.3 Industrial Applications
 - 34.7.4 Residential and Commercial Use

- 34.8 How Liquefied Natural Gas (LNG) Works
- 34.9 The Liquefied Natural Gas Production Process
 - 34.9.1 Natural Gas Extraction
 - 34.9.2 Liquefaction
 - 34.9.3 Treatment and Removal of Impurities
 - 34.9.4 Storage and Transportation
 - 34.9.5 Regasification and Distribution
- 34.10 Environmental Considerations and Sustainability
 - 34.10.1 Methane Emissions
 - 34.10.2 Carbon Capture and Storage
 - 34.10.3 Transition to Renewable Energy
- 35. REFRIGERANT GASES
 - 35.1 Purpose of Refrigerant Gas
 - 35.1.1 Heat Exchange
 - 35.1.2 Enabling Efficient Cooling
 - 35.1.3 Environmentally Friendly Options
 - 35.2 Common Category of Refrigerants
 - 35.2.1 Chlorofluorocarbons (CFCs)
 - 35.2.2 Hydrochloro-fluorocarbons (HCFCs)
 - 35.2.3 Hydrofluorocarbons (HFCs)
 - 35.2.4 Inorganic or Natural Refrigerants
 - 35.2.5 Mixtures
 - 35.3 Applications of Refrigerant Gas
 - 35.4 Manufacturing Process
 - 35.4.1 Raw Material Preparation
 - 35.4.2 Synthesis Process
 - 35.4.3 Distillation and Purification
 - 35.4.4 Blending
 - 35.4.5 Quality Control and Safety Measures
 - 35.4.6 Packaging and Distribution
- 36. GAS MIXTURES
 - 36.1 Types of Gas Mixtures
 - 36.1.1 Air
 - 36.1.2 Natural Gas
 - 36.1.3 LPG (Liquefied Petroleum Gas)
 - 36.1.4 Welding Gas Mixtures
 - 36.1.5 Medical Gas Mixtures
 - 36.1.6 Calibration Gas Mixtures
 - 36.1.7 Environmental Test Gas Mixtures
 - 36.1.8 Specialty Gas Mixtures
 - 36.2 The Wide Range of Uses of Gas Mixtures
 - 36.2.1 Industrial Applications
 - 36.2.2 Medical Applications
 - 36.2.3 Scientific Research and Analysis
 - 36.2.4 Calibration and Instrumentation
 - 36.2.5 Environmental Studies
 - 36.3 Physical Properties
 - 36.3.1 Pressure
 - 36.3.2 Volume
 - 36.3.3 Temperature
 - 36.3.4 Density
 - 36.3.5 Molecular Weight
 - 36.3.6 Diffusion

- 36.3.7 Partial Pressure
- 36.3.8 Solubility
- 36.4 The Manufacturing Process of Gas Mixtures
 - 36.4.1 Gas Selection
 - 36.4.2 Purification
 - 36.4.3 Blending
 - 36.4.4 Analysis
 - 36.4.5 Quality Control
 - 36.4.6 Packaging
 - 36.4.7 Storage and Transportation
- 36.5 A Strategic Approach for Success
 - 36.5.1 Understanding the Supply Chain of Gas Mixtures
 - 36.5.2 Branding Gas Mixtures
 - 36.5.3 Marketing Gas Mixtures
- 36.6 Market of Gas Mixtures
- 37. BREATHING GAS MIXTURE
 - 37.1 Composition of Breathing Gases
 - 37.2 Applications of Breathing Gases
 - 37.2.1 Diving
 - 37.2.2 Aerospace
 - 37.2.3 Medical and Healthcare
 - 37.2.4 Sports and Performance Enhancement
 - 37.3 Production Process of Breathing Gases
 - 37.3.1 Sourcing and Storage
 - 37.3.2 Purification and Compression
 - 37.3.3 Quality Control and Testing
 - 37.3.4 Packaging and Distribution
 - 37.3.5 Compliance with Regulatory Standards
 - 37.4 Safety Considerations
 - 37.4.1 Gas Purity and Contamination
 - 37.4.2 Equipment Compatibility
 - 37.4.3 Training and Certification
 - 37.5 Future Developments and Challenges
 - 37.5.1 Novel Gas Combinations
 - 37.5.2 Gas Delivery Systems
 - 37.5.3 Environmental Considerations
- 38. FORMING GAS MIXTURE
 - 38.1 Composition of Forming Gas
 - 38.2 Properties of Forming Gas
 - 38.3 Applications of Forming Gas
 - 38.3.1 Annealing and Heat Treatment
 - 38.3.2 Soldering and Brazing
 - 38.3.3 Electronics Manufacturing
 - 38.3.4 Powder Metallurgy
 - 38.3.5 Solar Cell Fabrication
 - 38.4 Advantages of Forming Gas
 - 38.4.1 Oxidation Prevention
 - 38.4.2 Improved Soldering Quality
 - 38.4.3 Enhanced Electrical Properties
 - 38.4.4 Cost-Effectiveness
 - 38.5 Production Process of Forming Gas
 - 38.5.1 Gas Generation
 - 38.5.2 Nitrogen Separation

- 38.5.3 Gas Blending
- 38.5.4 Gas Purification
- 38.6 Quality Control and Safety Measures
- 38.7 Supply Chain Challenges and Optimization
 - 38.7.1 Sourcing and Procurement
 - 38.7.2 Transportation and Logistics
 - 38.7.3 Inventory Management
 - 38.7.4 Supplier Relationship Management
- 38.8 Branding and Marketing Strategies
 - 38.8.1 Differentiation and Positioning
 - 38.8.2 Market Segmentation and Targeting
 - 38.8.3 Digital Marketing and Online Presence
 - 38.8.4 Customer Relationship Management
- 38.9 Regulatory Changes and Industry Compliance
 - 38.9.1 Environmental and Safety Regulations
 - 38.9.2 Quality Control and Standards
 - 38.9.3 International Trade Regulations
 - 38.9.4 Industry-Specific Regulations
- 39. SHIELDING GAS MIXTURE
 - 39.1 Understanding Shielding Gas
 - 39.2 Importance of Shielding Gas in Welding
 - 39.3 Composition of Shielding Gas
 - 39.3.1 Argon (Ar)
 - 39.3.2 Carbon Dioxide (CO₂)
 - 39.3.3 Helium (He)
 - 39.3.4 Oxygen (O₂)
 - 39.4 Types of Shielding Gases
 - 39.4.1 Inert Shielding Gases
 - 39.4.2 Active Shielding Gases
 - 39.4.3 Gas Mixtures
 - 39.5 Properties
 - 39.5.1 Purity of Shielding Gas
 - 39.5.2 Flow Rate and Pressure
 - 39.5.3 Gas Ionization Potential
 - 39.5.4 Thermal Conductivity and Heat Transfer
 - 39.5.5 Reactive vs. Inert Shielding Gases
 - 39.6 Shielding Gas Selection
 - 39.7 Production of Shielding Gas
 - 39.8 Quality Control and Safety Measures
 - 39.9 Importance of Quality Shielding Gas
- 40. PENNING GAS MIXTURES
 - 40.1 Applications of Penning Gas Mixtures
 - 40.1.1 Gas Discharge Lighting
 - 40.1.2 Particle Detectors
 - 40.1.3 Radiation Detectors
 - 40.1.4 Electron Multiplier Devices
 - 40.1.5 Ion Lasers
 - 40.1.6 Plasma Processing
 - 40.1.7 Gas Amplification Systems
 - 40.2 Manufacturing Process of Penning Gas Mixtures
 - 40.2.1 Gas Selection and Purity Control
 - 40.2.2 Gas Preparation and Handling
 - 40.2.3 Gas Blending and Mixing

- 40.2.4 Quality Control and Analysis
- 40.2.5 Packaging and Storage
- 40.3 Future Opportunities of Penning Gas Mixtures
- 40.4 Advancements in Technology
- 40.5 Energy Applications
- 40.6 Healthcare and Biomedical Applications
- 40.7 Supply Chain Management
- 40.8 Branding and Marketing Strategies
- 40.9 Regulatory Changes and Industry Compliance
- 40.10 Technology and Innovation
- 40.11 Internationalization and Global Supply Chains
- 40.12 Industry Collaboration and Partnerships
- 40.13 Continuous Improvement and Adaptability
- 41. BIS STANDARDS
- 42. ISO STANDARDS
- 43. PLANT LAYOUT AND PROCESS FLOW CHART & DIAGRAM
- 44. PHOTOGRAPHS OF PLANT AND MACHINERY WITH SUPPLIERS CONTACT DETAILS
- Acetylene Generator
- Oxygen Compressor
- Oxygen Gas Generator
- Cryogenic Storage
- Actuated Valves
- Gas Liquefaction Chillers Machine
- Gas Filter Machine
- Air Tank
- CO2 Compressor
- High Temperature Refrigeration Dryer
- Gas Mixers
- Pressure Gauge
- High Pressure Cylinders
- Gas Purity Tester
- Gas Filling Machine
- Gas Recovery Machine
- Expansion Engine
- Centrifuge
- Liquid Oxygen Pump
- Liquid Nitrogen Tank Filling Station
- Industrial Water Softener
- Hydrogen Gas Generator
- Moisture Separator
- Water Softener

About NIIR

NIIR PROJECT CONSULTANCY SERVICES (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the related industries.

Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Start up

Business Opportunities, entrepreneurship projects, Successful Business Plan, Industry Trends, Market Research, Manufacturing Process, Machinery, Raw Materials, project report, Cost and Revenue, Pre-feasibility study for Profitable Manufacturing Business, Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Business Opportunities, Investment Opportunities for Most Profitable Business in India, Manufacturing Business Ideas, Preparation of Project Profile, Pre-Investment and Pre-Feasibility Study, Market Research Study, Preparation of Techno-Economic Feasibility Report, Identification and Section of Plant, Process, Equipment, General Guidance, Startup Help, Technical and Commercial Counseling for setting up new industrial project and Most Profitable Small Scale Business.

NPCS also publishes various process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.

NIIR PROJECT CONSULTANCY SERVICES , 106-E, Kamla Nagar, New Delhi-110007, India. **Email:** npcs.india@gmail.com **Website:** NIIR.org

Wed, 24 Jul 2024 12:00:35 +0530