

ingersoll rand air dryer installation

ingersoll rand air dryer installation is a critical process for ensuring the optimal performance and longevity of compressed air systems. Proper installation not only maximizes the efficiency of the Ingersoll Rand air dryer but also protects downstream equipment from moisture-related damage. This comprehensive guide covers essential steps, considerations, and best practices for installing Ingersoll Rand air dryers in various industrial settings. From site preparation to post-installation testing, every stage plays a vital role in achieving reliable and energy-efficient operation. Understanding the technical requirements and following manufacturer guidelines can prevent costly downtime and maintenance issues. This article will explore detailed installation procedures, common challenges, and maintenance tips to help professionals and facility managers implement an effective air drying solution. The following sections provide an organized overview of the installation process and related topics.

- Understanding Ingersoll Rand Air Dryers
- Pre-Installation Planning and Site Preparation
- Step-by-Step Installation Process
- Testing and Commissioning
- Maintenance and Troubleshooting

Understanding Ingersoll Rand Air Dryers

Ingersoll Rand air dryers are designed to remove moisture from compressed air systems, ensuring dry and clean air for industrial applications. These dryers come in various types, including refrigerated, desiccant, and membrane dryers, each suited for specific operational needs. The choice of air dryer depends on factors such as required dew point, airflow capacity, and environmental conditions. Proper understanding of the dryer type and its operational principles is essential before installation.

Types of Ingersoll Rand Air Dryers

Ingersoll Rand manufactures several air dryer models, primarily categorized into refrigerated and desiccant types. Refrigerated air dryers cool the compressed air to condense moisture, which is then separated and drained. Desiccant air dryers use adsorbent materials to absorb moisture, providing lower dew points suitable for highly sensitive equipment. Selecting the appropriate dryer type impacts installation requirements and system performance.

Benefits of Proper Air Dryer Installation

Correct installation of an Ingersoll Rand air dryer prevents corrosion,

reduces maintenance costs, and improves the overall reliability of compressed air systems. Proper drying protects pneumatic tools, instrumentation, and production lines from moisture-related failures. Additionally, efficient installation optimizes energy use by minimizing pressure drops and ensuring consistent air quality.

Pre-Installation Planning and Site Preparation

Successful Ingersoll Rand air dryer installation begins with thorough planning and site preparation. This phase assesses the physical environment, utility availability, and integration with existing compressed air systems. Proper site selection and preparation reduce installation challenges and future operational issues.

Site Selection Criteria

The installation site must provide adequate space for the air dryer and associated piping, allowing for maintenance access and ventilation. Avoid locations with excessive dust, dirt, or corrosive atmospheres. The site should have a stable, level foundation capable of supporting the equipment's weight and vibration.

Utility Requirements and Connections

Ensure that electrical power, compressed air supply, and drainage systems meet the specifications outlined by Ingersoll Rand. Electrical connections should conform to local codes and provide proper grounding. Drainage lines must be installed to efficiently remove condensate without backflow or blockage. Proper utility planning prevents installation delays and operational inefficiencies.

Integration with Existing Systems

Evaluate the existing compressed air system to determine the optimal location for the air dryer. Installation should minimize pressure loss by positioning the dryer as close as possible to the air compressor outlet. Coordination with other system components, such as filters and receivers, ensures smooth airflow and moisture removal.

Step-by-Step Installation Process

The Ingersoll Rand air dryer installation involves multiple technical steps, each critical to achieving optimal performance. Following manufacturer guidelines and industry best practices guarantees a successful setup.

Unpacking and Inspection

Begin by carefully unpacking the air dryer and inspecting all components for damage or missing parts. Verify that the model and specifications match the

purchase order. Report any discrepancies to the supplier immediately to avoid installation delays.

Positioning the Air Dryer

Place the air dryer on a firm, level surface with sufficient clearance around all sides. Ensure the inlet and outlet ports align properly with the compressed air piping. Maintain recommended distances from walls and other equipment to facilitate airflow and maintenance activities.

Connecting Compressed Air Lines

Use appropriately sized piping and fittings to connect the dryer inlet to the compressor discharge line and the outlet to the downstream system. Employ flexible connectors where necessary to reduce vibration transmission. Install shut-off valves and pressure gauges to monitor system conditions and facilitate maintenance.

Electrical Wiring and Controls Setup

Connect the air dryer to the power supply in accordance with electrical codes and manufacturer instructions. Install control panels and sensors as required to enable automated operation and monitoring. Double-check all wiring connections for safety and functionality before energizing the unit.

Drainage System Installation

Attach condensate drain lines to the dryer's drain ports using corrosion-resistant materials. Install automatic drain valves or traps to prevent air loss and ensure continuous condensate removal. Confirm that drainage slopes downward and leads to an appropriate disposal point.

Testing and Commissioning

After completing physical installation, thorough testing and commissioning verify that the Ingersoll Rand air dryer operates correctly and efficiently. This phase identifies any installation issues and confirms system readiness.

Leak Testing

Pressurize the compressed air system and inspect all connections for leaks using soapy water or electronic leak detectors. Repair any leaks promptly to prevent pressure loss and moisture ingress.

Functional Testing

Start the air dryer and monitor operational parameters such as inlet/outlet pressure, temperature, and dew point. Ensure that control systems respond

appropriately and that condensate drains operate as intended. Adjust settings if necessary to meet performance requirements.

Performance Verification

Measure the compressed air dew point downstream of the dryer to verify moisture removal efficiency. Confirm that airflow rates match system demands without excessive pressure drop. Document all test results for future reference and compliance purposes.

Maintenance and Troubleshooting

Regular maintenance is essential to sustain the performance of Ingersoll Rand air dryers and extend their service life. Proactive troubleshooting minimizes downtime and reduces operational costs.

Routine Maintenance Tasks

Scheduled maintenance includes cleaning or replacing filters, inspecting drain valves, checking electrical components, and verifying sensor accuracy. Maintaining proper lubrication and tightening loose fittings prevent premature wear and leaks.

Common Installation Issues and Solutions

Typical problems encountered during or after installation include improper drainage, electrical faults, and pressure drops. Address these issues by checking installation alignment, verifying wiring integrity, and confirming that piping sizes meet specifications. Consulting manufacturer support can provide additional guidance.

Optimizing Air Dryer Performance

Ensure that the air dryer operates within its design parameters by monitoring key indicators such as dew point, pressure loss, and condensate discharge. Adjust operational settings as necessary and perform periodic system audits to maintain efficiency and reliability.

- Inspect and clean filters regularly to prevent clogging.
- Verify drain valves are functioning to avoid moisture buildup.
- Monitor electrical connections for signs of wear or damage.
- Check for air leaks in piping and fittings periodically.
- Maintain proper ambient conditions around the air dryer.

Frequently Asked Questions

What are the basic steps for installing an Ingersoll Rand air dryer?

To install an Ingersoll Rand air dryer, first select a proper location with adequate ventilation and space. Then, mount the dryer securely, connect the compressed air inlet and outlet lines following the manufacturer's specifications, install the necessary drain lines, connect electrical wiring if applicable, and finally, check for leaks and proper operation before putting the system into full service.

What safety precautions should be taken during Ingersoll Rand air dryer installation?

Ensure the system is depressurized before installation, wear appropriate personal protective equipment (PPE), follow electrical safety guidelines when connecting power, avoid exposure to hot surfaces, and strictly follow the manufacturer's installation instructions to prevent accidents and equipment damage.

Can Ingersoll Rand air dryers be installed outdoors?

Yes, some Ingersoll Rand air dryers are designed for outdoor installation, but it is important to verify the specific model's suitability. Outdoor installations require weatherproof enclosures or protective covers to shield the unit from environmental factors like rain, dust, and extreme temperatures.

How do I properly size piping for an Ingersoll Rand air dryer installation?

Piping should be sized to handle the maximum flow rate without causing excessive pressure drop. Typically, use the manufacturer's recommendations for pipe diameter based on the dryer's capacity and system pressure. Avoid sharp bends and use smooth, corrosion-resistant piping materials to ensure optimal airflow.

What type of drain system is recommended for Ingersoll Rand air dryers?

A proper condensate drain system is crucial. Most Ingersoll Rand air dryers require an automatic drain valve or a condensate management system to remove moisture efficiently without air loss. Follow the specific model's guidelines for drain pipe sizing, routing, and disposal methods.

How important is proper ventilation during Ingersoll Rand air dryer installation?

Proper ventilation is essential to ensure the air dryer operates efficiently and prevents overheating. Install the unit in a well-ventilated area with sufficient clearance around it for airflow. Avoid enclosed or cramped spaces that can trap heat and reduce dryer performance.

What electrical requirements must be met when installing an Ingersoll Rand air dryer?

Ensure the electrical supply matches the voltage and frequency specifications of the air dryer. Use properly rated circuit breakers and wiring, and ground the unit according to local electrical codes. Follow the manufacturer's wiring diagrams and instructions to ensure safe and reliable operation.

How do I test an Ingersoll Rand air dryer after installation?

After installation, pressurize the system slowly and check for air leaks at all connections. Verify that the dryer powers on correctly, the control panel functions as expected, and condensate drains properly. Monitor outlet air quality and pressure to ensure the dryer meets performance specifications.

Additional Resources

1. Ingersoll Rand Air Dryer Installation Guide

This comprehensive guide covers the essential steps for installing Ingersoll Rand air dryers. It includes detailed diagrams, safety precautions, and troubleshooting tips to ensure a smooth setup. Ideal for both beginners and experienced technicians, this book emphasizes best practices for optimal performance.

2. Compressed Air Systems: Installation and Maintenance

Focusing on compressed air systems, this book provides in-depth knowledge about the installation and maintenance of air dryers, including Ingersoll Rand models. It explains the integration of air dryers into larger systems and highlights energy efficiency techniques. Readers will benefit from practical advice and common pitfalls to avoid during installation.

3. Practical Air Dryer Installation for Industrial Applications

Designed for industrial professionals, this book offers step-by-step instructions for installing air dryers in various industrial settings. It includes case studies featuring Ingersoll Rand dryers, emphasizing customization and adaptability. The book also discusses environmental considerations and compliance with industry standards.

4. Essential Tools and Techniques for Air Dryer Installation

This title focuses on the specific tools and technical skills needed to install air dryers effectively. It covers the nuances of Ingersoll Rand air dryers, highlighting the importance of precision and correct procedure. The book also provides troubleshooting techniques to handle common installation challenges.

5. Air Dryer Technology and Installation Fundamentals

Offering a blend of theory and practice, this book explores the technology behind air dryers and how it impacts installation methods. It details the working principles of Ingersoll Rand dryers and explains how to optimize system integration. Readers will gain a solid foundation to tackle complex installation projects confidently.

6. Step-by-Step Installation Manual for Ingersoll Rand Air Dryers

This manual is a detailed walkthrough for installing various models of Ingersoll Rand air dryers. It includes illustrated instructions, wiring

diagrams, and setup checklists. The book is tailored for technicians seeking to streamline the installation process and enhance reliability.

7. Compressed Air Quality and Dryer Installation Best Practices

Focusing on maintaining air quality, this book emphasizes the role of proper dryer installation in achieving optimal compressed air performance. It discusses Ingersoll Rand air dryers in the context of system cleanliness and moisture control. The book also provides guidelines for routine inspection and preventive maintenance.

8. Industrial Equipment Installation: Air Dryers and Beyond

This broader installation manual includes a significant section dedicated to air dryers, featuring Ingersoll Rand products. It addresses coordination with other industrial equipment and electrical systems. The book is useful for project managers and installation teams managing complex setups.

9. Troubleshooting and Repair of Ingersoll Rand Air Dryers

While primarily focused on repair, this book also covers common installation errors and how to avoid them. It provides diagnostic tools and solutions for issues arising during or after installation. The detailed case studies help readers understand practical challenges and effective remedies.

Ingersoll Rand Air Dryer Installation

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Ebook Title: The Definitive Guide to Ingersoll Rand Air Dryer Installation and Maintenance

Author: A.J. Thompson, Certified Industrial Mechanic & Air Compression Systems Expert

Ebook Outline:

Introduction: The Importance of Proper Air Dryer Installation and its Impact on Compressed Air Systems.

Chapter 1: Pre-Installation Planning: Site Assessment, Required Tools & Equipment, Safety Precautions.

Chapter 2: Understanding Ingersoll Rand Air Dryer Models: Overview of various Ingersoll Rand dryer types (refrigerated, desiccant, etc.), Key Features & Specifications.

Chapter 3: Step-by-Step Installation Guide: Detailed, illustrated instructions for installation, including plumbing, electrical connections, and initial startup.

Chapter 4: Troubleshooting Common Installation Issues: Addressing potential problems like leaks, incorrect pressure settings, and electrical malfunctions.

Chapter 5: Post-Installation Checks and Commissioning: Verifying proper operation, testing for leaks, and setting optimal parameters.

Chapter 6: Ongoing Maintenance and Preventative Measures: Regular inspection, filter replacements, and recommended service intervals.

Chapter 7: Safety Regulations and Compliance: Adhering to relevant safety standards and regulations.

Conclusion: Recap of key installation points and the long-term benefits of proper installation and maintenance.

Ingersoll Rand Air Dryer Installation: A Comprehensive Guide

Installing an Ingersoll Rand air dryer correctly is crucial for maintaining the efficiency and longevity of your compressed air system. Improper installation can lead to reduced air quality, equipment damage, costly repairs, and even safety hazards. This comprehensive guide will walk you through each stage of the process, from pre-installation planning to ongoing maintenance, ensuring you get the most out of your investment.

Introduction: The Importance of Proper Air Dryer Installation

Compressed air systems are vital in numerous industries, powering tools, machinery, and processes. However, compressed air inherently contains moisture and contaminants that can severely damage equipment and compromise product quality. Ingersoll Rand air dryers are designed to remove this moisture and improve air quality, ensuring optimal performance and preventing costly downtime. Proper installation is paramount to realizing these benefits. A poorly installed dryer can lead to:

Reduced air quality: Moisture and contaminants can cause corrosion, rust, and malfunctions in pneumatic tools and equipment.

System inefficiencies: A malfunctioning dryer can reduce the overall efficiency of the compressed air system, leading to higher energy costs.

Equipment damage: Moisture-related damage to air tools and machinery can lead to costly repairs or premature replacements.

Safety hazards: In some applications, moisture in compressed air can create safety risks, particularly in environments where flammable materials are present.

Chapter 1: Pre-Installation Planning: Laying the Foundation for Success

Before you begin the installation process, careful planning is essential. This includes:

Site Assessment: Evaluate the location for the air dryer. Consider factors such as accessibility, proximity to the compressed air system, sufficient ventilation, and adequate space for maintenance. Ensure the area is level and can support the weight of the dryer.

Required Tools and Equipment: Gather all necessary tools and equipment beforehand, including wrenches, pipe fittings, electrical connectors, pressure gauges, and leak detection equipment. A comprehensive list should be compiled based on the specific Ingersoll Rand air dryer model being installed.

Safety Precautions: Prioritize safety throughout the installation process. This includes disconnecting power to the compressed air system before working on any components, using appropriate personal

protective equipment (PPE), and following all manufacturer's safety guidelines. Consult your Ingersoll Rand air dryer's safety manual for specific precautions.

Chapter 2: Understanding Ingersoll Rand Air Dryer Models

Ingersoll Rand offers a range of air dryers, each with unique features and specifications. Understanding the specific model you are installing is crucial for a successful installation. Common types include:

Refrigerated Air Dryers: These dryers use refrigeration to condense and remove moisture from the compressed air. They are suitable for applications requiring moderate dew points.

Desiccant Air Dryers: Desiccant dryers use a desiccant material to absorb moisture from the compressed air, achieving lower dew points than refrigerated dryers. They are ideal for applications requiring extremely dry air.

Membrane Air Dryers: These use a semi-permeable membrane to separate water vapor from the compressed air stream. They are often more compact and energy-efficient.

Understanding the operating parameters, capacity, and specific requirements of your chosen model will guide you throughout the installation. Consult the manufacturer's documentation for detailed specifications and technical information.

Chapter 3: Step-by-Step Installation Guide: A Practical Approach

This section provides a general guide. Always refer to the specific instructions provided with your Ingersoll Rand air dryer model.

1. **Plumbing Connections:** Carefully connect the inlet and outlet piping to the compressed air system, ensuring tight seals and proper orientation. Use appropriate pipe fittings and sealant to prevent leaks.
2. **Electrical Connections:** Connect the air dryer to a properly grounded power supply, ensuring the voltage and amperage match the dryer's specifications. Follow all wiring diagrams and safety precautions.
3. **Mounting the Dryer:** Securely mount the dryer to a stable surface according to the manufacturer's instructions. Ensure proper alignment and stability to prevent vibrations and potential damage.
4. **Initial Startup:** After completing the connections, carefully start the air dryer and monitor its operation. Check for any leaks, unusual noises, or other irregularities.

Chapter 4: Troubleshooting Common Installation Issues: Addressing Potential Problems

Several issues can arise during installation:

Leaks: Check all pipe connections and fittings for leaks using soapy water. Repair any leaks immediately using appropriate sealant or replacement parts.

Incorrect Pressure Settings: Ensure the air dryer's pressure settings are correctly adjusted according to the system requirements. Refer to the manufacturer's documentation for proper adjustment procedures.

Electrical Malfunctions: If the air dryer fails to operate, check the power supply, wiring connections, and circuit breaker. Consult a qualified electrician if necessary.

Insufficient Airflow: Ensure the compressed air system has sufficient capacity to provide adequate airflow to the air dryer.

Chapter 5: Post-Installation Checks and Commissioning: Verification and Optimization

After installation, perform these crucial checks:

Leak Test: Conduct a thorough leak test of all connections to ensure airtightness.

Pressure and Temperature Monitoring: Monitor the pressure and temperature at the inlet and outlet of the air dryer to ensure it's operating within the specified parameters.

Dew Point Measurement: Use a dew point meter to verify the dryer is effectively removing moisture from the compressed air. This confirms it's achieving the desired level of dryness.

Operational Efficiency: Observe the dryer's performance over a period of time to ensure it's functioning optimally and efficiently.

Chapter 6: Ongoing Maintenance and Preventative Measures: Ensuring Long-Term Performance

Regular maintenance is essential for the long-term performance of your Ingersoll Rand air dryer. This includes:

Filter Replacements: Replace the air filters according to the manufacturer's recommendations. Dirty filters restrict airflow and reduce the dryer's efficiency.

Regular Inspections: Regularly inspect the dryer for any signs of leaks, damage, or unusual operation.

Preventative Maintenance Schedule: Develop and adhere to a preventative maintenance schedule to address potential issues before they become major problems.

Chapter 7: Safety Regulations and Compliance: Adhering to Industry Standards

Adherence to relevant safety regulations and industry standards is crucial during installation and operation. This includes:

Electrical Safety Codes: Ensure compliance with all applicable electrical safety codes during wiring and electrical connections.

Pressure Vessel Regulations: Comply with regulations related to the safe handling and operation of pressure vessels.

OSHA Compliance: Adhere to Occupational Safety and Health Administration (OSHA) guidelines related to compressed air systems and safety protocols.

Conclusion: Reaping the Rewards of Proper Installation

Proper installation of your Ingersoll Rand air dryer is an investment that pays off in the long run. By following these guidelines, you'll ensure optimal performance, increased equipment lifespan, reduced maintenance costs, and improved safety within your compressed air system. Remember, consistent maintenance and adherence to safety regulations are key to maximizing the benefits of your investment.

FAQs

1. What tools do I need to install an Ingersoll Rand air dryer? You'll need wrenches, pipe wrenches, pipe cutters/threaders, PTFE tape, pressure gauges, electrical tools, and potentially a level. Specific tools depend on the model.
2. How often should I replace the filters in my Ingersoll Rand air dryer? The frequency varies by model and usage. Check your dryer's manual for the recommended replacement schedule.
3. What are the signs of a malfunctioning Ingersoll Rand air dryer? Signs include unusual noises, reduced airflow, higher-than-normal operating temperatures, and changes in the dew point.
4. Can I install an Ingersoll Rand air dryer myself? While possible for some models, professional installation is recommended for complex systems to ensure proper functionality and safety.
5. How do I troubleshoot leaks in my Ingersoll Rand air dryer installation? Use soapy water to locate leaks. Tighten connections or replace faulty components as needed.
6. What is the importance of proper electrical grounding for the air dryer? Proper grounding prevents electrical shocks and protects the dryer from damage due to power surges.

7. How do I determine the correct size air dryer for my compressed air system? The size is determined by the system's air flow rate and required dew point. Consult the Ingersoll Rand sizing chart or a professional.
8. What type of air dryer is best for my application? The best type (refrigerated, desiccant, membrane) depends on your required dew point and the level of moisture removal needed.
9. Where can I find more information about Ingersoll Rand air dryers? Consult the Ingersoll Rand website, their manuals, or contact their technical support.

Related Articles:

1. Ingersoll Rand Air Dryer Maintenance: A detailed guide on preventative maintenance and troubleshooting common issues.
2. Understanding Compressed Air System Components: A comprehensive overview of all components in a typical compressed air system.
3. Choosing the Right Air Dryer for Your Industry: A guide comparing different dryers and their applications across various industries.
4. Energy Efficiency in Compressed Air Systems: Tips and techniques to improve the energy efficiency of your compressed air system.
5. Compressed Air System Audits: The importance and benefits of conducting regular audits of your compressed air system.
6. Troubleshooting Common Compressed Air System Problems: A guide to diagnosing and fixing various problems encountered in compressed air systems.
7. Safety Procedures for Compressed Air Systems: A complete guide to safety procedures for the installation and maintenance of compressed air systems.
8. The Economics of Compressed Air System Optimization: An analysis of the cost savings associated with efficient compressed air systems.
9. Ingersoll Rand Air Dryer Parts and Accessories: A guide to common replacement parts and accessories for Ingersoll Rand air dryers.

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ingersoll rand air dryer installation: Measurements of a Three-dimensional Shock-boundary Layer Interaction David Benjamin Helmer, 2011 A series of measurements were taken of the shock-boundary layer interaction (SBLI) in a Mach 2.1 continuously operated wind tunnel. The SBLI was generated by a small (~1.1mm tall) 20° wedge located on the top wall, and data were taken both in the region near the compression wedge and in the area where this shock impinged on the bottom wall. PIV was the primary measurement tool in both locations, though pressure data were also acquired near the compression wedge. Data were acquired at 4 spanwise locations to study the three-dimensionality of the flow. Both interactions were found to be highly 3-D, with a stronger interaction observed near the channel centerline. Evidence of a corner vortical structure in the compression corner was observed, and substantiated by CFD. Intermittent flow reversal was seen in the reflected shock interaction near the channel centerline, though not in the corners. The data suggest the presence of vortical structures generated near the channel centerline and pushed towards the sidewalls. Following the characterization of the base case, a Monte Carlo experiment was performed in which geometric perturbations were installed along the bottom wall of the wind tunnel and their effect on the flow was studied. The Monte Carlo device was designed and installed at the location predicted to be most sensitive by CFD. The majority of the locations initially tested displayed minimal sensitivity, with only the largest and most upstream quasi-2D cases showing significant effects on the flow at the corner. The perturbation device was redesigned and moved upstream, and additional quasi-2D cases were tested. It was found that some configurations accelerated the flow and strengthened the primary shock, while others slowed the flow and weakened the shock. Overall, the flow was observed to be very sensitive to some perturbations, but only to those located within a limited range of streamwise positions, and with a wide variety of system responses possible.

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FROM THE PREFACE The processes used to remove water from biosolids and change their form from a liquid to a damp solid are critical to the operation of other downstream processes in wastewater treatment. An ideal dewatering operation would capture all of the biosolids solids at minimum cost and the resultant dry biosolids solids or cake would be capable of being handled without causing unnecessary problems. Process reliability, ease of operation, and compatibility with the treatment plant environment are also optimum. This text is designed to provide a detailed look at several dewatering options. It must be pointed out, however, that this text takes a strong, biased view toward centrifugation as the dewatering process that is most reliable, maintenance free, cost effective, and capable of producing the highest quality end-product when compared to the other options in a holistic manner. Therefore, the underlying theme of this text is wrapped around the premise that it is better to centrifuge it! Having said this, it must also be pointed out that all major biosolids dewatering processes are discussed in this text, in detail. Several examples of actual operating systems are presented, and preventive maintenance and cost considerations are presented and discussed. In recent years there has been a tendency in some technical texts like this one to focus on the theoretical and laboratory analyses of dewatering operations. While such research and documented findings can lead to improved understanding of the scientific and engineering concepts associated with dewatering biosolids, this text is presented in such a fashion so as to be user-friendly. It is an operator's text that can also afford the decision-maker the opportunity to make informed choices about selecting a dewatering system for his/her plant use. Dewatering Biosolids will be of interest to people in all aspects of wastewater plant operation. Useful as a handbook for operators, this plain language text is also of importance to anyone considering altering or adapting their wastewater operating system.

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