Low Nitrox Percentage Output Troubleshooting

THE PROBLEM

We occasionally hear from customers reporting a decrease in the nitrox percentage from their compressor systems, despite making no adjustments. This drop may occur suddenly or gradually over time. Our nitrox systems use high-quality Nuvair membranes, which, with proper care and maintenance, provide reliable performance for many years—setting them apart from membranes in other systems.

Given the high reliability of our membranes, it is unlikely that the membrane itself is the cause of low nitrox generation percentages. More often, the issue stems from a simple adjustment or a minor supply problem.

The list below highlights common causes but keep in mind that other factors not listed may also contribute to the issue. Before performing any checks or adjustments, ensure you have the manufacturer's user manual readily available and follow all listed safety precautions.

CHECK THE FOLLOWING

1. **Hose Connections**
   Inspect the hose connections carrying nitrox from the membrane to the intake of the HP compressor. Check for loose connections at all joints and ensure that hose clamps are securely fastened. Examine the supply hose for signs of wear, such as deterioration, cuts, or breaks. If any issues are found, address them promptly.

2. **Carbon Monoxide Scrubber**
   If your system includes a carbon dioxide (CO_2) scrubber, verify that it is packed correctly. An overly tight packing or a saturated scrubber element can restrict nitrox flow to the HP compressor, resulting in a reduced nitrox percentage.

   a) Ensure the scrubber main top O-ring is properly positioned and not dislodged.

3. **Low Pressure Air Supply**
   Ensure the low-pressure air supply to the membrane is adequate. A drop in pressure can lead to a reduction in the nitrox percentage. Check for potential leaks in the low-pressure air supply, including:

   a) Inspecting the auto-drain system on the compressor. A stuck-open or leaking auto-drain can cause pressure issues.

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b) Examining the drain hose connected to the condensate receiver. Pull the hose from its coupling while the low-pressure compressor is running to check for air leaks. If air is leaking, service or replace the solenoid for the auto-drain system as needed.

4. **Low Pressure Filter Drains**
   Inspect the low-pressure filtration drains for leaks.

5. **Low Pressure Filter Elements**
   Verify that the low-pressure filter elements are not blocked or overdue for replacement. Blocked or contaminated filters can restrict airflow to the membrane system.

6. **Low Pressure Filter Canisters**
   Check for leaks in the low-pressure filter canister connections. Any reduction in low-pressure air volume from the compressor can lead to a drop in nitrox percentage.

7. **Low Pressure Transmission Belt Tension**
   Examine the belt tension of the low-pressure compressor. Ensure it is properly tensioned, as a loose drive belt can decrease air supply to the membrane, resulting in a reduced nitrox percentage.

8. **Low Pressure Compressor Connections**
   Inspect all connections on the low-pressure compressor. Loose or damaged hoses can allow ambient air to mix with the nitrox supply, resulting in a lean nitrox mixture delivered to the HP compressor.

9. **Oxygen Sensors**
   Verify that your oxygen sensors are functioning properly and not expired. Test the analyzers for accuracy using a calibration gas. The production sensor is critical for adjusting nitrox percentages. If it appears faulty or expired, replace it with the manufacturer's recommended sensor.

10. **Sensor Connections & Power Supplies**
    Check all connections between the remote, production, or permeate oxygen sensors and the analyzer. Additionally, confirm that the analyzer's battery or power supply is functioning correctly.

11. **Air Receiver**
    If a low-pressure air receiver is part of your system, inspect all connections for leaks.

REMEMBER: Loose connections in the low-pressure air supply to the membrane or blockages in the air supply will result in reduced nitrox mixtures.

12. **Membrane Regulator**
    Ensure the supply regulator, which adjusts pressure to the membrane, is not blocked or leaking.

13. **Membrane Heater**
    Verify that the air supply heater is functioning properly. A malfunctioning heater will prevent the membrane from reaching optimal efficiency, potentially causing a drop of around 2% in the nitrox mixture even if other components are working correctly.

a) The heater typically activates once the air supply reaches approximately 58 psi (4 bar). Check its operation by observing the heater temperature gauge or lightly touching the heater to confirm it is warm and working.

b) If the heater is not working, the issue is likely electrical, with the most common fault being a blocked or faulty heater control switch. Contact Nuvair for assistance if needed.

Note: The heater is essential for the membrane to perform efficiently.

14. **Waste Gas Discharge Valve**
If all previous points are in order, the issue might be related to the membrane waste gas discharge valve, which may need adjustment. (Waste gas—nitrogen—is vented during the process.)

a) This factory-set valve allows waste gas to vent from the membrane into the atmosphere and is critical for overall membrane performance.

b) Ensure the waste gas is vented far from the compressor system to prevent it from being drawn back into the compressor intake, as this would alter the ambient air mixture.

Warning: For safety reasons, waste gas must be vented outside the compressor room. Breathing waste gas with low oxygen concentrations can pose serious risks to individuals in the area.

15. **Waste Gas Discharge Valve Adjustment**
The membrane waste gas (nitrogen) discharge valve plays a crucial role in maintaining the correct nitrox mixture.

a) **Excessive Venting**
Over-venting waste gas reduces the volume of nitrox reaching the HP compressor. This causes the system to draw in ambient air (21% oxygen) to compensate, resulting in a leaner nitrox mixture.

b) **Insufficient Venting**
If the valve is blocked (e.g., dirty) or too tightly closed, it restricts waste gas escape. This also leads to a leaner nitrox mixture.

Proper adjustment of this valve is essential to achieving the correct nitrox mixture.

c) **When Adjustment is Needed**
- Rarely, after installing or commissioning a new machine.
- After several years of operation, cleaning and adjustment may be required.

d) **Maintenance Recommendation**
- For systems in use over several years, remove the waste gas valve (noting its original setting), clean it thoroughly, and reinstall it. After reinstallation, adjust and roughly reset the valve to ensure proper functioning.

e) **Valve Location**
- The waste discharge valve is typically located at the bottom of the membrane. In some cases, a short hose extends from the membrane, with the valve at the hose's end.

f) **Needle Valve Systems**
- Later models are equipped with needle valves, simplifying the adjustment process. No tools are required for needle valve adjustments, making it more user-friendly.

16. **Adjusting the Waste Gas Discharge Valve**

a) **Tools Required**
- 7/16" AF ring spanner (avoid open-end spanners unless absolutely necessary).
- A short stubby flat-head screwdriver.

b) **Preparation**
- Adjustments are best performed with two people: one to make the adjustment and the other to monitor the production oxygen analyzer readings in real time.
- Locate the valve, prepare your tools, and ensure you can access the area comfortably.
- Address all safety concerns thoroughly before proceeding. If you are not completely confident in the safety of the setup, contact Nuvair.

c) **Adjustment Steps**

1) **System Preparation**
   - Start the low-pressure compressor and allow the pressure to build up.
   - Reduce the output pressure on the LP supply regulator that feeds air to the membrane system.
   - Start the high-pressure (HP) compressor and safely release gas through the open fill hose.

2) **Calibrating the Oxygen Analyzer**
   - Run both compressors for about two minutes while venting gas from the fill hose and HP filtration system.
   - Ensure the gas stream is purged of residual nitrox so that only air (20.9% oxygen) is passing through the system.
   - Calibrate the production oxygen analyzer to read 20.9% using the analyzer's adjustment knob.

3) **Regulating LP Air Supply**
   - Gradually increase the regulator pressure feeding the LP air to the membrane to its maximum setting, typically around 145 psi (10 bar).

4) **Warming the Membrane Heater**
   - Allow the system to run for about five minutes for the membrane heater to activate and heat the air supply.

Warning: Follow these steps precisely to ensure proper adjustment. If you encounter any difficulties or have safety concerns, stop immediately and consult a Nuvair technician.

17. **Testing the System**

During testing, carefully monitor:
- **Supply Pressure** to the membrane.
- **Nitrox Mixture** produced.
- Record the **supply** pressure and **nitrox percentage**. Typically, 116–130 psi (8–9 bar) should produce a nitrox mixture around 40%. If this percentage isn't achieved, proceed with adjusting the membrane waste discharge valve.

a) **Membrane Discharge Valve Adjustment**

1) **Preparation**
   - Ensure both compressors are running.
   - One person monitors the production oxygen analyzer, while the other adjusts the waste gas screw.

2) **Unlocking the Adjustment Screw**
   - Slightly loosen the locking nut on the valve.
   - If glue was applied to secure the nut, carefully scrape it away before proceeding.

3) **Making Adjustments**
   - Use a short flat-head screwdriver to slightly turn the adjustment screw, either left or right.
   - The person monitoring the oxygen analyzer will guide the adjustment:
     - Stop or reverse direction to increase the mixture.
     - Continue in the same direction if the percentage rises.
   - Adjust carefully, as excessive adjustment in one direction may cause the nitrox percentage to decrease.

4) **Finalizing the Adjustment**
   - When the desired nitrox percentage (e.g., 40%–40.5%) is achieved, lock the nut to secure the adjustment.
   - Be cautious while locking the nut to prevent the screw from shifting. If the mixture alters, unlock the nut and reset the adjustment.

5) **Post-Adjustment**
   - Once the nitrox mixture is set, back off the regulator to adjust the mixture to your desired level (up to 40%).

Reminder: Fine-tuning requires precision and patience. Any deviation during locking or adjusting may require re-evaluation and resetting.

If Issues Persist: If none of the above steps resolve your nitrox production issues, contact PDS to arrange for a qualified technician.

Warning: Only allow certified technicians to handle major system issues or any minor in-house tasks if there is any doubt about your ability to perform them safely or correctly.

18. **High Pressure Compressor Drive Belt**

If your nitrox system starts producing higher-than-expected nitrox mixtures using your standard production settings, the issue may be due to the drive belt on the high-pressure compressor slipping, particularly under high-end pressure. Inspect the belt and adjust it as necessary.

This issue may result in the membrane supplying enough mixture to the HP compressor, but the HP compressor runs slower due to a loose drive belt.

When the HP compressor operates at a reduced speed, its lower gas supply requirement can lead to a higher-than-normal nitrox mixture being delivered.

Key Maintenance Tips

- Always check the belt tension on both the low-pressure (LP) and high-pressure (HP) compressors to ensure proper adjustment.
- Regularly monitor and document the pressure setting supplying the membrane and the corresponding nitrox mixture produced.

Recommendation: Nuvair strongly recommends keeping a record of the pressure settings near the nitrox system for quick reference to maintain optimal performance.

Example Pressure-to-Mixture Ratios

- 100 psi (7 bar) = 32% nitrox
- 115 psi (8 bar) = 36% nitrox
- 130 psi (9 bar) = 40% nitrox

Please Note
These values are examples only. Actual ratios will depend on your specific system and local conditions.

Support and Servicing

Our technicians are available to provide support and service. Nuvair maintains a large inventory of compressor spare parts as well as many parts for older compressor models we service and sell.