

# Ethylene Glycol Coolant Degradation in Natural Gas Engines

Understanding How Coolant Breaks Down — And How to Extend Its Service Life

In the oil & gas industry, **stationary natural gas engines** power compressors across upstream, midstream, and processing applications. These engines operate under extreme thermal conditions, so maintaining the correct coolant chemistry is essential for reliable operation and low maintenance cost. Ethylene glycol-based antifreeze coolant — combined with corrosion inhibitors and additives — is the standard fluid for managing engine temperature. Under certain conditions, however, this coolant **degrades, turns black, and forms damaging residues** on internal components. This bulletin explains how degradation occurs, the consequences of ignoring it, and proven best practices to extend coolant life.

## WHAT CAUSES COOLANT DEGRADATION?

In high-temperature zones of the engine — particularly near the **piston liner** — ethylene glycol breaks down under localized overheating. Three primary mechanisms drive the failure:



### OXIDATION

Ethylene glycol oxidizes under thermal stress, producing organic acids such as **glycolic acid** and **formic acid** that drop pH and accelerate corrosion.



### POLYMERIZATION

Catalyzed by dissolved metals, partially degraded glycol forms longer-chain compounds — creating **viscous, sticky residues** that foul heat transfer surfaces.



### BLACK DEPOSITS

Carbon-like polymer degradation products interact with dissolved metal ions and contaminants to form **tar-like deposits** on the hottest surfaces.

*These residues deposit on the hottest surfaces — including **cylinder liners** and **heat exchangers** — leading to heat transfer loss, under-deposit corrosion, and eventual component failure.*

## WHY COOLANT MONITORING MATTERS

### CONSEQUENCES OF RUNNING DEGRADED COOLANT

- ▶ **Plugged coolant passages** restricting flow through jackets and heat exchangers
- ▶ **Accelerated corrosion and erosion** of cylinder liners, pumps, and yellow-metal components
- ▶ **Decreased heat transfer efficiency** driving operating temperatures above design limits
- ▶ **Costly downtime and repairs** — sometimes requiring complete engine rebuilds

⚠ **Visible warning sign:** When antifreeze coolant turns dark brown or black, it is a clear indicator of thermal and chemical breakdown. Managing coolant quality is not optional — it is a core part of engine reliability management.

A structured coolant management program protects engine reliability and significantly extends fluid service life. Follow these six industry best practices to maximize the value of your antifreeze coolant investment.

### 1 USE HIGH-QUALITY COOLANT

Begin with a premium ethylene glycol-based coolant designed for heavy-duty engines. The inhibitor package should use **OAT** (Organic Acid Technology) or **HOAT** chemistry — or hybrid **NMOAT** — to resist degradation at high temperatures.

### 3 MONITOR INHIBITOR LEVELS

Test coolant every **1,000 hours** of engine operation. Track pH, reserve alkalinity, nitrite, and molybdate concentration. Many coolants support re-inhibition with additive packages — follow the manufacturer's guidelines.

### 5 FLUSH AND REPLACE WHEN NEEDED

If contamination or degradation is severe, flush the cooling system with a chemical cleaner such as **AdvanceClean™ EJC 100** or **EJC 200**, then refill with fresh coolant. Reusing degraded coolant is not advised.

### 2 CONTROL COOLANT CHEMISTRY

Maintain the proper glycol-to-water ratio — typically **50/50**. Use deionized or distilled water to prevent introducing minerals that catalyze breakdown. Never top off with untreated tap water.

### 4 WATCH FOR EARLY WARNING SIGNS

**Cloudy appearance**, color changes to dark brown or black, or a **sweet, burnt odor** are early indicators of degradation. These signs warrant immediate testing and corrective action.

### 6 MAINTAIN PROPER OPERATING CONDITIONS

Proper engine tuning, functioning thermostats, and clean heat exchanger cores minimize hot-spot formation that accelerates glycol breakdown. Address root causes — don't just replace coolant.

## CONCLUSION

The proper selection, testing, and management of ethylene glycol-based antifreeze coolant are essential for the reliable operation of natural gas engines used in compressor service. Coolant degradation — indicated by black residue and thermal breakdown — leads to severe engine damage and costly downtime. By following industry best practices and implementing a structured coolant monitoring program, operators significantly extend coolant life and protect critical engine components.

### EXTEND COOLANT LIFE WITH ADVANCEGUARD®

Chem Advances offers a complete coolant management portfolio for stationary natural gas engines: **AdvanceGuard® HDX 50** ready-fill ethylene glycol coolant with NMOAT inhibitor technology, **AdvanceGuard® WLX** water-only inhibitor for enhanced heat transfer, and **AdvanceClean™ EJC 100 / EJC 200** cooling system cleaners. Backed by service programs that include coolant testing, on-site monitoring, and technical support — designed to extend the life of your antifreeze/coolant and protect your engines.

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