MINING GEOTECHNICAL ENGINEERING

Technical Analysis of the Atlas Copco DIAMEC 262 EC: Engineering Excellence in Underground Core Drilling

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Evolution and Significance of Underground Core Drilling

In the high-stakes environment of underground mining and geotechnical exploration, the ability to extract high-quality geological samples is paramount. The **Atlas Copco DIAMEC 262 EC** represents a pinnacle of engineering designed to meet the rigorous demands of underground core drilling. Unlike surface drilling, underground operations face severe spatial constraints, ventilation requirements, and the need for high-maneuverability equipment. The Diamec series, particularly the 262 EC model, was engineered to provide a modular, robust, and highly efficient solution for both **Wireline (A–N)** and **conventional (46–131 mm)** drilling applications.

Core drilling is the process of removing a cylindrical sample of rock (a core) from a formation. This sample allows geologists and engineers to analyze the physical and chemical properties of the sub-surface, identifying mineral veins, fault lines, and structural integrity. The Diamec 262 EC facilitates this through a sophisticated hydraulic system that balances torque, rotation speed, and feed force, ensuring maximum core recovery even in fractured or difficult strata.

Core Engineering Concepts and Hydraulic Framework

The operational efficiency of the Atlas Copco DIAMEC 262 EC is rooted in its **hydraulic power unit**. A standout feature of this rig is its simple yet robust power unit equipped with a **double hydraulic pump**. This dual-pump configuration is a critical engineering choice that allows for the separation of hydraulic circuits. By permitting simultaneous operations—such as rotation and feed—without a significant drop in pressure or performance, the rig maintains a consistent penetration rate.

The Role of the Double Hydraulic Pump

In standard single-pump systems, the division of hydraulic fluid can lead to fluctuations in energy delivery. When the drill bit encounters a harder rock layer, the increased torque requirement can starve the feed cylinder of pressure, leading to stalling or bit damage. The **DIAMEC 262 EC**circumvents this through its double-pump system, which ensures that:

- Primary Circuit: Dedicated to the rotation unit, providing the necessary torque for cutting through varying rock hardness.
- Secondary Circuit: Dedicated to the feed frame and rod holder operations, maintaining constant Weight on Bit (WOB).
- Efficiency: Reduced heat generation in the hydraulic fluid, as the pumps are not constantly pushed to their relief valve limits.

Feed Version 3300 Integration

The rig is strongly recommended for use with **Feed version 3300**. The feed frame is the backbone of the drilling operation, responsible for both the advancing (thrust) and retracting (pull) of the drill string. A longer feed length, such as the 3300mm variant, reduces the frequency of rod additions, thereby increasing the overall **Net Penetration Rate (NPR)**. This version is particularly effective in large-scale underground galleries where ceiling

height allows for the deployment of longer feed frames, optimizing the time spent on the 'tripping' process.

Technical Specifications and Capacity Matrix

To understand the versatility of the DIAMEC 262 EC, one must examine its capacity across different drilling standards. The rig is designed to handle both Wireline and conventional drilling methods, catering to a wide range of hole diameters and depths. Below is a comprehensive breakdown of the core diameters and the technical capabilities of the system.

Table 1: Core Drilling Capacity and Diameter Comparison

Drilling Standard	Core Diameter (mm)	Hole Diameter (mm)	Primary Application
Wireline A	27.0	48.0	Deep exploration, small diameter sampling
Wireline B	36.5	60.0	Standard geotechnical exploration
Wireline N	47.6	75.7	High-volume mineral exploration
Conventional 46	36.0	46.0	Short-hole sampling, grout hole drilling
Conventional 131	101.0	131.0	Large diameter structural analysis

The ability to scale from a 48 mm hole to a 131 mm hole makes the Diamec 262 EC one of the most flexible rigs in its class. This flexibility is achieved through interchangeable rotation units and rod holders that can be adjusted to the specific **drill string geometry** required for the project.

The Mechanics of Core Recovery: Wireline vs. Conventional

One of the primary decision points for an operator using the Atlas Copco DIAMEC 262 EC is whether to utilize **Wireline** or **Conventional** drilling. Each method has distinct mechanical workflows and economic implications.

Wireline Drilling Mechanics

In Wireline drilling, the core barrel is retrieved through the center of the drill string using a cable and an overshot assembly. The outer rods stay in the hole until the bit needs replacement. The DIAMEC 262 EC excels in this mode because its rotation unit has a large enough spindle bore to accommodate the high-speed rotation required for diamond bits used in wireline systems. This method is preferred for deep holes because it eliminates the need to pull all the rods to retrieve each core sample, significantly reducing **non-productive time (NPT)**.

Conventional Drilling Mechanics

Conventional drilling requires the entire drill string to be pulled from the hole to retrieve the core barrel. While this is less efficient for deep holes, it is often used for shorter, larger-diameter holes (up to 131 mm) where the structural integrity of the core is the priority. The Diamec 262's robust power unit provides the high torque necessary to rotate the heavier, larger-diameter conventional rods and barrels.

Step-by-Step Operational Workflow

Implementing the DIAMEC 262 EC in an underground environment requires a systematic approach to ensure safety and data accuracy. The following procedure outlines a typical drilling cycle:

1. Site Preparation: The rig is moved into position. Due to its modular design, the power unit can be located up to several meters away from the drill frame to minimize noise and heat in the immediate drilling area.
2. Anchoring: The feed frame is anchored against the mine wall or roof using hydraulic roof jacks or mechanical bolts to counteract the thrust and torque generated during drilling.
3. Collaring: The initial phase of drilling where the hole is started. This requires low rotation speed and low feed pressure to ensure the hole is perfectly aligned.

4. Drilling Phase: The operator monitors hydraulic gauges to balance the double pump's output. The Feed version 3300 allows for a smooth stroke, advancing the bit into the formation.

5. Core Retrieval: For Wireline operations, the inner tube is pulled via the winch. For conventional, the rod holder secures the string while the rotation unit is disconnected to add or remove rods.

6. Logging: The core is extracted from the barrel, marked for orientation, and placed in core boxes for geological logging.

Mathematical Modeling of Drilling Performance

The performance of the Atlas Copco DIAMEC 262 EC can be quantified using several engineering formulas. Understanding these allows for better planning and optimization of the drilling program.

1. Weight on Bit (WOB) Calculation

The effective force applied to the bit is a function of the hydraulic pressure in the feed cylinder and the angle of the hole. For a vertical hole:

$WOB = (P \times A) + W_{string}$

Where:P = Hydraulic pressure (Pa)A = Area of the feed cylinder (m^2)W_{string}= Weight of the drill string in the borehole fluid.

2. Penetration Rate (R)

The rate at which the bit progresses through the rock is influenced by the rotation speed (N) and the bit type. For diamond core drilling, the relationship is often expressed as:

$R = k \times (N \times WOB) / D$

Where k is a rock drillability constant and D is the bit diameter. The DIAMEC 262 EC's ability to maintain a high N (rotation speed) while providing stable WOB through its dual-pump system is what leads to superior Rvalues compared to older, single-pump rigs.

Maintenance and Troubleshooting Protocols

To maintain the high reliability of the Atlas Copco DIAMEC 262 EC, a strict maintenance schedule is required. The complexity of the hydraulic systems means that contamination is the primary enemy of the rig's longevity.

Table 2: Preventative Maintenance Schedule

Component	Action	Frequency (Hours)
Hydraulic Filters	Inspect and/or Replace	Every 250
Hydraulic Oil	Viscosity and Purity Test	Every 500
Rod Holder Jaws	Clean and Check for Wear	Daily
Feed Frame Chains/Cylinders	Lubricate and Tension	Every 50
Rotation Unit Seals	Inspect for Leakage	Daily

Common Troubleshooting Scenarios

- Issue: Loss of Rotation Torque.Potential Cause: Primary pump failure or relief valve bypass.Solution: Check the hydraulic pressure of the first pump circuit; inspect the rotation motor for internal bypass.
- Issue: Irregular Feed Movement (Chattering).Potential Cause: Air in the hydraulic lines or worn feed frame guides.Solution: Bleed the hydraulic system; tighten or replace the wear plates on the feed frame.
- Issue: Core Blockage.Potential Cause: Excessive WOB or fractured ground.Solution: Reduce feed pressure and increase water flow to flush cuttings; pull the inner tube to clear the blockage.

Strategic Implications for Underground Exploration

The deployment of the DIAMEC 262 EC has significant implications for the economic viability of a mining project. In the exploration phase, speed and accuracy determine the quality of the **resource model**. If a rig is unreliable or produces poor core recovery, the entire feasibility study of a mine may be compromised.

By utilizing a rig with the capabilities of the 262 EC, mining companies can achieve **multi-directional drilling**(fan drilling) from a single station. The rig’s ability to drill at any angle—from vertically downward to vertically upward—allows for the systematic mapping of an ore body with minimal setup changes. This versatility, combined with the power of the double hydraulic pump, ensures that even the deepest and most difficult targets are reachable.

Future-Proofing Through Digital Integration

Modern iterations of the Diamec series are increasingly incorporating digital monitoring systems. While the 262 EC is celebrated for its "simple and robust" nature, modern operators often retrofit these units with data loggers that track hydraulic pressures, RPM, and penetration rates in real-time. This data can be transmitted to the surface to provide an immediate view of the drilling progress and the geological conditions encountered. This transition toward **Data-Driven Drilling**ensures that the legacy of the Diamec 262 EC continues to be relevant in the era of Mining 4.0, where efficiency is measured not just by meters drilled, but by the quality and accessibility of the data generated.

The Atlas Copco DIAMEC 262 EC stands as a testament to the philosophy that robustness and simplicity are the keys to performance in the world's harshest environments. Its design acknowledges the reality of underground work: space is limited, the rock is unforgiving, and the equipment must work every time. Through its sophisticated hydraulic design, versatile drilling capacities, and the reliability of its Feed 3300 system, it remains a benchmark for core drilling excellence.

Baca Juga (Artikel Terkait)

- **The Definitive Guide to Core Drilling Rigs: Engineering, Exploration, and Operational Excellence**
  URL: http://alaskawriters.com/comprehensive-guide-core-drilling-rigs-exploration-technology.pdf

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