New-Generation GrizzlyDrive® Drum Motors and How They Work

The conveyor belt drive is a critical component of the conveyor system. Failure of the drive not only results in system downtime and associated repair costs, but also in substantial losses in operational throughput and overall productivity. Due to the high demands and harsh environmental conditions in which mining and aggregate belt conveyors operate, robustness, reliability and safety are essential for minimizing operational costs while optimizing production.

TRADITIONAL EXTERNAL MOTOR AND GEARBOX BELT DRIVE

A typical belt conveyor system consists of a heavy structural frame, troughing idlers, a head pulley, and a belt. The belt is driven by the head pulley, which is supported on the conveyor frame by pillow block bearings and mechanically connected to an external motor and gearbox (a traditional conveyor drive) mounted on a platform adjacent to the conveyor frame.

The exposed components of a traditional external drive can pose safety hazards to the workforce. In addition, these drives require routine maintenance and frequent lubrication of the pillow block bearings and are susceptible to the harsh environmental conditions in which they operate.

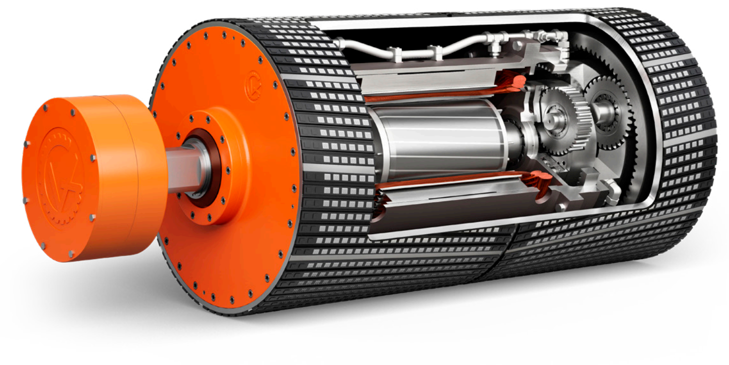
Exposed drive components, particularly the electric motor, bearings, and gearbox are especially susceptible to the elements. Dusty, wet, and other harsh environmental conditions significantly affect the performance and lifespan of traditional conveyor drives. Motor or gear reducer failures result in costly downtime and lost production. Maintaining a conveyor driven by a traditional external motor and gearbox is both expensive and time-consuming.

INTRODUCTION OF THE VDG DRUM MOTOR

In the 1980s, VDG introduced the first alternative conveyor belt drive, the VDG Drum Motor, a motorized head pulley that addressed common issues with traditional conveyor drives. The drum motor design prioritized protection against harsh, dusty environments and weather conditions that often cause motor failures, while also eliminating the need for routine maintenance.

The Drum Motor has no external drive components. All drive components, including the electric motor, gear reducer, and bearings, are enclosed within the head roller (drive drum), eliminating external maintenance while improving workforce safety and increasing efficiency. The drum motor is partially filled with oil, which lubricates the gears and bearings and helps dissipate heat.

Since the drum motor has non-rotating shafts on both ends of the drum, it does not require pillow block bearings or any other external components that need maintenance. The drum motor is mounted on the conveyor frame using brackets. This is an important design departure from traditional external conveyor drives that require frequent and costly maintenance to keep the system running.



ORIGINAL DRUM MOTOR DESIGN CHALLENGES

While the original drum motor design addressed safety, efficiency, and maintenance, it was not widely accepted as a reliable alternative to the traditional external motor and gearbox drive in the mining and aggregate industry.

As the leader in the design and manufacturing of drum motors, VDG conducted a comprehensive in-house study with its engineering team to identify operational issues affecting drum motor reliability. The study found that the drum motor's performance and reliability were limited by insufficient heat dissipation from the electric motor and gear reducer inside the drum.

Unlike a conventional external conveyor drive electric motor, which has a cooling fan, the drum motor relies on the oil inside the drum to dissipate heat. Heat generated by the electric motor and gear reducer within the drum motor is transferred to the drum and then dissipated to the belt. Wrapping rubber lagging around the drum substantially reduces the amount of heat transferred to the belt, which increases the internal temperature and lowers the oil viscosity. Low oil viscosity results in inadequate lubrication of bearings and gears, eventually causing mechanical failures.

The temperature rise inside the drum motor varies depending on the size and horsepower of the electric motor. Higher horsepower produces greater electrical losses, leading to higher temperatures. Trapped heat increases the internal pressure to 18 psi or higher, causing premature oil seal failure and oil leakage. Since the drum motor's reliability and performance are affected by heat buildup, it was not a viable option for the high operational demands of the mining and aggregate industry at that time.

DEVELOPMENT OF THE NEW-GENERATION GRIZZLYDRIVE® DRUM MOTOR

Since the primary cause of drum motor failures observed in these industries was insufficient internal heat dissipation, the next step was to analyze the heat sources within the drum motor.

The two sources that generate heat inside the drum motor are the electric motor and the gear reducer, with approximately 85% generated by the electric motor and 15% by the gear reducer. Since the electric motor generates most of the heat, VDG engineers concentrated their efforts on developing a cooler-running electric motor for its drum motors.

For an electric motor to produce torque, it requires a rotating electromagnetic field. The electric motor windings (the stator) provide the rotating electromagnetic field to the stator core, and the rotor produces the rotating torsion. The stator copper windings, the laminated core, and the rotor produce heat. The heat generated by the electric motor windings is the result of the electrical current that travels through the copper conductors. The higher the current, the higher the magnetic field, and the higher the heat. The electric motor windings produce magnetic flux density. The higher the magnetic flux density, the higher the torque. Higher torque generates higher heat levels. The high heat level is not a problem for a traditional external drive since the electric motor is equipped with a cooling fan. This is not the case for the drum motor.

The design challenge for the drum motor to achieve heat reduction while maintaining the rated horsepower and torque was to reduce the electric current and magnetic densities of the electric motor to lower levels. After months of testing and data collection, it was determined that to reduce the oil temperature to the targeted temperature of 75°C, it was necessary to use laminated cores and rotors with different metallurgic compositions, larger core length and diameter, and redesign the electric motor windings with lower current and magnetic densities. As a result, VDG designed and produced a new electric motor that operates at full load and at a lower temperature.

The new cooler-running electric motor was found to be satisfactory for drum motors up to and including 50 hp. However, for drum motors higher than 50 hp, the targeted temperature of 75°C was not achieved as the oil viscosity remained low and was not enough to be an effective lubricant. This is because drum motors higher than 50 hp have higher electrical and mechanical losses in proportion to the drum motor heat radiation area. To achieve the required oil temperature and viscosity, VDG designed and patented an external oil cooler system.

The oil cooler system extracts the oil from inside the drum motor, filters it, cools it, and then pumps it back inside the drum motor. The VDG Oil Cooling and Conditioning unit is supplied as standard with every GrizzlyDrive® Drum Motor from 75 hp to 500 hp.

With these advancements, the new-generation GrizzlyDrive® Drum Motor delivers 80,000 hours of continuous operation before maintenance, providing the reliability and durability required to handle the demands of mining and aggregate belt conveyors.

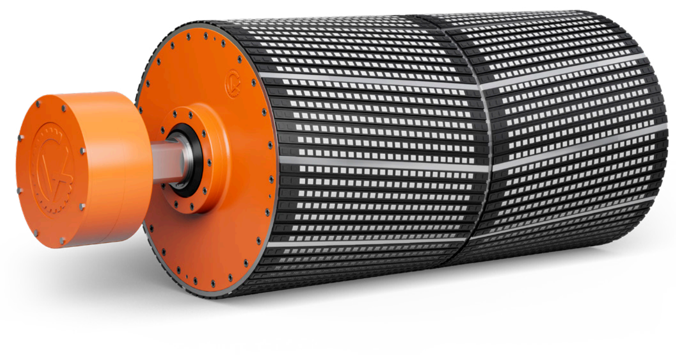
ADDITIONAL IMPROVEMENTS FOR THE GRIZZLYDRIVE® DRUM MOTOR

Since conventional rubber lagging applied to the drum motor has a short lifespan, VDG invested in research to improve the durability of the lagging and extend its service life.

A standard conveyor drive head roller is normally lagged with rubber for better traction and belt grip. The rubber lagging is adhered to a standard head pulley with hot bond vulcanized adhesive applied to the rubber and the roller. The method of applying lagging is very important as it requires it to withstand high shear forces between the drum and the loaded belt. Often, the lagging will wear unevenly, resulting in belt mistracking. Eventually, the bond between the rubber lagging and the drum weakens, resulting in delamination. Downtime due to lagging repair or replacement is costly and results in a loss of production. The IronGrip™ lagging system, developed and patented by VDG, is an innovative solution for addressing the lagging issues encountered with standard rubber lagging.

The IronGrip™ lagging has metal bars welded on the length of the drum, and the spaces between the bars are lagged with rubber, available in plain and diamond patterns or rubber embedded with ceramic tiles. With this system, the loaded belt force pushes the lagging against the welded bars and not the glue. There is no shear force placed on the glue, only a compressed force acting on the metal bar.

The IronGrip™ lagging lasts 4 to 5 times longer than standard lagging, and because the rubber cannot wear below the metal bars, it improves belt tracking and increases belt traction by 40%. The VDG Drum Motor with IronGrip™ lagging extends the service life of the overall conveyor drive and reduces maintenance and operating costs.



CONCLUSION

The VDG engineering team faced a huge challenge in developing and implementing the new motor design. Significant investments along with in-house design and manufacturing of all components, including electric motors and all gear reducers, made it possible for the engineering team at VDG to overcome heat issues experienced with all drum motors when it first entered the market. In mid-2021, VDG unveiled the new generation of VDG Drum Motor designs.

NOTE:

All of the above drum motor design improvements have been carried out by VDG engineers and research and development team. All new-generation drum motor components are manufactured by VDG exclusively for its drum motor products. The designs are proprietary to VDG and do not apply to or cannot be followed by any other drum motor manufacturer.