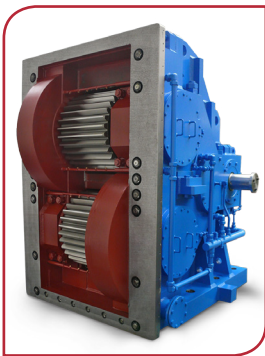


Lukas Steiner, Wikov Industry

## An ingenious solution for driving tube mills with girth gears

Wikov, a gearbox engineering and manufacturing company, has a field-proven product for driving tube mills with large girth gears, a space-saving Side Drive gearbox. While there are several such side drive gearbox solutions on the market, the features of Wikov's Side Drive give end users increased reliability, reduced maintenance and service costs. These aspects of process optimisation result in improved positions for cement producers in the highly competitive modern market place.



**Above:** Wikov Side Drive.

The Side Drive gearbox saw the light of day for the first time in 2006 and it has undergone a lot of development based on a real-life experience from years of 24/7 operation.

The objective of the development of the Side Drive gearbox by Wikov was a product that would be compatible with the majority of existing plants using single pinion solutions for mills or kilns. The point was to make the product feasible for cement plants without the need for large construction modifications that lead to increased capital costs. At the same time reliability and low maintenance requirements were the primary drivers for an efficient, modern product.

The Side Drive is now proven and cost-competitive with conventional solutions, while providing reliable operation at low maintenance and service costs. This has a positive impact on the Total Cost of Ownership, a far more useful measure than just the initial investment figure.

The convenience of the Side Drive lies in the patented separated lubrication system, which is a unique technical solution - a self-aligning pinion and rigid gearbox casing. In the field, these mechanical groups are proven to be decisive for trouble-free operation.

The separated lubrication system is key to ensure extended lifetime of the gearbox by eliminating gearbox contamination by cement dust and impurities coming from the girth gear. Despite the fact that the rim is thoroughly sealed during installation, field experience shows that this sealing is far from perfect and it wears very quickly.

Conventional side drive gearboxes that are open in the direction of the rim get contaminated by cement dust. This results in rapid wear of the gears and bearings, contamination of the lubrication

oil and clogging of filters and the entire lubrication system. The gearbox tends to fail prematurely.

The Side Drive by Wikov has a closed and sealed design so that contact with the girth gear is limited to outlet pinions only. Sealing in the area of pinion shafts at outlets is implemented using non-wearing labyrinth seals and scraper rings. The advantage of the system is the significant increase in gearbox reliability, especially of bearings that are extremely sensitive to cleanliness and lubricating oil quality. In order to achieve purity of the lubricating oil that fully conforms to the operation of the bearings in the original design, one would have to include in the lubrication system a full-flow filter, filtering at about three microns. This is not realistic for practical applications and therefore one has to ensure that the lubricating circuit of the bearings and the transmissions is as insulated as possible from the external environment of the casing. The time between repairs or replacement of bearings in the new gearbox can be doubled by using this system.

The gearbox lubricating system was designed so that the separated spaces have independent oil supplies from two separated lubricating units. This contributes to keeping the gears and bearings free of contamination from the girth gear. The oil from the girth gear space is drained to a tank of the girth gear's lubricating system and the oil from the separated inner space of the gearbox is drained to the second lubricating unit. Each circuit can use a different oil grade: the gearbox using VG 320 and the girth gear using VG 460, for example. The separated lubrication system allows cement plants to use high-quality synthetic oil without wasting money, which would be the case with a conventional side drive gearboxes where contamination of the oil would cause degradation almost immediately. In the case of the Side Drive by Wikov, synthetic oil may increase gearbox efficiency and reduce energy costs, while maintaining its properties.

Piping for the girth gear lubricating circuit, which is prone to contamination by cement dust, may require cleaning from time to time. Therefore complete

**Below:** Common oil contamination on conventional side drive solutions that lead to fatal damage of bearings and scoring of gear teeth.




distribution of the lubricant for the gearbox and the girth gear is realised from the outside of the gearbox. The gearbox casing has openings for lubricating pipes with spraying nozzles that lubricates gear stages and a girth gear. These lubricating pipes can be dismantled and cleaned easily during operation breaks. This service takes 2-3 hours. It does not require any special equipment or tools because the gearbox does not have to be dismantled, as is the case with conventional solutions.

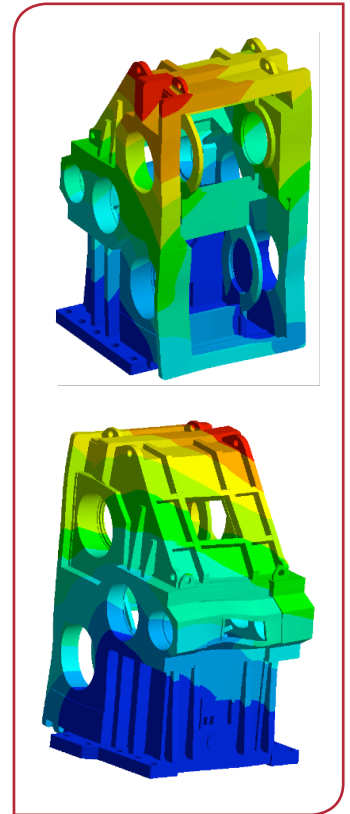
Finally, yet importantly, the partition system significantly increases the rigidity of the gearbox casing. In the case of a conventional side drive gearbox, the side adjacent to the rim is open and therefore not reinforced, whereas with the innovative gearbox the partition system closes the gearbox from this side as well and significantly increases rigidity of the whole casing.

The optimally rigid gearbox casing is a result of research of dynamic behaviour of the Side Drive, which included various analyses such as structural analysis of the gearbox casing and modal analysis using finite element methods (FEM), to determine the natural mode shapes and frequencies of an object or structure during free vibration and other vibration conditions. The calculations were compared to real-life operation and results implemented into an optimised design for the gearing in order to secure maximum meshing of gearing under load and thus improve reliability and service life of the gearbox.

A self-aligning pinion is a prerequisite of a smooth operation because the mill, the girth gear and the base

are subject to elastic deformations, have deviations due to manufacture and suffer from wear. An assembly of self-aligning pinion is used in applications where an ideal meshing of gears is needed, where a pair of pinions is meshing with one gear or where the variable misalignment of a pinion and a gear is expected. This is the case in side drive gearboxes for cement mills and kilns. The advantage of the Wikov system is that a tilting pinion allows it to align optimally with the meshing gear independently, on both shaft and gear deformations. The principle lies in a relative movement between two pairs of spherical rings and the spherical shape of a pinion's gear teeth. The spherical rings ensure axial stability. The value of misalignment and radial movement that the self-aligning shaft can bear depends on the actual design. Generally it is possible to accommodate misalignments up to 0.5°. The maximum misalignment may affect the lifetime of the equipment. Therefore final design of the self-aligning shaft should be optimised for each case individually.

The Side Drive design and dimensions enable easy drop-in replacement for other side drive solutions in the market, for power of 2.8-6.0MW. Existing oil systems can be used. However, the major added value remains reduced maintenance costs, increased efficiency and gearbox lifetime. 



**Above:** Static and modal FEM analysis to ensure optimally rigid gearbox casing.

**Below:** The ADOÇİM AŞ Tokat Cement plant.

## Case-study: ADOÇİM's Tokat plant

**A**DOÇİM AŞ's Tokat integrated cement plant in Turkey had two Wikov Side Drive gearboxes installed as part of a mill unit by a third party OEM in 2007. A third identical mill unit, also with a Wikov Side Drive gearbox, was erected in 2011. ADOÇİM also has a fourth grinding plant in the Marmara region in Tekirdağ, also with a Side Drive. The company thus operates a total of four Wikow Side Drive gearboxes.

"The price to performance ratio was the most important criteria during comparisons," explained Mehmet Erdem Fidangül,

Methods and Planning Manager. "The Side Drive solution also required a minimum area, which is another significant selection criteria, as well as the compatibility to our mill configuration. The projects were new and we did not replace any older drives."

"We had seen improvements in maintenance times and effectiveness during our 10 years of experience of cooperation with Wikov Service specialists. Our best practice is regular six months maintenance tasks based on strictly-controlled maintenance master plans. Any findings are acted upon immediately."

