



## MINIMUM QUANTITY LUBRICATION MQL®

Minimal Quantity Lubrication MQL® is Primetals Technologies' next generation roll-gap lubrication solution applying neat rolling oil atomized with air onto the surfaces of the work rolls. It fully replaces any conventional roll-gap lubrication systems in the entry of a mill stand, such as emulsion lubrication or direct application. MQL® generates a neat oil layer with defined thickness on the work roll surface, which can significantly improve the friction conditions between the work roll and the strip. MQL® allows to be permanently operated in combination with existing emulsion lubrication, as, due to the small amounts of oil, no undesired enrichment of the emulsion concentration will occur.

With respect to the continuously increasing requirements on the cold rolling process due to highest strength grades, challenging product dimensions and highest quality standards, tribology (the interaction of effects related to friction, lubrication and wear) in the roll-gap becomes a more decisive factor than ever before. Improved lubrication efficiency consequently supports to produce new grades, to extend the product spectrum, to save costs due to decreased oil and energy consumptions and to deliver better strip quality.

### CHALLENGE

The frictional conditions between the work rolls and the strip in the roll-gap play an important role for both the cold rolling process and the resulting product quality, in particular the surface of the cold rolled product. Friction cannot be measured directly, yet the consequences of poor friction immediately become evident. High rolling forces, limited reductions and excessive wear lead to reduced rollability and deteriorated strip surface cleanliness. Conventional lubrication systems need to fulfill two basically contradictive requirements: efficient lubrication and proper roll and strip cooling. Whereas a high oil content would be beneficial for the former, it is counterproductive for the latter. Moreover, with emulsion lubrication, the coefficient of friction cannot be influenced

directly in a quick and flexible way. Modification of the emulsion parameters is in many cases a tedious and complicated task.

In addition to that, the demands on lubrication may greatly vary between different mill types and even between different stands in a mill. The reason for such varying demands are highly different preconditions related to the strip or the rolling process. Hot rolled and pickled strip enters the first stands or first passes in either dry or pre-oiled condition and with relatively high surface roughness. Later on, the rolling speed is increased, the strip gets thinner and the surface roughness is flattened or worn. Residual oil and iron are accumulated on the strip, and the friction conditions gradually improve. However, the same emulsion is usually applied in the early and later passes of a rolling schedule (except for the last pass). As a consequence, significant deviations from the optimum friction conditions occur. The potential of the mill is not fully utilized, which could otherwise be converted into an extended product mix, or, alternatively, into reduced oil and energy consumptions with reduced strip wear and improved surface cleanliness in both cases.

### SOLUTION

MQL® by Primetals Technologies is typically installed in the mill stand entry and applies smallest amounts of neat rolling oil onto the work roll surface. As only a small portion of the oil is consumed inside the roll-gap, the amount to be newly applied in order to maintain a defined layer thickness is minimized. Furthermore, this technique allows to directly influence the oil layer thickness in a flexible way and with short response times. Changing the lubrication regime from one coil to the next can be realized by modifying the amount of oil applied. The oil application is solely defined by lubrication requirements of the respective rolling pass, such that different conditions can be employed in different stands or passes. Cooling with emulsion is exclusively applied on the exit side of each stand, where cooling efficiency is high and interference of the emulsion flow with



Minimum Quantity Lubrication MQL® equipment overview and spray test

the oil mist on the entry side is prevented. The coefficients of friction between the work roll and the strip can be decreased compared to other lubrication methods.

It is up to the mill operator to define the lubrication level: new products, previously beyond the mill capabilities, might be produced due to increased oil amounts, or standard products can be rolled at rolling force levels comparable to emulsion lubrication. Thirdly, the rolling force and energy consumption might be decreased at intermediate oil applications comparable to those with emulsion lubrication. In any case, the reduced coefficients of friction will lead to less strip wear, in particular in the early passes of a cold rolling schedule. MQL® thus offers potential to address strip surface cleanliness issues at their root cause – the generated wear.

MQL® is delivered as a mechatronic package ready to be integrated in arbitrary stands of any existing mill (batch and continuous tandem mills, skin pass mills, double cold reduction mills). It consists of 2 spray bars per stand, an oil supply and a process unit comprising the mechanical and electrical components. In addition to that, a pressurized air supply must be available. Pre-defined interfaces allow for an easy integration into existing plant automation systems. The spray bars are robust and maintenance friendly with quickly exchangeable oil/air nozzles. The spray bars do not include and electrical components. A mobile MQL® test unit and a set of spray bars is available for temporary test installations to evaluate the benefits prior to placing an order for the industrial solution.

### BENEFITS AND CONCLUSION

MQL® by Primetals Technologies is a well-proven and efficient system for optimizing lubrication efficiency of both new and existing cold rolling mills. Installation of MQL® can be done in quick and easy way within one

### MAIN BENEFITS

- Flexible and product-dependent lubrication strategy
- Up to 20 % roll-force reduction per stand
- Extension of product mix
- Extension of reduction capability
- Up to 10 % less energy consumption
- Up to 10 % extended work roll lifetime
- Improved strip surface cleanliness up to 10 percentage points reflectivity

planned maintenance shutdown. This revamp provides rolling mills with a state-of-the-art lubrication system ensuring a fast return of investment. Customers can expect improved product quality, increased product mix diversity, and decreased operational expenses. The improved lubrication efficiency can be exploited through higher strength grades, increased strip width or reductions or lower gauges. Rolling forces and strip wear are reduced, and the work roll life time is extended. MQL® is a first step towards decoupling lubrication from cooling and provides plant operators with the possibility to take advantage of so far unused optimization potential.



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A joint venture of Mitsubishi Heavy Industries and partners

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