ENVIRONMENTAL TECHNOLOGY

Sealing the Steel & Metal Industry

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L-UK/US-SLURRY-03 | Issue 3

Introduction

The Steel and Metals Industry offers many opportunities to improve seal life, given the harsh environment in which the equipment operates.

In addition to the more conventional mechanical seal applications, major opportunities exist to extend plant equipment reliability with the application of correct bearing seals.

Typically, the consequences of bearing failure in the steel industry are incredibly high. Slag, molten steel, wire, dust and debris, work there way past conventional lip seals and into the bearing chambers.

As bearings rapidly deteriorate, equipment such as rolls lose their tolerances and can introduce defects in the processed steel strip or billet.

Leaking oil from overhead gearboxes can tarnish and scrap tens of thousands of dollars worth of finished steel product.

On top of the tangible costs of maintenance, labour, scrap and lost production through downtime, the less tangible costs of plant health and safety and/or risk of fire due to leaked oil around high temperature processed steel, are arguably more important.

Rolls

The diagram overleaf shows the operation of a Twin Strand Continuous Caster.

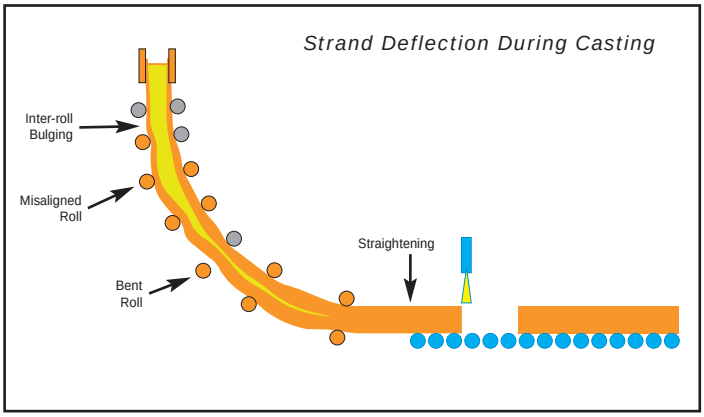
Molten metal is poured from a steel ladle into a Tundish. The Tundish then feeds the molten metal into two R.A. moulds which define the initial size and shape of the desired cast slab.

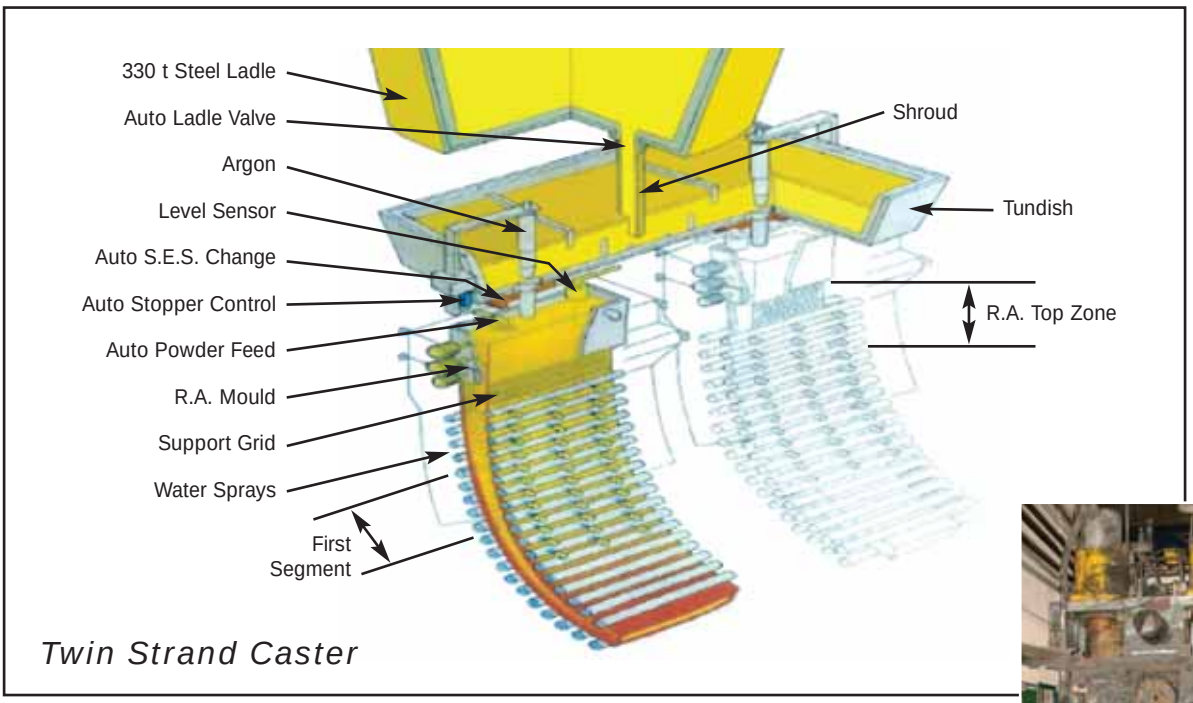
Each R.A. mould sits adjacent to two sets of rolls which are designed to gradually reduce the thickness of the molten metal as it falls under gravity towards the horizontal roller bed.

At the horizontal position the molten metal solidifies sufficiently to create a steel slab, which is then cut to length and driven on the horizontal rollers for further processing.

Clearly the rolls play a vital part in reducing and controlling the material thickness as it is cast. To achieve a desired material thickness, each roll is supported by precise bearings at either end of the roll.

As the image below shows, if the bearings deteriorate, for example due to contamination and/or loss of lubricant, the rolls will loose their alignment and precision.





Twin Strand Caster

A misaligned roll permits a wave in the material as it is cast, simply because lost bearing precision permits the roll to deflect under the force of the rolled material.

As the solidified 'waved' of material falls further, it hits each subsequent roll in the system. The sudden impact of a material wave often bends rolls, causing further problems as bent rolls create more material 'waves'.

The net result is that the combination of a non-uniform material thickness and bent rolls means that the slab gets stuck between the rolls, as shown in the photo to the right.

Once stuck, the slab slowly cools and solidifies creating one huge headache for the plant engineers who then have to stop the production line and somehow remove the solidified material before the equipment can be reused.

Twin Strand Caster seizure due to poor bearing protection.

The photos to the left shows the twin strand continuous caster, sited in a steel mill in the UK.

To eliminate bearing deterioration and roll misalignment as previously described, flange mounted LabTecta™ bearing seals may be installed at either end of the roll. The net result is a roll that is less susceptible to bearing deterioration, therefore will permit the material to be cast in longer production runs. By simply protecting the bearings with LabTecta™ seals, the plant-wide savings are immense.

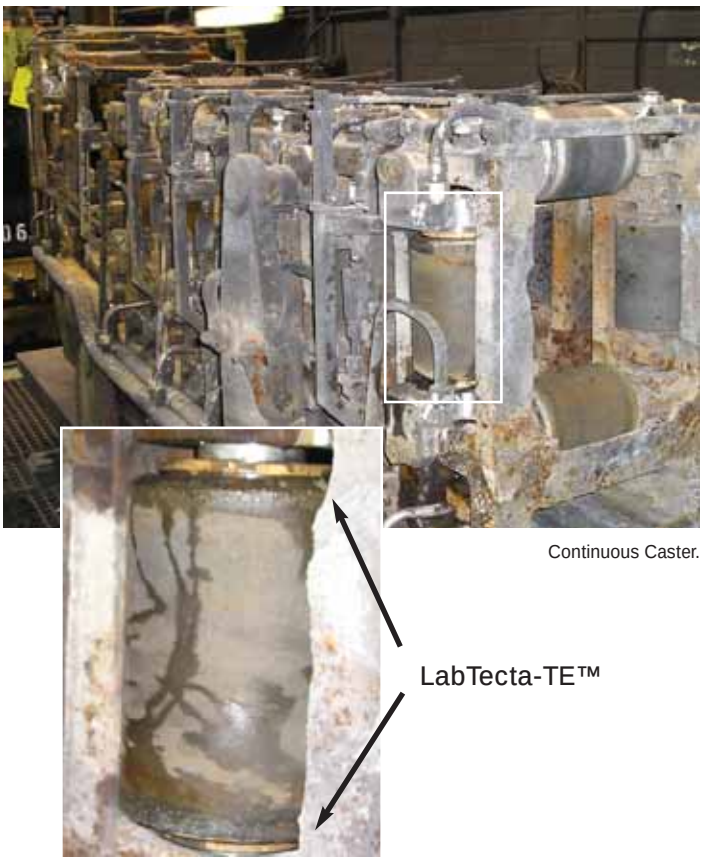
The photos to the right show an alternate continuous caster sited in a steel mill in Germany.

The rolls in the continuous caster turn extremely slowly and are grease lubricated. Traditionally, these are sealed with lip seals which permit contaminants to enter the bearings destroying them after a typical three week production run. The poor bearing life costs the plant many thousands of Euros in lost production time, repair and replacement parts.

Contaminants are created as the abrasive dross/slag forms on the molten metal at 1,200ºC (2,192ºF). The close proximity of this to the lip seals and the poor sealing performance of the lip seals, means that it is inevitable that the bearings will be effected.

The plant has installed 300 LabTecta-TE™ bearing seals on each side of the water cooled rolls after finding that the bearings remained in excellent condition after a considerable production run.

The photo below shows a hot slab of metal being processed over an item of rotating equipment. This environment creates problems for traditional bearing seals, causing them to leak (as shown). Not only will the equipment life deteriorate in such conditions, the leaked oil/grease will create a fire hazard for the plant.



Continuous Caster.

The photo to the left showing leaked oil is a clear example justifying the use of correct bearing seals to prevent plant fires.

The cost of a single minor plant fire incident and the resulting investigation and management/engineer time, is more than the initial cost of fitting high quality bearing seals on ALL items of rotating equipment within the plant.

FACT: **Fitting correct bearing seals on rotating equipment will reduce the probability of a plant fire.**

Case References

1449, 1908, 3388

Brest Roll Table

An alumina works in the UK approached AESSEAL® to protect their Brest Roll Table bearings, shown right.

The Brest Roll Table processes aluminium sheet, reducing it in thickness for use in aluminium drink cans and tin foil.

If the roll bearings are contaminated with debris, wear occurs which in turn causes radial movement of the roll. This movement changes the thickness of the rolled material leading to many plant problems, including scrap and re-work.

Each Brest Roll Table requires 21 LabTecta™ bearing seals and the first set was installed in 2006.

Following their successful operation, in January 2007 a further 42 LabTecta™ orders were received for another two Brest roll tables. Case Ref: 3458.

Brest Roll Table

Electric Motors

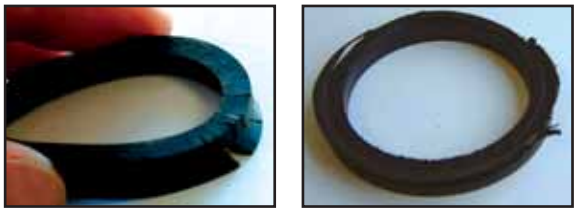
An alumina works in Ireland purchased two new 900kW electric motors with variable speed packages for over £27,000(€40,000/$50,000) each.

After a presentation on LabTecta™, the works was curious as to what was protecting the bearings on their new motors. When they removed the cover, they found the only thing protecting their £27,000(€40,000/$50,000) motor was a rubber v-ring, valued at around £6.70(€10/$12.50).

It took around 0.3 of a second to realize that after a few hours the rubber v-ring would look something like the one that AESSEAL® tested in the laboratory, below.

Given the LabTecta™ seals IP55 certification and conformance to IEEE 841-2001, the alumina works purchased 140mm standard LabTecta™ seals for both the drive and fan end of the motor. The motors have been running well ever since.

See case history 3261 for further information.



Conventional v-ring after a few hours of dynamic equipment operation.

LabTecta™ installed on an electric motor.

FACT: **AESSEAL® purchased an industry standard IP55 electric motor and ran it dynamically for 500 hours. When it was re-tested it failed the IP55 test.**

Process Pumps

Clearly, there are a number of process pump applications in the steel and metals industry, which are used in the main, to process water around the plant.

Unfortunately, it is not uncommon for the water to be contaminated with mill scale and other slurrious contaminants given water is mainly employed in various cooling duties.

For example, pumps are employed to process the water which is used to quench billets which pass through the mill. Further applications include the processing of water, which is used to cool the skid rails in the bottom of the furnace on which the billets run.

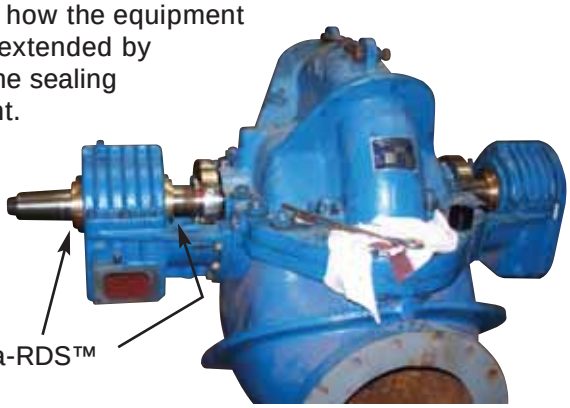
Pumps are also used in duties such as the draw of condensed product from the bottom of the primary coolers. The product in such duties is a mixture of water, tar, ammonia, hydrogen sulphide and gritty coke particles.

Needless to state, the nature of the environment provides a challenging range of duties for equipment sealing solutions.

AESSEAL® have supplied mechanical seals and systems to steel processing plants for over two decades, extending equipment life by the correct use of materials and technology.

As encountered in many industries, the mechanical seal is only part of the equipment sealing solution. As mechanical seals have replaced shaft packing over the years, equipment seal life has been further extended many fold by the correct use of seal support systems.

The photos to the top right show a double mechanical seal supported by a 25 liter / 6.60 gal (US) support system with air blast coolers installed in an alumina plant in Ireland. This is one example of how the equipment life can be extended by changing the sealing environment.



SSE25™ system with air-blast coolers installed in an alumina plant in Ireland.

Once the primary pump is sealed in such a manner, it makes little sense not to realise the benefits of such an arrangement given the likelihood of premature failure of the equipment bearings.

For this reason, plant engineers are turning to premium bearing seal arrangements such as the LabTecta™ and MagTecta™ products, which compliment the total sealing package and extend equipment operating life beyond three years.

The photo to the left shows four LabTecta-RDS™ bearing seals installed on either end of a Hazleton pump in an alumina plant in the UK.

The plant engineers needed a better solution than the conventional lip seals which did not keep contamination out of their pump bearing chambers. They preferred a split bearing seal solution which was flange mounted to the pump bearing chamber.

The LabTecta-RDS™ seals were that successful, that further pumps have now been upgraded in the same manner.

Case References

048, 049, 071, 072, 072, 153, 154, 229, 230, 231, 943, 1426, 1568, 1814, 2609, 2726, 2727, 2729, 2730, 3238, 3438.

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Gearboxes

Gearboxes are found in many places in the Steel and Metals industry from overhead cranes to drive rolls.

Given the harsh environment of molten steel, high temperatures, water spray cooling, scale and metallic particles, it is not surprising that lip seals installed on the drive and driven input/output shafts do not perform satisfactorily.

The issue of moisture ingress resulting in lubrication deterioration is a clearly present, however it is the egress of lubricant, specifically oil, from gearboxes that is a major problem in this industry.

Some of the main drivers for improving and eliminating oil egress from gearboxes are;

- **Health & Safety issues:** Oil pools/puddles on the floor and working area clearly create an operator safety hazard and increase the possibility of a fire given the elevated temperatures and ignition sources in the surrounding environment.
- **Damage to finished product:** Dripping oil onto finished steel, as a minimum, will tarnish the product resulting in major scrap/re-work costs.
- **Gearbox position:** Gearboxes under rolls are prone to being coated in scale and debris. In wire mills, the wire scrap can wind its way around the rotating shafts and tear lip seals apart.

Many gearboxes have been successfully sealed in this industry. An example is shown below.

Case Ref: 3370 - 100mm LabTecta-RDS™ (Split seal) working on gearbox at 1,500rpm

Case Ref 3394 - 9.500" LabTecta™ seals on a Pipe Mill gearbox in the USA.

The photos above show a gearbox in a pipe mill in the USA, where the plant engineers had constant problems with water passing through the lip seals on their vertical shaft guide rollers.

The plant engineers had to regularly drain the water from the gearbox and replace the bearing assemblies. After they installed the LabTecta-TE™ seals they were so impressed with the improved performance, they ordered further units to upgrade their other gearboxes.

Case References

1616, 1922, 1923, 2397, 3221, 3252, 3370, 3394.

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Case References

The non-exhaustive list of case references below provides an indication of the work AESSEAL® has done in the steel and metal industry over the last two decades.

Case Ref. 1449
Two 120mm M-TXS MagTecta™ bearing seals were installed in February 2003 on either side of a horizontal roller in a UK steel processing plant.

The MagTecta™ seals protect the roller bearings and are oil splash lubricated rotating about 300rpm. The MagTecta™ seals replaced lip seals which leak on equipment start-up. The oil seals allowed oil to escape causing a fire hazard to the plant. The Magtecta™ seals were installed early February 2003 and in July 2005 were still reported to be running leak free.

Case Ref. 1922
In July 2003, 3.500" Magtecta™ seals were installed on David Brown gearboxes which were fitted onto Kohne overhead cranes in a UK steel mill. The shafts were previously sealed with lip seals, which fail on a frequent basis. Upon failure, oil leaked onto the finished product below which caused quality issues.

Case Ref. 1923
In June 2005 in a UK steel production plant, AESSEAL® replaced lip seals with 115mm MagTecta™ bearing protectors on a Davy McKee screw down gearbox on a 2 metre mill. The lip seals leaked oil onto finished product which caused quality issues.

Case Ref. 2397
In December 2003, two 4.000" VLXS MagTecta™ seals were fitted to a David Brown Radicon 7CU20 gearbox on a materials handling conveyor in a UK steel plant. The bearings were oil splash lubricated and the seals worked very well.

Case Ref. 3221
In June 2006, 50mm LabTecta™ seals were installed on a gearbox seal splash feed oil in a steel processing plant in Argentina.

The seals replaced conventional lip seals which did not perform in the arduous environment. The LabTecta™ seals worked excellently and further units have been supplied since.

Case Ref. 3238
In April 2006, a 42mm CAPI B2 dual seal (AESSEAL® stock code AZA11188SSBSK12401M) was fitted to a KSB CPK pump for a steel plant application in South Africa. The seals were supported as per the API Plan 53 configuration. The pumps rotated at 2,945rpm with the seals sealing 100% pitch at 450ºC (842ºF). For further information see GA 7148012 and ADM No 24271/1.

Case Ref. 3252
In May 2006, 5.500" LabTecta™ seals were installed on the horizontal output shaft of a Lufkin mill stand gearbox sealing 220 ISO gear oil in a steel mill in the USA. The shaft speed was variable and operating temperature was around 66ºC (150ºF). The LabTecta™ seals (stock code L1I44-PP-001-150) worked excellently, preventing mill slag getting into the gearbox.

Case Ref. 3370
A steel mill in Germany had trouble with lip seals on their gearboxes and required a split seal solution. The shaft size was 100mm (3.937") operating at a speed of 1,500rpm using standard gear oil.

The customer chose a LabTecta-RDS™ (Split Labyrinth Seal) which pressed into the existing lip seal cavity. The gearbox was installed in October 2006 and has been running well since.

Case Ref. 3388
A steel mill in Germany was looking for a better solution to the existing lip seals on their rolls in the continuous caster. After a typical three week production run, the lip seal and bearings would be completely destroyed by the abrasive dross/slag forming on the molten metal at 1,200ºC (2,192ºF) near the seal.

The customer tried two 50mm LabTecta-TE™ seals on each side of the roll (water cooled) and after the same three week production period the LabTecta™ seals and the bearings were in excellent condition.

The rolls turn extremely slow and are grease lubricated. Subsequently the customer has order further LabTecta™ seals given there excellent performance.

Case Ref. 3394
In April 2007, 9.500" LabTecta TE™ seals were installed on two guide roll gearboxes for pipe weld line in a pipe making mill in the USA, replacing lip seals.

The guide rolls were quenched with water based cooling fluid and therefore the old sealing arrangement allowed fluid and pipe slag to enter gearbox, reducing the bearing life to typically six months.

Every six months, the bearings had to be replaced costing $1,200 (£600) each. On top of this, the gearset costs plus other gearbox damage, labour costs and plant downtime meant that the low cost lip seals where actually costing the plant tens of thousands of dollars each year. The LabTecta-TE™ seals are currently running without problems.

Case Ref. 3438
In 2004 an alumina processing refinery in Ireland asked AESSEAL® to specify a Seal Support System to be used with two DMSF™ seals on a new installation of two pumps. The pumps are pumping caustic liquor. AESSEAL® designed a Seal Support System consisting of a single SW2™ with 25 liter / 6.64 gal (US) vessel size with an air blast cooler to feed the two DMSF™ seals. The two pumps have been installed with the Seal Support System and DMSF™ seals for two years without any problems following updating of the outboard rotary face on the DMSF™ seals. MagTecta™ bearing protectors are also installed on these two pumps.

For further information and case references, please see the applications section of www.aesseal.com.

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