BRITISH COAL SEALING TECHNOLOGY STILL RELEVANT TODAY!

For many years British Coal Ltd, the major state owned organisation, was the primary producer here in the UK of both deep mined and open cast mined coal – producing millions of tons annually. Accordingly they also had a very high level of input into the technical aspects of conveyor system design and manufacturing, with their major suppliers around the UK.

This input extended for example not only to the raw material specifications accepted for underground conveyor structure – but also extended to the design and manufacture of much of the conveyor systems themselves – including some of the necessary component parts used within various elements of the structure. This also covered the sealing arrangements necessary within the roller to protect the bearing from potentially harmful contamination – in order to maximise the working life of the rollers.

Working with one of their major suppliers during the 1960s, a new design of seal was established, for use within British Coal conveyor rollers both above and below ground. This sealing arrangement was based on the principle of a shaft contact lip seal. The final design was developed in the form of a 3 lip shaft contact seal, manufactured in polyurethane.

This eventually became one of British Coal's standard sealing arrangements for many years – and continued in use in UK coal mines, when British Coal became privatised and was subsequently known as RJB Mining Ltd and thereafter again as UK Coal Ltd.

Therefore when we were looking at manufacturing a standard sealing arrangement for our own range of products, which are actually built into conveyor rollers – where better to look than starting with such a proven concept?!

PROBLEMS WITH THE OLDER METHODOLOGY

Since the original design of this seal was produced in the early 1960s – it was obviously based upon design criteria at that time - and also upon raw material specifications and upon injection moulding tooling also used at that time. This meant that certain characteristics in the original design were not really suitable for the modern technical requirements of conveyor roller manufacturers.

Also the earlier 1960s methodology required the seal to be firstly assembled into its own dedicated pressed steel housing. This seal sub-assembly was then retrospectively assembled into the mouth of the roller bearing housing (already welded onto the roller tube) via interference fit between the outside diameter of the seal's steel housing and the inside diameter of the pressed steel bearing housing.

This was not an ideal arrangement. One major reason for example was that within a circular pressed steel housing there will **always** be a few microns of ovality – when measuring either the inside diameter or the outside diameter. This meant therefore that there would not physically be 100% guaranteed positive contact between the outside diameter of the seal steel housing and the inside diameter of the pressed steel bearing housing welded upon the roller.

RE-ENGINEERING THE SEAL DESIGN

In order to arrive at a suitable modern design of this seal, several elements of the original design needed to be re-examined in order to meet modern day requirements. Also the new design of seal would be designed to suit a different method of roller construction – which had not been part of the original concept.

The main characteristics which therefore needed to be re-examined to achieve our objectives, were:

- The seal outside diameter.
- The specification of the polyurethane raw material.
- A new profile for each of the sealing lips within the seal.
- The outer wall thickness of the seal.
- The height of the seal from bottom outside edge to the top of the component.

In essence therefore, taking on board the requirements mentioned above, we reverse engineered the original concept used by British Coal, and introduced many technical design changes to the original seal.

- The seal diameter was increased to match precisely the inside bore diameters of the roller pressed steel bearing housing.
- The raw material specification was changed to a modern formula, to allow for a more precision injection moulded component.
- Each of the three sealing lips within the seal were refined – with a new external profile and an extremely thin tip to the sealing lip.
- The outer wall thickness of the seal was increased by more than 200% to provide rigidity and strength.
- The height of the seal was also reduced by around 50% - again to create rigidity and strength.

NO LONGER JUST A SEAL – NOW PART OF THE STRUCTURE

Because of the nature of our bearing housing assembly design – this new modern version of this seal would now guarantee 100% sealing contact between:

- The outside diameter of the seal body and the inside diameter of the pressed steel bearing housing.
- The bottom edge of the outer seal wall and the upper edge of the bearing outer race.
- The inside surface of the pressed steel retaining washer and the upper surface of the polyurethane seal.

This is in addition to maintaining the original concept under which the three internal flexible lips each sealed upon the surface of the roller shaft outside diameter.

However, in addition - this new design of 3 lip shaft contact seal was also designed to be an integral part of the actual structure of the end of the roller – hence the thicker outer walls of the seal and the increase in seal outside diameter – as well as height of the seal - while still performing its primary function as an extremely efficient roller sealing arrangement.

This idea of using the seal itself as part of the roller structure was completely new, and to the best of our knowledge remains unique within the international roller manufacturing market.

COAL – POTASH - AND UK OFFICIAL RECOGNITION!

After successful preliminary field trials of prototype seals during the 1980s - primarily using a 6205/25 mm specification seal – we commenced the bulk manufacture of the new design of bearing housing assemblies – first of all to suit 6204/20 mm and 6205/25 mm specifications, incorporating the new seals. These were increasingly used in the coal industry by British roller manufacturers to produce rollers of this specification during this period.

Subsequently the use of these new assemblies (cartridges) during the late 1980s and into the 1990s became standard practice with several roller manufacturers both here in the UK and overseas – particularly in the USA and Canada for different applications.

For example – Edwin Lowe Ltd cartridge based rollers have been used in a North American potash mines for around twenty years or so, to excellent effect. As potash mine owners can tell you – potash is an extremely aggressive contaminant. It is known for its ability to penetrate several common sealing arrangements, resulting in bearing contamination. Once bearing contamination takes place – the roller very swiftly ceases to function.

Here in the UK - the seal design also received official approval from RJB Mining UK Ltd, the successor to British Coal, on 24th March 1998. This was a major milestone in the universal acceptance of this new design of seal.

EXPANDING THE RANGE OF SPECIFICATIONS

As the use of new 6204/20 mm and 6205/25 mm sealing arrangement gained further acceptance – the range of specifications was expanded to include a range of heavier duty bearings – up to and including 6308/40 mm – the very heaviest specification of roller used in the UK at that time, incorporating a 40 mm diameter shaft.

This expanded product range meant therefore that internationally speaking, this new design of seal covered not only all common UK roller specifications – but also the majority of all common international ISO standards and all common North American CEMA standards – up to and including CEMA F.

One of the major technical advantages of this modern seal design is that it can easily be scaled upwards or downwards to suit different bearing specifications - from low duty rating to very heavy duty rating. I.e to suit a 6202/15 mm bearing - 15 mm diameter shafts - or alternatively to suit a 6312/60 mm bearing - 60 mm diameter shafts.

In other words - all of the necessary design research and related development – as well as the manufacturing research and development – will have already been carried out and proven on this design. Therefore any variation in the size of seal, is simply dealing with the question of scale.

This obviously makes life much, much easier for the roller manufacturer when designing and manufacturing new roller specifications, to expand his product range.

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