Morgan Advanced Materials

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Advanced Thinking in Advanced Materials

NEWS RELEASE

Press Releases from January to March 2016

New Morgan Advanced Materials Facility Will Serve Growing Demand in China

JANUARY 2016

A pioneering joint venture between Morgan Advanced Materials Greater China and Yongda Technology Group has come to fruition with the opening of a new state-of-the-art manufacturing facility in Wuxi, in the People's Republic of China.

The Morgan Ceramic Core Technology Co Ltd facility based in Wuxi, Jiangsu, will specialise in the manufacture of sacrificial ceramic cores and other ceramic injection products for use in investment casting processes. It was officially opened by Dr Pete Raby, Chief Executive Officer of Morgan Advanced Materials during his visit to China.

The nine-month £1 million project has created a facility that will help to serve Morgan's growing customer base in the industrial gas turbine and aerospace sectors in China. It will eventually employ around 160 staff.

The venture follows extensive growth within the civil aviation sector where Morgan's high performance ceramic cores are instrumental in the creation of durable yet lightweight turbine blades. Similarly, seismic demographic changes in China continue to fuel growth in energy demand in the region, subsequently driving demand for Morgan's proprietary range of engineered cores for industrial gas turbine applications.

The opening ceremony in Wuxi was also attended by senior Morgan executives from Greater China and across Asia, as well as guests from Yongda and its subsidiary, Suvast, who also took the opportunity to tour the facility.

Pete Raby commented: "This joint venture has created a facility which is ideally placed to serve the developing needs of key industrial sectors in China and further afield. Our partnership with Yongda has been a close and mutually beneficial one to date and will continue to be so as the facility now moves into full production mode."

Morgan Makes Strides In Zero Flow Offset Measurement

JANUARY 2016

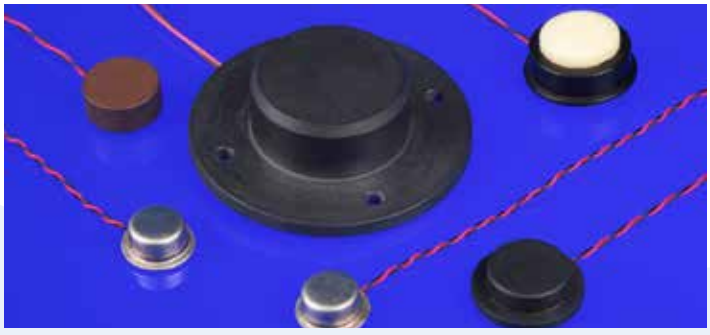
Morgan Advanced Materials has for the first time developed a method to measure the zero flow offset property for a broad spectrum of transducers, optimising overall flow measurement accuracy in ultrasonic sensors.

Morgan, a global leader in the design and manufacture of advanced materials for use in demanding environments, has made significant advances in minimising zero flow offset, to levels as low as 60ps. By streamlining the transducer design and production methods, this has been shown to restrict variation to less than 5% over a wide range of environmental conditions. Put simply, the lower the variation, the more accurate the meter reading.

In industrial and domestic ultrasonic flow measurement applications accuracy in measuring flow rates in dynamic flow conditions is essential. Given that customers are charged on the basis of their meter readings, the reading needs to accurately reflect the quantity of material used, be this gas or water.

Measuring the "time of flight" between the upstream and downstream transducers, and then reversing the process gives two figures which, together, provide a measurement of the flow rate of liquids and gases. However, even where there is no flow in the tube, there is typically a minimal discrepancy between the two. This phenomenon, known as 'zero flow offset', is a by-product of the physical constraints of materials and signal processing technologies that may impact on the accuracy of meters. Advancements made by Morgan's team of sensor specialists have gone a long way towards addressing this.

Oksana Jaroszak, Transducer Development Engineer at Morgan, explained: "Drawing on our knowledge of materials and experience in transducer design, we have specifically developed a portfolio of materials that will enable us to create a transducer with the lowest zero flow offset possible. This development is reflected in our results, which demonstrate clear improvements across a variety of environmental extremes. Overall, this will lead to increased accuracy in ultrasonic water and gas flow sensors."



Morgan Adds Brazing of Zirconia to Growing Portfolio

JANUARY 2016

Morgan Advanced Materials has enhanced its production capability to include brazing of zirconia in response to a growing market demand for zirconia products.

In demanding applications, such as those within the petrochemical and industrial sectors, it is not uncommon for components to become damaged when subjected to sustained wear and corrosion, which can result in significant cost and disruption. Where other materials fail, zirconia remains highly resistant while exhibiting high fracture toughness. As a result, it is rapidly becoming a material of choice for components where wear and corrosion are primary concerns.

Brazing is an essential part of the process of creating components and while common techniques for connecting metals and ceramics include shrink fitting and gluing, they are not always entirely appropriate, particularly when there is a requirement for components with complex geometries intended for applications in harsh environments. Morgan's ceramic-to-metal brazed assembly portfolio has been augmented by the additional capability of utilising zirconia, which offers new solutions for satisfying demand for robust and resilient joints.

Unlike other methods currently employed, brazing of zirconia offers a greater degree of flexibility in terms of the complexity of the surface geometries it can join together, meaning there is significantly greater freedom around the type of components to which this technology can be applied. Another key advantage is that brazing offers a fundamentally superior joint, which offers better strength and hermeticity. The expansion of Morgan's capability in this area opens up the possibility for the brazing of zirconia to a range of metals for a wide variety of applications that were previously unavailable, such as nickel alloys.

Oliver Ridd, International Sales and New Business Development Manager at Morgan Advanced Materials, explained: "Our capability to braze zirconia onto a range of materials will give us a real edge in the marketplace. There is already a huge demand for this kind of service, particularly where analytical instruments for the oil and gas industry are concerned. We have been able to successfully demonstrate our capability in this area, having successfully employed zirconia brazing to create joints that are unmatched in terms of precision and quality."

New Digital Modelling To Enhance Morgan's Brazed Assembly Capability

JANUARY 2016

Morgan Advanced Materials has announced that it now has the capability to carry out digital prototyping at its Technical Ceramics facilities, maximising its design capability and providing more rigorous evaluation during development projects, particularly for brazed assemblies.

The global materials leader, Morgan has acquired high-specification software that will enable them to perform stress and thermal analyses on existing and prototype designs for a variety of demanding applications. The introduction of digital modelling has had a tremendous impact on new product introductions and development, enabling Morgan's Technical Ceramics business to refine designs of their brazed assemblies more easily.

Specific benefits seen by the customer include more 'right first time' manufacture – getting products to the customer sooner, and lower associated design costs reducing cost to the customer at the start of the process. For development work, especially when it comes to brazed joints within the products, it brings piece of mind to the customer that the product has been optimised for their application.

For critical products, stringent measures need to be taken to ensure that they meet design specification and Morgan's modelling capability significantly improves its ability to deliver optimised products, particularly those intended for use in harsh environments.

Oliver Ridd of Morgan Advanced Materials explained: "A significant portion of the products that we supply are used in critical applications and we need to develop robust, integrative designs to meet customers' ever-demanding specifications.

Digital prototyping represents an important step forward for us in our design process; we can now accurately model how a particular material will react under certain conditions and minimise residual stresses in our designs within the shortest possible timeframe.

This capability gives us a competitive advantage and leaves us well placed to solve our customers' biggest design challenges."

Morgan Unveils Industry-Leading Ceramics for ADCP Transducers

JANUARY 2016

Morgan Advanced Materials, a global leader in ceramic materials, has revealed that it now has the capability to design and manufacture components for use in ultrasonic Acoustic Doppler Current Profilers (ADCP) technologies for oceanographic, waterway and waste water usage.

ADCP is a hydro-acoustic current meter, similar to a sonar, which attempts to measure water current velocities over a depth range using the Doppler effect of sound waves reflected back from particles within the water column. While ADCPs have been on the market for a number of years, recent developments have driven improvements in efficiency and versatility. Typically, working frequencies now range between 38 kHz and several megahertz.

Morgan is creating ceramic ultrasound transducers in a range of shapes and geometries up to 254mm (10 inches) in diameter and is also harnessing its industry-leading knowledge and manufacturing capability to produce the large ceramic blocks used for the low frequency requirement of ADCPs. To achieve optimum efficiency, increased bandwidth and range, Morgan's transducers use piezo-composite elements. The transducers are made from a modified range of soft piezoelectric (PZT) materials such as PZT5H1 or PZT5A1, which have been developed from Morgan's proprietary range of ceramics and deliver greater sensitivity. The large size block increases the directivity, lowers the operating frequency and hence the profiling range while reducing potential interference from objects located within the profiling range.

Frédéric Pimparel, Technical Application Manager for Morgan Advanced Materials explains: "Many of our exclusive, proprietary materials have qualities which make them ideal for these kind of applications. For instance, our PZT5H1 material strikes a balance between high permittivity, low dielectric losses, high density and high piezoelectric activity - a combination of key material characteristics not commonly found in a single commercial formulation.

"This material also makes a transducer that is extremely efficient, and maximises the propagation of ultrasound wave energy. Another ceramic, PZT5A1, offers excellent results and both formulations have been tested in house at pressures up to 27,000 psi, a level found at depths of around 18,500m (60,696ft) underwater.

"Results show our PZT5H1/PZT5A1 'soft' formulations are effectively very stable showing no signs of depolarisation. This has always been a concern for transducer design engineers in the selection process of ceramic materials for deep sea applications, where the general preference is to use a 'hard' based ceramic material such as PZT401."

New Fully Stablised Zirconia Products Deliver Optimum Performance up to 2,000°C

FEBRUARY 2016

Morgan Advanced Materials has announced the launch of a new range of furnace products made from fully stabilised zirconia which offer extensive performance benefits in temperatures of up to 2,000°C (3,632°F) in a variety of industrial process applications.

Fully stabilised zirconia has been developed by Morgan to deliver unrivalled resistance to chemcial corrosion and temperatures, with a long and reliable service life. Boasting flexural strength of 200MPa and thermal conductivity of 1.5 – 3.0 Wm-1K-1 at 200°C (392°F).

Products available include sheath tubes for temperature monitoring, ideal for atmospheres containing carbon commonly used in DSS furnaces for the production of photovoltaic silicon ingots. Their design allows the easy incorporation and protection of an interior sheath tube and insulation rod.

Meanwhile, an impressive range of crucibles is available in calcium fully stabilised zirconia (CaO-FSZ) which possesses excellent refractory properties as well as high resistance to the alkalis, acids and caustic chemicals encountered in chemical processing applications.

Manufactured to extremely tight tolerances, the high purity of these products delivers outstanding stability in a full range of thermal processes. As well as standard sizes and shapes, designs can be customised to meet individual application requirements.

Dr Michael Rozumek, R&D Director at Morgan's Haldenwanger facility, commented: "The material most commonly used for these products types has until now been alumina but customers are seeking ever more impressive performance and longer life.

This led Morgan's dedicated research and development team to formulate fully stablised zirconia which delivers extremely effective performance at the highest process temperatures alongside design flexibility and strong chemical resistance."

Morgan's Salamander SIC Crucible a Promising Energy-Saving Solution

FEBRUARY 2016

The consumption of energy is of key importance to the metal casting industry, with most energy expenditure – 55 per cent - occurring during the melting process. However, until now it has been difficult to find data relating to energy use and crucibles, and so to assess the cost of crucible ownership in a way that includes energy savings. That situation has now changed, with a comparative study revealing that Morgan Advanced Materials' Salamander silicon carbide (SiC) crucible performs particularly well in terms of energy consumption. Furthermore, changes made to the crucible in light of the study mean that the resultant energy-optimised Salamander SiC may offer very considerable savings to foundries, through its increased energy transfer capability.

Reducing energy costs

The high energy costs involved in metal casting are of significant concern to foundries, and so Morgan Advanced Materials commissioned an independent laboratory to compare the thermal conductivity of its Salamander SIC crucible with that of two competitor crucibles, from room temperature to 1600°C. This temperature range was set in order to include the temperatures that are reached when aluminium, copper and other non-ferrous alloys are melted.

The lab found that, during heating from room temperature, the Salamander SiC had a thermal conductivity value approximately double that of the competition. In other words, the Salamander SiC reached the target temperature most quickly, suggesting it used less energy and would achieve a higher throughput in use.

The comparison also showed that both the Salamander and 'Competitor 1' had advantageously low thicknesses in the upper and lower portions of the crucible, with similar thickness in the chine. This leads to faster heat transfer, which generates energy savings yet also maximises the strength of the crucible where it matters.

Better performance

In light of these findings, Morgan Advanced Materials has carried out work to optimise the Salamander SiC, and, through the use of advanced materials, has reduced the wall thickness by a further 20% per cent and increased thermal conductivity by 60 per cent compared with 'Competitor 1'. As a result, the energy-optimised Salamander SIC now offers an increased energy transfer of more than 50 per cent. Field results are currently being collected, but the data suggests that the optimised Salamander SIC may generate energy cost savings of 10-20 per cent.

Salamander crucibles are widely recognised as being the world's first trademarked crucibles (having been trademarked in 1907), and are acknowledged as being among the highest quality products available, due to their ability to resist high temperatures and thermal shock. Salamander brand products are available in a range of sizes and materials, including carbon-bonded silicon carbide and ceramic bonded clay graphite, so there is a Salamander product to suit virtually any foundry melting application.

Morgan Delivers Standard Flow Tube Solution for Water Flow Measurement

FEBRUARY 2016

Morgan Advanced Materials, one of the leading experts in the design and manufacture of standard and bespoke sensors using ultrasonic technology, has developed a ready-made standard flow tube solution which enables significant time savings for water flow meter manufacturers during the design and development phase of production.

Ordinarily, manufacturers would have to source multiple parts in order to produce a component of this nature, which can result in delays and additional cost. Morgan's standard flow tube solution, which comes ready to use, elimates discrepancies in the measurement of flow rates by granting manufacturers access to the pioneering technology developed by Morgan. By ensuring uniformity in the instrumentation used to measure flow rates, this enables manufacturers of flow meters to more accurately track improvements in prototypes, expediting the design process.

Building upon Morgan's world-leading expertise in the field of transducer technology, the solution boasts a particularly high ultrasonic signal level, providing more accurate meter readings across a range of flow rates. An added benefit is that flow tube can be optimised to work with different transducers that operate at different frequencies. As a result, it can be used in meters for domestic, municipal and industrial markets.

Commensurate with Morgan's recent advancements in ultrasonic technology, measurement accuracy will remain constant over time, ensuring increased accuracy, longevity and value for money. The same also applies to the ceramic wedges which are used in the solution, exhibiting significantly enhanced acoustic performance and lower degradation than alternative materials, for instance, stainless steel.

Charles Dowling of Morgan Advanced Materials explained: "Our continued efforts have resulted in greater measurement accuracy than ever before, without the drop in performance associated with moving part technology.

Such advancements offer significant benefits to our customers in the area of flow meter manufacturing, where a greater ability to reliably quantify improvements in their prototypes substancially shortens development lead times. Our standard flow tube solution is highly versatile, covering a wider range of flow volumes, ensuring that all bases are well and truly covered and that readings remain accurate irrespective of the scale of the end user."

Morgan Publishes White Paper on the Trends in Aluminium Processing

FEBRUARY 2016

Morgan Advanced Materials has published a white paper identifying current trends in primary and secondary aluminium processing, focusing on technology solutions for the global aluminium processing sector.

The paper examines the current state of the aluminium market with reference to annual growth and future production. The market has an average annual growth of 6 per cent per annum with a current total market value of around £45 billion. A summary of market trends is provided drawing on examples of activity in key regions including India, China, EMEA and the Americas.

The white paper also discusses the importance of quality in the aluminium processing sector, detailing sources of impurity and physical imperfections, and some of the high-performance solutions now available; which are contributing to improvements in overall metal quality, productivity and safety.

Examples of potential sources of contamination are explored, including the effect of crucibles from which fragments can break off and melt into the molten aluminium, impacting significantly on purity and therefore on casting quality down the line. High-specification coatings are now available which can help to combat this issue.

The paper goes on to cover the need to optimise furnace insulation in light of the high energy usage of aluminium furnaces and the vital importance of maintaining consistent temperatures to optimise quality.

Mirco Pavoni, Global Technology Directorof Morgan Advanced Materials, commented: "We believe the global aluminium market is set to remain buoyant for the next few years at least, and in this paper Morgan has presented a comprehensive overview of the sector. We have provided future predictions drawing on our extensive knowledge gleaned from many decades supporting major aluminium producers with technology-led solutions.

The white paper explains how harnessing innovative materials technology and design, and the continued development of existing technologies, will continue to create new opportunities for those suppliers able to deliver an agile, responsive service."

Morgan Launches Piezoelectric Transducers Used in Ring Laser Gyroscopes

FEBRUARY 2016

Morgan Advanced Materials, a global leader in ceramics and other advanced materials, has developed the capability to design and manufacture piezoelectric transducers for use in ring laser gyroscope (RLG) technologies, used in a variety of high-precision applications.

Morgan is creating the transducers in a range of shapes and geometries from a modified range of hard piezoelectric (PZT) materials, developed from the company's proprietary range of ceramics. Other piezoelectric formulations are available on request, depending on the temperature range required in the application.

In recent years the industry has witnessed a multitude of developments in the area of optical gyroscopes which deliver highly reliable, solid state performance immune from many of the mechanical effects which restrict the performance of conventional spinning mass gyroscopes.

RLGs are inertial sensors based on the Sagnac rotation effect which causes the frequency of the two counter-propagating beam in the ring cavity to be shifted by a quantity proportional to the angular velocity. This shift (the Sagnac frequency) can be easily measured, letting the two beams beat. By bringing the two frequencies of laser light to interference, a beat frequency can be obtained. The beat frequency is the difference between the two frequencies and can be thought of as an interference pattern in time.

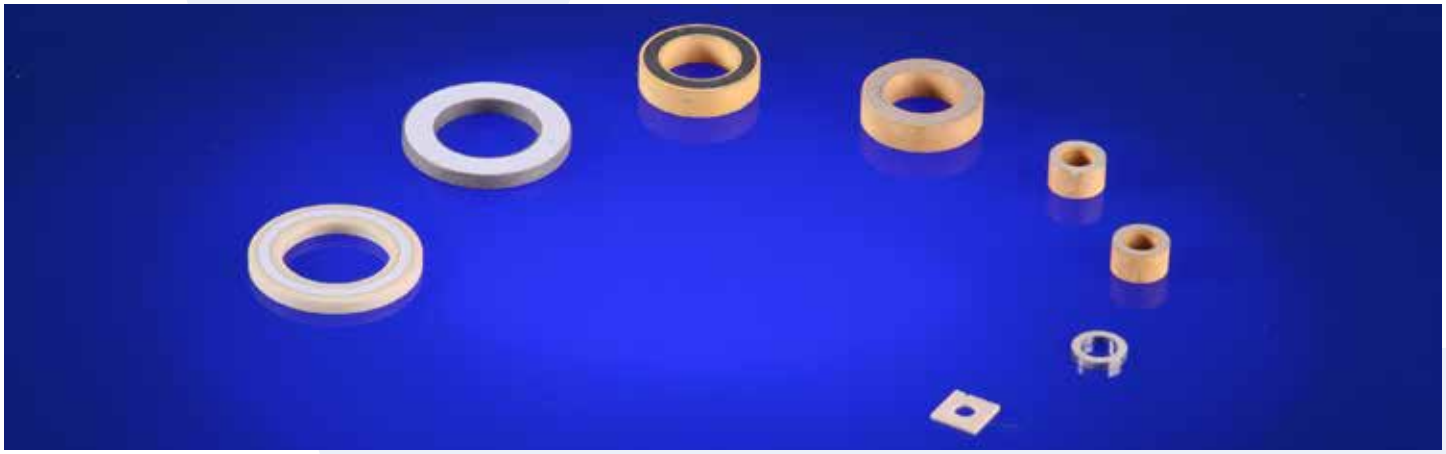
Compared with conventional spinning mass gyroscopes, RLGs offer several advantages: they boast a large dynamic range, high precision, a small footprint, and do not require any moving mechanical parts. Their digital output is linear with angular rotation, while they are also highly sensitive and thermally stable across a wide range of operating temperatures, with quick reaction times, and immunity to most environmental effects. They are also insensitive to translational accelerations. Thanks to these features, RLGs are gaining an increasingly prominent role in many applications, ranging from inertial navigation systems on commercial airliners, weapons guidance systems, ships and spacecraft to geodesy and geophysics, to test of fundamental physics.

RLGs combine the functions of optical frequency generation and rotation sensing into a laser oscillator within a ring-shaped cavity. Typically, they consist of a solid block - either square or triangular - of glass ceramic material, into which a lasing medium is introduced. The electrodes provide gain for the lasing medium, generally a helium/neon mixture due to its short coherent length and index of refraction of nearly 1.0, which generates two independent beams in opposite directions around the cavity.

Frequency stabilisation is obtained using a piezoelectric transducer to precisely move one or more of the four mirrors located on the perimeter of the cavity. Meanwhile, a change in the length of the ring can occur by thermal expansion, bias in the discharge current on either side of the laser. This will produce a change in the readout which is equivalent to the real wander of a mechanical gyroscope. Both of these can be compensated by using active control of the discharge current through an error detection system coupled with feedback system and active control of the path length by moving one or more of the mirrors using piezoelectric ceramic actuation technology.

As Frédéric Pimparel, Technical Application Manager at Morgan Advanced Materials, explains, a number of Morgan's cutting edge ceramic materials are particularly suitable for RLGs: "Many of our proprietary PZT materials have qualities that are desirable in RLGs. For example, PZT406 and PZT401 offer a fine compromise between high permittivity, low dielectric losses, high density, high piezoelectric activity and a high mechanical factor.

"This combination enables production of an actuator that is extremely efficient under high driving modes, and maximises the accuracy of the mirror positioning in situ during the compensation sequence. Another ceramic, PZT503, is excellent as a feedback sensor, because it offers high permittivity and excellent sensitivity levels, which means a stronger signal to noise ratio back to the amplifier unit. The actuator and feedback sensor are vital factors in the performance of the RLG."



Morgan Event Recognises Young Talent in Materials Science

MARCH 2016

Morgan Advanced Materials, a global leader in advanced material technologies, has hosted its first ever partnership event in collaboration with the Armourers & Brasiers' Company (A+B) in recognition of excellence within the field of materials science.

The event, which took place at the Armourers' Hall in London, was the product of Morgan's burgeoning relationship with the Armourers & Brasiers' Company, a livery company of the City of London, which is committed to promoting and developing the highest possible standards within materials science. The partnership is designed to support the development of early talent, continued learning and research in materials science and activities with key education partners.

The event celebrated the most impressive achievements from across the industry, bringing together some of the most promising young talents within Morgan Advanced Materials, including apprentices, placement students and members of the Graduate Leadership Programme (GLP) cohort, as well as members of the wider academic community. The candidates were nominated by Morgan's partner institutions for their exceptional contributions to materials science. One particular success story was Dr Sneha Rhode, the winner of the Professor Sir Richard Brook prize sponsored by Morgan, who received the accolade on the strength of her cutting-edge research into the atomic structure of ceramic nitride films.

The event also provides a forum for the aspiring scientists to meet with industry leaders, members of the A+B Materials Science committee and Graduate Leadership Programme participants, to discuss key issues facing the materials science industry. A number of presentations were given by senior Morgan figures, including Morgan CEO Pete Raby, who explored the impact of top talent acquisition on the continued success of the business. A presentation given by Mike Murray, Chief Technology Officer at Morgan, explored some of the ground-breaking innovations currently in the pipeline, while Mehul Chavda, Research Analyst for Morgan Advanced Materials at the National Graphene Institute and currently in the second year of his Graduate Programme, was able to provide an insight into the GLP as well as an overview of Morgan's industry-leading collaboration work with the Graphene Institute at the University of Manchester.

Pete Raby explained: "Talented young graduates and apprentices are the lifeblood of our business and we always seek to attract the very best talent on offer. Our continued aim is to create an environment which encourages this fresh talent to thrive and lead future innovation through cutting-edge research and the pushing of technological boundaries. Our unrivalled expertise in materials science is what gives us a competitive advantage in the marketplace and allows us to find solutions to our customers' most challenging engineering problems."

Professor Bill Bonfield, CBE FRS FREng, FMedSci, Chairman of the A+B Materials Science Committee said: "The Armourers & Brasiers' Company has supported education and innovation in metals and materials since its foundation in 1322. Our primary charitable purpose in the 21st century is to encourage young people to enjoy science and to explore and develop careers in Materials Science which is full of fascinating and rewarding opportunities. We are delighted to be working with Morgan Advanced Materials to deliver these shared goals. It was a great pleasure to welcome these outstanding candidates to Armourers' Hall to receive their awards."

Slip Rings – at the Heart of Modern Packaging Applications

MARCH 2016

The packaging sector presents a variety of challenges for individual machine components depending on the application. Not only must production run without unscheduled interruption, placing reliability at a premium, but the correct speeds of operation for each individual aspect of the process must be maintained to ensure seamless and correct processing.

In packaging applications from carton board processing through to the bulk packaging of bags containing cement, slip rings – also known as collector rings, rotary electrical contacts and electrical slip rings- are found almost everywhere thanks to their versatility. Introduced to the sector more than 30 years ago, a slip ring is an electromechanical device which enables the transmission of power and electrical signals from a stationary to a rotating device. Their advantage is that while a slip ring allows for unlimited rotations of the connected object, a slack cable can only be twisted a few times before it will fail.

Typically, the slip ring comprises a stationary graphite or metal contact or brush which rubs against the exterior diameter of a rotating metal ring. As the ring turns, the electric current or signal is conducted through the brush to the metal ring making the connection. Additional ring/ brush assemblies can be located along the rotating axis if multiple electrical circuits are required.

Not only can slip rings improve mechanical performance and simplify system operation; they can also potentially eliminate the issues associated with damage-prone wires hanging from movable joints.

Their benefits are now enjoyed by machine operators across a broad spectrum of applications. In winders and rewinders used in the lamination of carton board, they transmit the power and encoder signals. They also power cutters and winders used in film production. Even the heat-sealing process on packets of sweets can be driven by a slip ring, while they are also found in tobacco product processing.

This versatility is of course an advantage but it makes correct specification and maintenance absolutely critical. The decision on the type of slip ring used will inevitably be governed by a range of factors. These include operating speed; the system current and voltage; dimensional space available; the IP, data and bus system in operation; and the presence of media such as water, oil or compressed air. Slip rings are typically made from copper or brass –and plated with either gold, silver or rhodium depending on the application requirements.

Various modified versions of slip ring are available depending on the specific application requirements.

Mercury-wetted slip rings boast low resistance and a stable connection but instead of a sliding brush contact they have a pool of liquid metal molecularly bonded to the contacts. During rotation the liquid metal maintains the electrical connection between the stationary and rotating contacts. However, the use of mercury poses safety concerns and is not an option in sectors such as food & beverage, pharmaceutical or anywhere else where contamination could be a serious threat. In these sectors, precious metal contacts should always be specified.

Carbon to copper slip rings, meanwhile, are best suited to higher rotation applications of up to 3,000 rpm, for example in equipment with twist cables.

Modular systems are also available which are ideal for transmission of information via an Ethernet or when working with sensitive analogue signals. Typical rotation speeds are up 20 rpm.

In applications where space is limited, or rotational speed is very low (no more than 5 rpm), a slip ring plate system or 'pancake' can be specified.

In a pancake slip ring the conductors are arranged on a flat disc as concentric rings centred on the rotating shaft. This configuration has greater weight and volume for the same circuits, greater capacitance and crosstorque, greater brush wear and more readily collects wear debris on its vertical axis. However, it offers reduced axial length for the number of circuits, and with a service life of up to 4 million cycles – which can be maintenance-free depending on the application – represents an attractive option in many applications, though it should be noted that 16A is the usual maximum current.

Pancake systems are attracting considerable research and development currently and systems offering faster rotation and at a higher current are likely to be introduced in the near future.

As with any production-critical component, working with a supplier such as Morgan who can develop a detailed understanding of an application and then recommend design and supply an appropriate solution is crucial.

Feature: Current Trends and Technology Solutions For The Global Aluminium Processing Sector

Mirco Pavoni, Morgan Advanced Materials

As the second largest metals market in the world, the aluminium sector currently has a total value of around £45 billion.

Demand for aluminium continues to grow, not least in the automotive sector, where ever stricter regulation on emissions is behind a continued drive to reduce weight.

Meanwhile, the rising prices of potential alternatives such as zinc and copper continue to make aluminium an attractive option for specifiers across a broad spectrum of sectors. Aluminium prices currently remain low currently due to oversupply and stockpiling, although modest output cuts have seen prices start to rise slightly in recent times.

Global demand estimates are for roughly 40 million tons of aluminium production by 2025 – meaning 230 million additional tons of bauxite must be extracted and processed. Analysts predict that the increased demand will mainly be fuelled by emerging economies such as India and China.

Production by the end of 2016 is expected to be 59 million tonnes with consumption slightly higher, making modest inroads into stockpiles. However, prices are likely to remain depressed, perhaps even as low as US$1,400, though they may rise towards the end of the year.

Global aluminium production in the first seven months of 2015 averaged just over 158,000 tonnes per day (tpd) compared with 143,300 tpd during the same period in 2014, according to the International Aluminium Institute. However, Chinese production fell to 87,871 tpd from 91,867 tpd in June. A long-term drop in Chinese output would be the key to creating the type of supply deficit which would have a real impact on the stock burden.

Demand is likely to remain robust as it is still one of the metals with the most rapidly growing demand profiles.

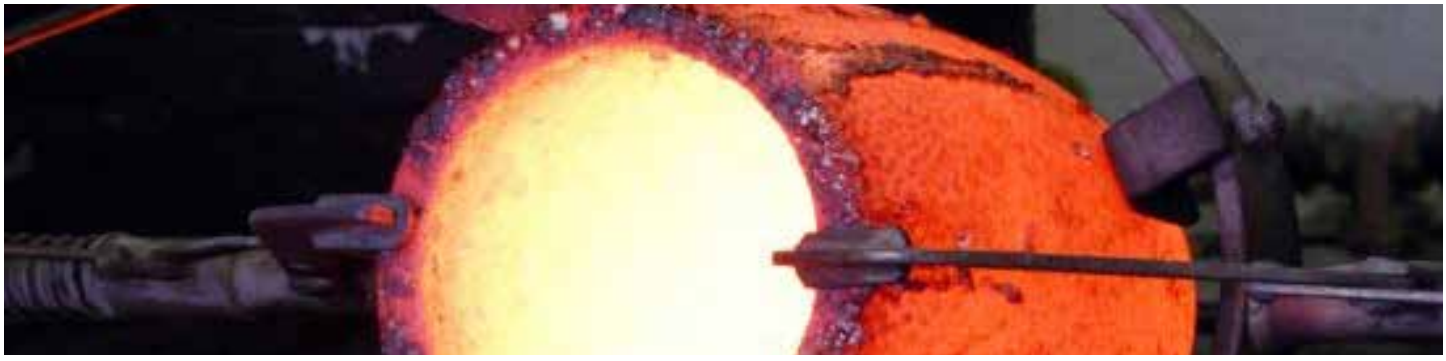
Optimising Furnace Insulation

Given the high energy usage of aluminium furnaces and the need to maintain consistent temperatures to optimise quality, any action which can be taken to reduce energy loss during the melting process is to be welcomed. Alongside this sits the requirement to meet increasingly stringent local and global safety regulation in the area of insulation materials.

For many years, refractory ceramic fibreboard was the industry standard but concerns about its carcinogenic properties – meaning it is being outlawed completely in some regions – led to the development of the first low biopersistent fibre-based alternatives. These were originally launched to the market in the late 1990s, and recent innovations have delivered higher melting points and improved insulation to meet ever more demanding process requirements. Well-suited to the aluminium industry because of their ability to withstand temperatures of up to 1,200°C (2192°F), these products are available in both blanket and board forms, making them suitable for applications in anode bake ovens, casthouses and potlines, and boast key properties such as low shrinkage – less than 1% at 700°C (1292°F) - and compression. A suitable solution can be developed based on individual application requirements such as operating temperature; duration of exposure; compression; environment; installation method; single or multiple use; amount of handling; and airborne fibre exposure. Recent tests carried out at the most common operating temperatures for furnace back-up board – between 600°C (1112°F) and 800°C (1472°F) – revealed that in the key area of thermal conductivity, the latest low biopersistent fibre-based board outperformed calcium silicate alternatives by an average of 20% at 600°C (1112°F) and 15% at 800°C (1472°F).

Block products are also available for use as insulation layers in aluminium reduction cells where they offer low thermal conductivity – no higher than 0.16W/m.K at a mean temperature of 900°C (1652°F), high dimensional stability and hot compressive strength, and high cryolite resistance. Thickness shrinkage reaches a maximum of 2.8% at 1,100°C after 24 hours' soaking, with linear shrinkage under the same conditions no higher than 1.8%.

The latest low biopersistent fibre systems also available in paper, felt, modules and custom shapes. Specialised materials are even available for caster tips while furnace cones, seals, gaskets, thermal covers and flexible launders are also on offer.



Lining Developments

In the area of melt-hold furnace lining, continued investment in the optimisation of monolithic materials is delivering enhanced productivity and quality. These furnaces present a variety of challenges as each area of the furnace has varied requirements in terms of factors such as temperature, metal contact, flux contact and thermal shock, meaning suppliers must offer a variety of products with differing performance attributes. Products used on ramps, for example, must offer strong resistance to abrasion and thermal shock, as well as to aluminium and alkalis. Some of the latest products boast abrasion loss as low as 2.8cm^3 at 815°C (1499°F), significantly lower than that of competing products. Their pick-up of at 0.011% at 1,000°C (1832°F) over 100 hours is also more than 10 times lower than that of the nearest competing product. It is a similar story on belly bands, where the highly aggressive metal-to-air interface makes resistance to salts and alloys crucial, as well as resistance to abrasion, aluminium and thermal shock. The lower walls, superstructure, door, jambs and lintels, back-up lining and burner blocks all have their own requirements too – and the issue of testing is complicated by the fact that many industry standard test conditions, based on lower temperatures and operating times, do not truly reflect how operators use their furnaces. The only real way to ensure the product is appropriate is to test it under real operating conditions in the application in question.

Modern products are improving all the time and the right combination is not just easily achievable but integral to optimising performance and productivity while reducing energy usage.

Supporting the Journey Towards Enhanced Quality

Quality in the secondary aluminium processing sector is inextricably linked to purity, especially in high-specification applications in sectors such as electronics. One of the key sources of impurity and physical imperfections – and therefore strength and performance issues - in cast aluminium components is the presence of gas, in particular dissolved hydrogen. This makes effective degassing technologies vital to production.

However, their role in removing gas from the process area must be married to a long service life and an inertness to the presence of molten aluminium, as any reaction with the aluminium will itself cause impurities and potentially the loss of the cast product when it is machined.

The latest degassing rotor technology has been developed in silicon carbide, delivering a high-performance and cost-effective alternative to the graphite material traditionally used for this task. Graphite has previously been the most widely used material for degassing rotors but is subject to high replacement costs and frequent changeovers. Silicon carbide boasts superior wear resistance and anti-oxidation qualities when compared with graphite, meaning the new rotors can last several times as long as their graphite counterparts - one test revealed a usable life of more than 800 cycles in a heavy fluxing application, compared with an average of 300 for comparable graphite products - and are made from an isostatically pressed, single-piece design. The rotor head has been optimised to reduce bubble size and deliver optimum gas dispersal through an innovative six-vane design. In testing, the new rotors have shown significantly lower oxidation levels compared with graphite products, whose degassing performance deteriorated as head geometry became distorted, while melt densities using the silicon carbide rotors were notably higher over time than with graphite products.

Degassing technology is also widely adopted in the primary aluminium sector, with the use of compact in-line degassing rotors to process molten aluminium via rotating nozzles directly in the casting trough between the furnace and the casting pit. These products are contributing to improvements in overall metal quality, productivity, and safety, as well as reducing operation and maintenance costs by up to 60%. In particular, the need for high cost heating elements and thermocouples is removed, while there is no need to remelt aluminium or to maintain molten aluminium between casts in the degassing chamber.

Coating Technology

Another potential source of contamination in aluminium casting is the crucible in which the aluminium is melted. The high operating temperatures can cause fragments from crucibles, especially older products which have already seen lengthy service, to break off or melt into the molten aluminium, impacting significantly on purity and therefore on casting quality down the line – which may not be discovered until it is too late. The composition of the crucible itself can also be a cause of pollution. Where crucibles are 'run to failure' or changed at timed intervals rather than on the basis of actual wear, these effects can be significant and highly deleterious.

To combat these issues, a variety of specialist coatings have been developed for all types of crucibles with different performance attributes depending on usage temperatures and desired performance. Coatings made from Al2O3, for example, play a key role in reducing dross adhesion and limiting metal contamination at temperatures of up to 1,600°C (2912°F). Other Al2O3 formulations deliver the same performance in very high purity applications. Where alloys using many fluxes are being processed, special glaze formulations can be applied to reduce flux attack on the crucible material.

These coating types are all well-established but are now being joined by a new technology which pushes performance boundaries even further. Boron nitride coatings can contribute towards superior dross adhesion reduction and limit contamination in very high purity applications (e.g. 5N and 6N Al) and can withstand temperatures of up to 1,000°C (1832°F).

The global aluminium market is set to remain buoyant for the next few years at least due to its versatility, the variety of new applications, especially high-purity ones, and the high costs of many alternatives. Most regional markets are committed to growth and are seeking to work with consumable partners able to deliver solutions which can help them marry productivity and quality with reduced energy usage and emissions. The harnessing of innovative materials technology and design will continue to create new opportunities for those suppliers able also to deliver agile and responsive service.

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