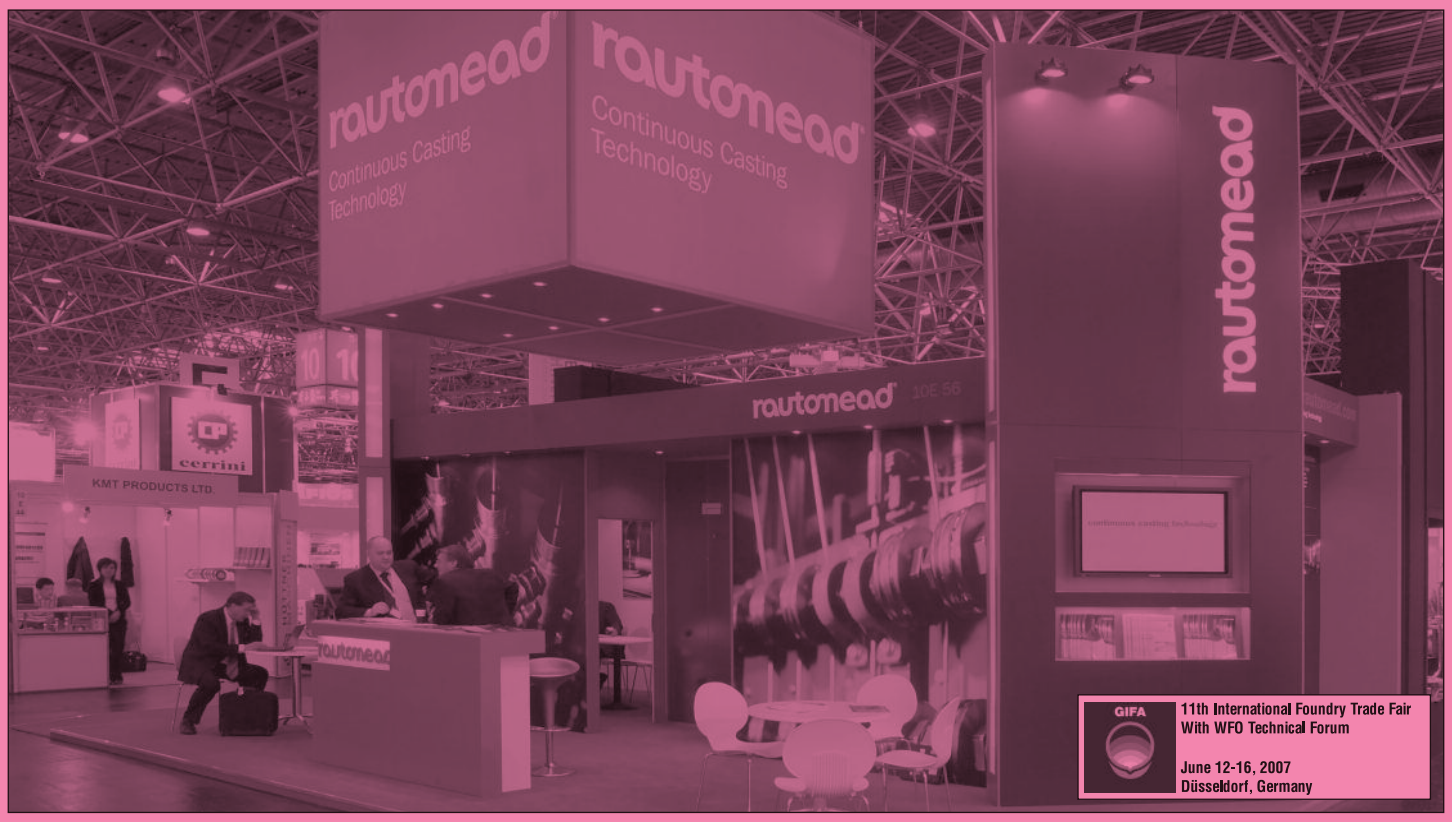
continuouscasting.com



contents

Rautomead Quick Die Change technology captures the imagination of GIFA

The 11th GIFA International Foundry Trade Fair in Dusseldorf, during June 2007, proved a resounding success for Rautomead.

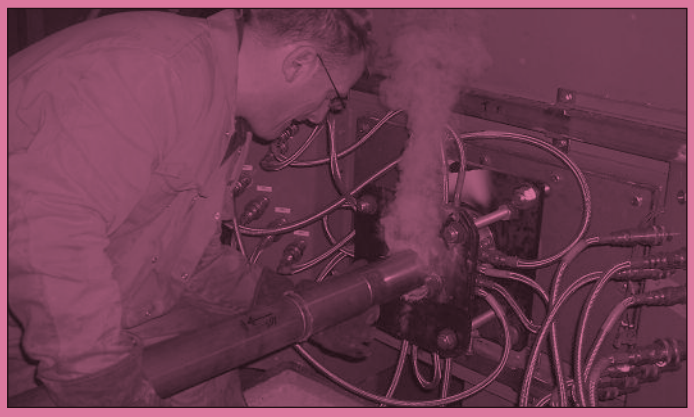
On Stand 10 F 30, delegates were able to learn more about the processing of brass and bronze billets, bars and hollow sections using Rautomead continuous casting technology. At the same time, Rautomead used the occasion to present its new QDC (Quick Die Change) technology that has been purpose-designed to enable the changing of casting dies on a hot metal crucible within an hour, rather than having to wait for cooling to occur.

Heralded for its ability to reduce downtime and significantly increase available production time of horizontal continuous casting equipment, QDC caught the attention of numerous delegates. Commented Rautomead Chairman, Sir Michael Nairn, "GIFA provided an exceptionally worthwhile opportunity to present our technologies to the foundry industry and we were especially delighted with the interest that was shown in our Quick Die Change system.

For more details about Quick Die Change, see page 2

Rautomead QDC technology

reduces casting die change to one hour – and improves operating efficiency by at least 20%



The innovative Quick Die Change (QDC) patented technology presented by Rautomead at GIFA 2007 is rapidly gaining favour amongst the companys global customer base.

Enabling casting dies to be changed without first cooling the furnace, Rautomead's Quick Die Change solution reduces die change time from around thirty hours to, typically, one hour, with an improvement in operating efficiency by more than 20%.

Stability, strength and metallurgical cleanliness

Rautomead machines operate at temperatures from around 1,000 deg C to 1350 deg C, according to the alloys in production. Hallmarks of Rautomead furnace designs have been the use of a graphite containment system for the molten metal, electric resistance heating and inert gas protection of the internal hot working components of the machines. Advantages of using graphite crucibles include the stability, strength and metallurgical cleanliness of the material at these elevated temperatures. Customers also have experience of eight and ten years' typical service life from a single crucible in these machines.

Nevertheless, graphite erodes quickly in air at such high temperatures and, for that reason, until the development of Rautomead's Quick Die Change, it has, until now, been necessary to cool the machine down to change the casting dies to avoid internal damage to the furnace.

Non-graphitic protective sleeve

With QDC technology, a non-graphitic protective sleeve is used between the casting die assembly and the other internal hot working components of the machine, enabling the casting die to be changed immediately once the molten metal has been suitably drained or cast out.

Over 40% increase in efficiency

In casting campaigns involving more aggressive alloys, where die life may only be five days, the increase in efficiency using QDC rises to over 40%. An added technical advantage of the new QDC technology is the avoidance of regular thermal cycling of the casting machine, thus greatly reducing the inherent stresses borne by the equipment in such a pattern of operation. In terms of operating cost, not only is there substantial extra productive time available, but energy, labour and inert gas costs in re-heating the machine between die changes are all eliminated.

Retrofit opportunity

Available with new Rautomead equipment, QDC may be retrofitted to most older Rautomead horizontal continuous casting machines. International patent coverage is pending. Commented Rautomead Sales Manager, Guy Henderson, "Rautomead, aims to work closely with customers to further develop and enhance the benefits provided by their investment in Rautomead technology. Die change - necessitated either by varying production requirements or day-to-day usage - is an inevitable part of the casting process. Through the development of this latest Rautomead solution, we look forward to providing rapid die change – something that should prove especially useful to those customers involved in the manufacture numerous product types."

Typical example of efficiencies to be gained by using Rautomead QD technology:

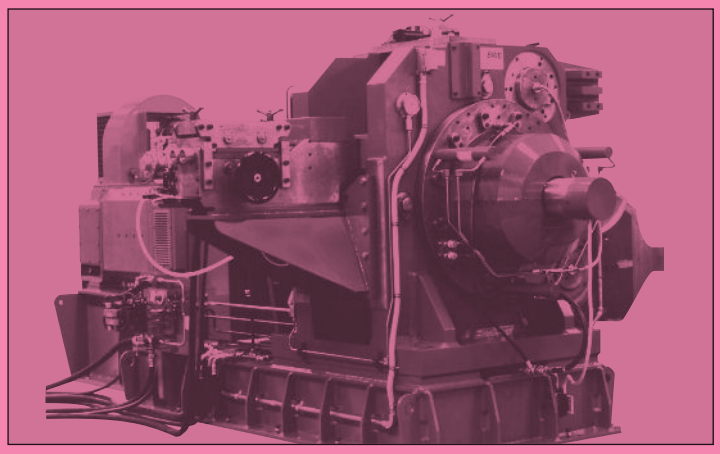
Criteria

Working days per year	322	Days
Working hours per day	24	Hours
Casting campaign	10	Days
Time to cool down & change dies – old	30	Hours
Time to change dies – QDC	1	Hour

Comparison

	Old System	QDC
Production campaigns/year	322/12.25 = 26.29	322/10.04 = 32.07
Productive days/year	26.29 x 10 = 262.9	32.07 x 10 = 320.7
Increase in efficiency		320.7/262.9 = + 22%

GOING WITH THE FLOW IN THE MANUFACTURE OF NON-FERROUS COMPONENTS



Many of the advances in the manufacture of non-ferrous metal components over recent years have been through the replacement of discontinuous and batch production by continuous manufacturing processes.

High conductivity copper profiles for transformer strip, commutator sections and busbars are produced conventionally by discontinuous billet extrusion, where a final draw pass is used to give the required temper in the finished product.

Complex process and high equipment cost

Preparation of the billets themselves has advanced over the years from discontinuous stick moulding, through semi-continuous casting to continuous casting, each necessarily followed by billet heating, prior to extrusion. This sequence comprises a minimum of five individual process steps and a very high equipment cost. Billet extrusion is a notably inefficient process with yields not often exceeding 80%. For very high production volumes (15,000 tonnes per year and over) a modern version of this process sequence may still be competitive, but there is now an alternative route.

The Rautomead & BWE alternative

A radically different combination of technologies, involving continuous casting of copper rod and continuous extrusion (Conform™, a registered trademark of BWE) of profiles, is now available to produce these products and is finding increasing favour in the non-ferrous industry. Rautomead Limited and BWE, both of the UK, are leading specialists in the technology of continuous casting and Conform™ continuous extrusion respectively.

RS upwards process

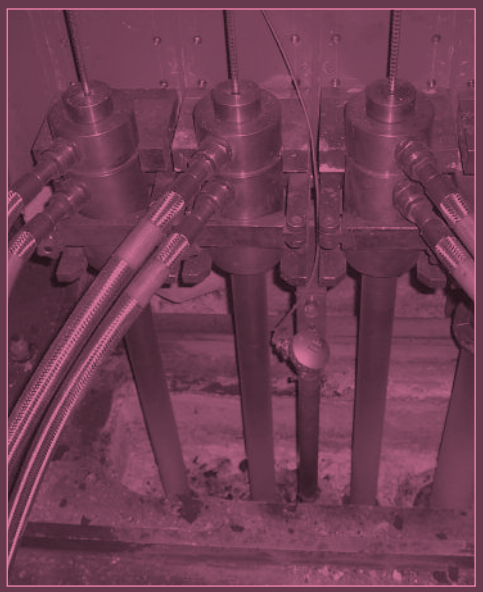
Using grade A copper cathode as the feedstock, the copper is melted and continuously cast in a Rautomead RS upwards-vertical copper casting machine to produce rods of 8mm to 20mm diameter, according to dimensions of the finished product required. The rods are formed into coils of typically 4 tonnes. The copper rod is oxygen-free with a nominal oxygen content of less than 3ppm, and is cast with a clean unoxidised surface.

Conform™ extrusion

The cast rod is subsequently decoiled and fed directly to the Conform™ machine, which continuously extrudes the selected profile of fully soft, fine grain copper section. As in the traditional extrusion route, a final draw pass may be necessary to give the required temper in the finished product.

An elegant combination

Using this elegant, modern combination of technologies, the number of process steps is reduced from five to three and a process yield of over 90% can be expected. Combined lines are available with capacities from 4,000 to 10,000 tonnes per year.



New Brass EDM Wire rod plants in Far East.

Rautomead has recently completed the commissioning of new brass EDM wire rod casting plants in Japan and Taiwan. Both machines are designed for casting 60:40 brass wire rod at 8.0mm diameter.

The Rautomead machines (RS 1000 and RS2500) are fed with pre alloyed liquid metal from separate melting furnaces. The melting equipment is fed with copper cathode and high quality zinc ingot pieces. Output from the casting lines is 400 and 800kg/hr respectively. The cast rod is formed into coils of between 2.0 – 4.0 tonnes and subsequently processed to finished EDM wire by a combination of drawing and annealing.

RAUTOMEAD TECHNO CASTING OF C

Horizontal Casting Machines

The origin of the Rautomead continuous casting process was through the development in 1978 of a horizontal resistance-heated graphite crucible furnace with submerged casting die for production of leaded brass and gunmetal alloys. The horizontal process has since been developed to cast a wide range of copper-based alloys.

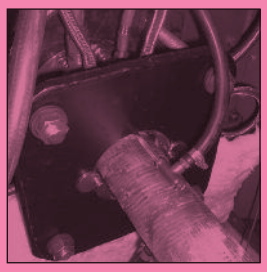
The machines were designed initially as integrated melting, holding and casting machines, to be continuously fed either with solid metal in the form of scrap returns, machining swarf or pre-alloyed ingot. More recently, customers with more varied sources of feedstock materials, prefer to melt and to form the alloy in a separate melting furnace and to batch-feed the Rautomead casting machine with pre-alloyed liquid metal. When operated as integrated melting-holding-casting machines, output is generally constrained by the melting capacity of the furnace. When fed with molten metal, output is generally higher and is constrained by the maximum casting speed possible for a given product section.

Graphite crucible

A common feature of these horizontal machines is the use of a graphite crucible, lined at the top to protect it from erosion and abrasion and using low voltage electric resistance heating. Each machine is supplied with its own mains transformer. Secondary voltage is a very safe nominal 30V. The crucible is surrounded by a chain of graphite resistance heating elements protected in a nitrogen gas atmosphere.The casting dies and primary coolers are thrust against a casting orifice towards the base of the crucible, so that the whole system is naturally reducing. Life of the graphite crucible depends on the material processed and the manner in which it is looked after, but lives of up to ten years are not uncommon.

Current Range of Horizontal Machines

Currently, four models of horizontal machine are available, RT 650, RT 850, RX 1100 and RX 1400, as above. The RT 650 and RT 850 models can be configured with one or two die ports, while the wider



RX 1100 and RX 1400 models can be equipped with one, two, three or four die ports. See chart below.

Depending on the application, withdrawal of each strand can be separately controlled, so that differing sizes of product can be made simultaneously at the casting speed most suitable.

Furnace temperature is measured by thermocouple and the power necessary to maintain temperature is closely controlled via thyristor stack. All essential services, including temperature, cooling water and insert gas are monitored and alarmed. Rod withdrawal is by pinch roll withdrawal mechanisms, using AC servo geared motors. These provide very accurate, repeatable withdrawal cycles, including pushback where required. Both solid and hollow bars can be produced.

Long production run capability

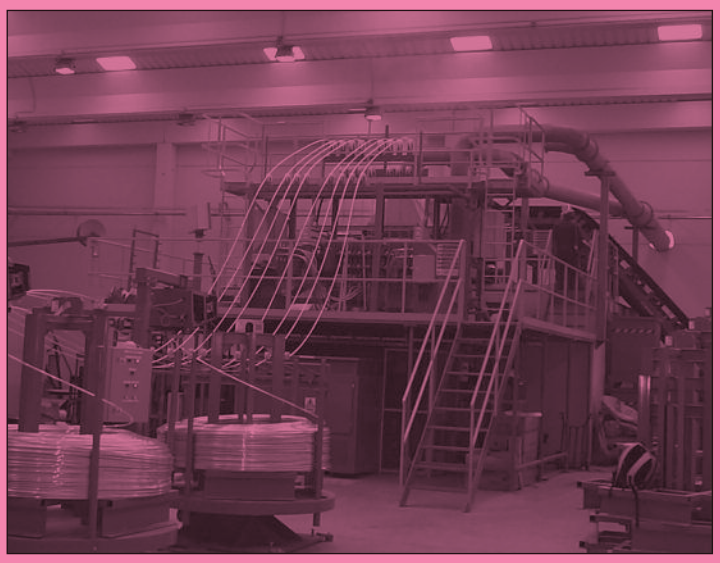
Once a machine is set up with its casting dies in place, it lends itse to relatively long production runs. Customers often run for 5 x 24 hours, followed by a die change over a weekend. Where the dies do not require to be changed, the machine can be left in standby mode, full of molten metal and production restarted when required.

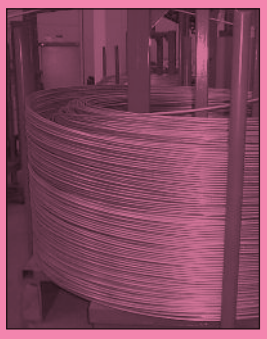
Model	power	max output kg/hour (brass)		max cast diam. Mm			
	kVA	integrated	molten feed	single strand	twin strands	four strands	eight strands
RT 650	150	175	650	175	125	12	n/a
RT 850	175	250	850	175	125	12	n/a
RX 1100	240	430	1000	250	200	32	28
RX 1400	240	430	1200	250	200	32	28

LOGY IN CONTINUOUS OPPER ALLOYS

Rautomead Upwards Vertical Casting Machines

Rautomead's upwards vertical casting machines were introduced in 1994 for the initial purpose of manufacturing 8mm diam. High conductivity oxygen-free copper wire rod. Shortly thereafter, tests were made in production of small diameter (8mm to 30mm) rods in a variety of brasses, bronzes and nickel-silvers, where it was found that casting speed and physical properties of these copper alloys when cast upwards were better than the equivalent products made by horizontal casting.





An added advantage was that with the molten metal bath below the casting dies and withdrawal gear, it was possible to replace the casting dies quickly and efficiently, without the need to cool down and reheat. The process is now well-established for casting brass, bronze and nickel-silver wire rod, formed into coils for subsequent rolling/annealing/drawing to final sizes.

In production of bronzes and brasses, conventionally, customers cast at around 20mm, though more recently, Rautomead has supplied three machines for production of binary brass rods at 8mm diam, thus reducing the downstream working stages required.

Upwards casting machines in these applications are usually fed with molten metal from a separate melting furnace, enabling the alloy composition to be checked and adjusted before the charge is fed to the casting machine. An ingot feed can also be used.

Common attributes

Technically, the upwards machines share many common features with Rautomead's horizontal casting machines, including graphite crucibles, electric resistance heating and nitrogen gas protection for the hot working components. Casting die assemblies with their coolers are held in a frame above the crucible. A float mechanism is used to maintain a constant immersion depth of the casting dies in the molten metal, as this rises and falls. Rod withdrawal is by geared servo motor with accurate control and repeatability of withdrawal sequences. Rods are coiled into 2 to 4 tonne coils.

A characteristic of the Rautomead upwards process is that there remains a significant bath of molten metal in the crucible at the end of a production run. Where the change in composition is relatively small, the remaining charge can be simply diluted to the next alloy composition. For more radical changes, the furnace has a taphole, through which the contents can be emptied into a ladle to be used in a subsequent run. Where a particularly pure alloy is required, a wash run of copper is used to purge any likely contaminants from previous production.

Upwards vertical models are designed to produce straight lengths. They produce particularly concentric hollow bars, with an ID/OD tolerance of less than 2%. Rod length is normally 3-4 meters. See chart below:

Current Range of Vertical Alloy Machines

model	power	output	product sizes		feed	form
			min diam.	Max diam.		
	kVA	kg/hour	mm	mm		
RS 1000	150	400	8	30	molten	coils
RS 2500	400	800	8	30	molten	coils
RSL 750	105	200	8	30	ingot	straight lengths
RSL 1100	150	300	8	35	molten	straight lengths

Rautomead redraws the rules of copper rod production with new 10,000 – 30,000 tonnes annual capacity

Leading continuous casting technology specialists, Rautomead Limited, of Dundee, Scotland, have introduced a new range of copper rod casting machines that represent a significant leap forward in copper rod production.

Combining the advantages of Rautomead continuous casting and rod coiling technology with large induction melting furnace technology, the new RDG machines, have rated outputs from 10,000 to 30,000 tonnes-per-annum combined with impressively low operating costs.

Up to 30,000 tonnes p.a.,

Available in 10,000 – 12,000 tonnes-per-annum and 15,000 – 20,000 tonnes- per-annum-and 24,000 – 30,000 tonnes-per-annum capacities –- RDG Series machines feature automatic cathode feed, channel-type induction furnaces, multiple-strand casting stations, super-cooling design and withdrawal technology, and rod coilers with capacity up to five-tonnes.

The RDG-360 machine for 30,000 tonnes per year features a primary melting furnace transferring liquid copper through an enclosed channel into a holding and casting furnace, complete with Rautomead continuous casting withdrawal, tooling, controls and rod coiling units. The design of the RDG machines is the result of close technical collaboration between Rautomead - with its specialist knowledge of continuous casting systems - and INDUGA GmbH & Co. KG of Germany, well-known specialists in induction melting. Both companies have over twenty years' experience in their respective fields.

Alumina linings are used in the induction furnace, and graphite technology is used in the holding and casting chamber for conditioning the molten copper prior to casting. A state-of-the-art Siemens plc control and monitoring suite provide the operator with a full picture of process status and sequences at all times, with automatic data-logging and complete traceability.

Complete continuous casting flexibility

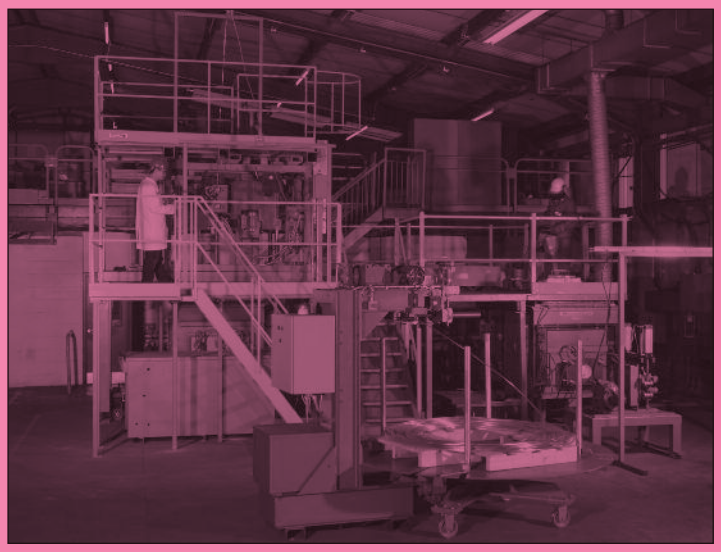
With the new RDG machines providing users with the ability to cast up to 30,000 tonnes per year of the highest quality oxygen-free copper redraw rod (8.0mm – 12.7mm dia.) using a cathode feedstock and Rautomead's well-established RS electric resistance graphite technology, Rautomead is now able to offer a range of elegant casting solutions for all manufacturing quantities from 3,000 – 30,000 tonnes per year.

Reliable production

Throughout many years of use, Rautomead RS Series machines have proved reliable in production and are associated with the highest quality oxygen-free copper rod for magnet wire and superfine wire production. As an additional benefit, these machines offer the advantage of a modular design, enabling an initial installation to be easily expanded as the scale of an operation increases or production requirements change.

Commented Rautomead Chairman, Sir Michael Nairn, "With the introduction of the new RDG Series machines, Rautomead customers now enjoy even greater flexibility of choice. Large-scale CuOF rod producers have gained the opportunity to purchase a single Rautomead model capable of meeting their entire annual manufacturing requirement. Alternatively, for smaller manufacturing quantities, or for the production of a range of different copper alloys, customers may decide to invest in a single or multiple 5,000-6,000 tonne p.a. resistance-heated RS Series machine."

ADVANCING THE TECHNOLOGY



Committed to the advancement of casting technology, Rautomead maintains its own specialised continuous casting development shop where projects are usually customer-led and may be undertaken on a bilateral or consortium basis.

Will your process make this?

The question most frequently asked by a customer is, "Will your process make this?" If a search of past trials carried out does not throw up a parallel project, and if the challenge appears feasible, Rautomead will offer to make a trial, in any of upwards, horizontal or downwards casting processes, using the company's own facilities in Dundee. Customers are invited to participate in the work and to contribute any relevant knowledge they may have of the material in question and its behaviour.

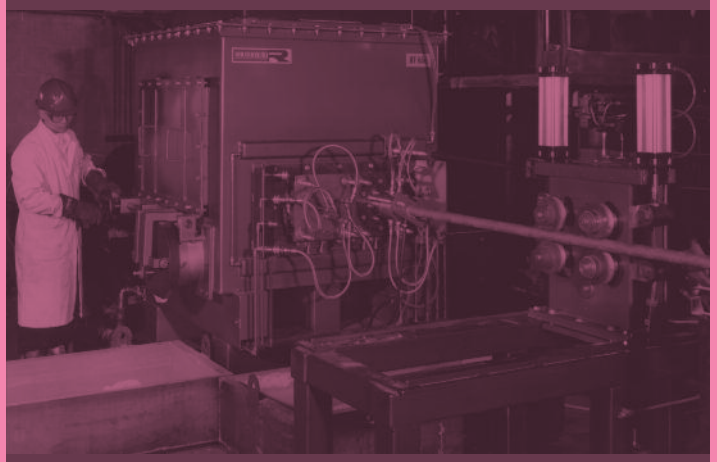
Greatly improved control

Often, a new ceramic, graphite or refractory material not available in the past, will enable a product to be continuous cast. Greatly improved control and process monitoring systems enable this sort of development work to be carried out much more scientifically than in the past. Not only does the technology genuinely advance in these ways, but it also contributes significantly to reducing the technical risk in adopting new technology, where the user can test the continuous cast product in his own downstream processes and at his customer, before making any commitment to invest in new plant and equipment.

Recent development projects undertaken by Rautomead include:

- Lead-free forging and machining brasses for the plumbing industry
- High tensile brasses
- Copper-chrome for resistance welding nozzles
- 8mm diameter EDM brass wire rod
- Special corrosion-resistant bronze wire rod for submarine applications

'Industrial evolution' creates geographical customer spread in bronze & brass alloy production



Although Rautomead's customer base for continuous casting technologies for bronze and brass alloy sections has been traditionally UK-oriented, over recent years, customer installations for brass and bronze bar production have been focused around Taiwan, India, Malaysia, Thailand, Latin America, Middle East and China.

The most recent installations have been in China and the Middle East - a changing pattern reflecting the general trend of primary manufacturing away from Europe to the new emerging economies. Recent customer installations, which illustrate the emergence of new manufacturing centres globally, include:

Tomghsia Industry Co, Taiwan: Rautomead RX 1400 machine used for production of solid and hollow bronze bars.

S.V. Metals, Thailand: Rautomead RT 650 machine purchased for recycling brass scraps and swarf - converting them to bars for subsequent manufacture of LPG valves.

SMI, Saudi Arabia: Multiple Rautomead RT 850 machines employed to manufacture bronze hollows for use as bearings in SMI water pumps and replacing imported bronze hollows.

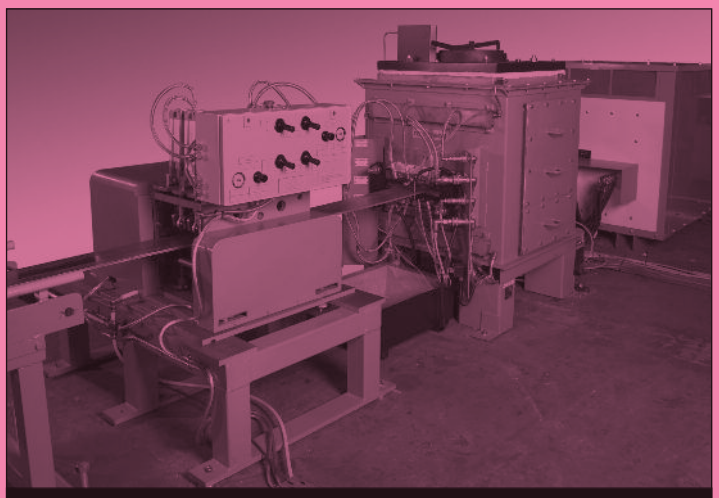
Samco, Iran: Rautomead RT 650 machine for brass and bronze tubes and Rautomead RMK 030 for brazing alloy production.

Opportunities exist for EU-based manufacturers

Comments Rautomead Chairman, Sir Michael Nairn, "Across the UK and Europe, opportunities still exist for metal manufacturers to compete. Such companies, however, must have the technology and capability to produce high quality products to tight composition tolerances and to be able to respond quickly to customer demands. At Rautomead we are more than happy to advise on how such products can be achieved."

RAUTOMEAD TECHNOLOGY ADDS SIGNIFICANT VALUE TO PRECIOUS METAL PRODUCTION.

Since the launch of its very first precious metals continuous casting machines in the early 1980s, Rautomead Limited has become world-renowned for highly versatile casting technologies. Only recently, the company supplied several silver strip casting machines to leading precious metals producers in the United States and China – and it is receiving considerable interest from numerous international companies.



The Rautomead RMT 200 horizontal continuous casting machine

Highest quality continuous cast

Embracing the very hallmarks of Rautomead's advanced casting expertise, using a naturally oxygen-reducing graphite crucible and safe, low voltage resistance heating, all models in the Rautomead precious metals machinery range are designed for the production of the very highest quality continuous cast, semi-finished gold and silver-based alloy products.

Solution for all applications

With ten integrated casting and melting units available – in both vertical and horizontal casting formats – Rautomead offers technology for a range of applications and production capacities. Power outputs range from 15KVA to 105KVA, melt rates range from 30kg to 390kg per hour; whilst the ability to produce semi-finished rod products from 2mm – 10mm dia. and metal strip from 5mm – 400mm wide ensures all applications can be easily fulfilled. For those many smaller volume producers, Rautomead also offers machines with crucible capacities of as little as 0.5 litres, with volumes increasing to 80 litres for those with larger requirements.

The Rautomead graphite crucible

Technology is key when considering the alternative types of precious metals continuous casting solutions available and the naturally oxygen-reducing graphite crucible offered by Rautomead provides significant, measurable advantages over the purchase of induction-heated, ceramic-lined furnaces.

Resistance heating technology

In the Rautomead system, melting is achieved via the company's world-renowned resistance heating technology, a method that operates at inherently safe low voltages and is exceptionally simple to operate and maintain. The graphite crucible and heating elements are protected from oxidation in an inert gas atmosphere. Furnace temperature is automatically controlled within a tolerance of +/- 2° C, using a thermocouple located at the crucible and a hinged lid is provided to close the crucible when it is not being charged. The result is a reliable, high quality and sound cast semi-finished product, de-gassed and without porosity or inclusions for the highest yield down-stream processing.

Continuous or 'discrete' operation

Fully PLC controlled, with quality control downloads available to the user's computer system, an additional benefit of Rautomead precious metals technology is the flexibility of either continuous or 'discreet' operation, where the machine is operated on a batch basis, with full production resuming in just 30 minutes as required.

The full range of Rautomead precious metals continuous casting technologies – complete with comprehensive specifications and literature downloads - can be viewed at www.rautomead.com

rautomead®

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