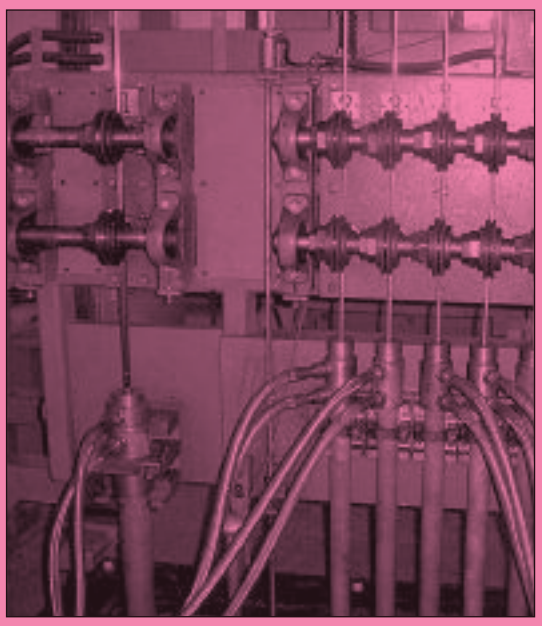
continuouscasting.com

5.0m/minute 8.0mm dia. CuOF Wire Rod Production

Rautomead has successfully completed the installation and commissioning of an automated RS 3000 upward vertical casting machine for the production of the highest quality oxygen-free copper wire rod by NGO Han Co. Ltd. of Vietnam.



NGO Han Co. Ltd, Vietnam

The first Rautomead model to be delivered to and installed in Vietnam – and with an annual output of some 6,000 tonnes – the RS 3000 model has been designed to produce the highest quality oxygen-free copper wire rod in a range of sizes from 8.0mm to 22mm diameter.

As leading manufacturers of enamelled wires and transformer strip sections, copper rod surface quality and the absence of surface oxides on the cast rod are critical considerations for NGO Han Co. Ltd. The Rautomead single furnace, integrated melting and casting machine is fed automatically with Grade A copper and produces 8.0mm Cu-OF wire rod at a rate of 5.0m/ min. Each strand is produced through a single "supercooler" controlled from a central PLC which allows operators to select from pre-programmed casting speeds or to adjust and control the production speed according to their preference.

Mr Nguyen van Sung, Managing Director of NGO Han Co. Ltd "Rod quality improves as casting speed increases."

INDUSTRY AWARD
– see page 7

CONTENTS

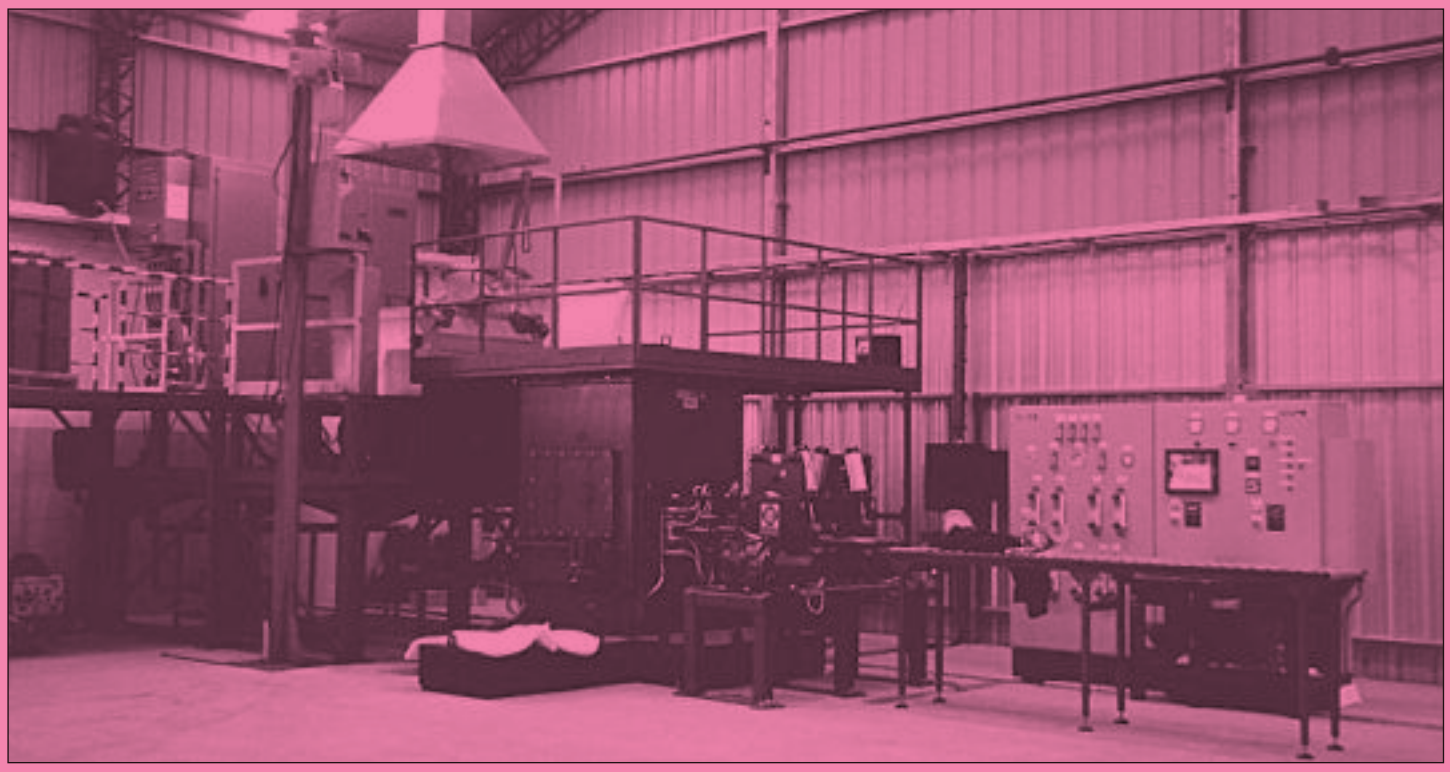
Drawing on Expertise

The economical manufacture of semi-finished brass rod for forging & machining applications

Take – brass forging and machining scrap and swarf at market value

Add – direct operating costs and overheads

Save – significantly in materials cost



Induction pre-melting and RT850 installation

By adding only direct operating costs and overheads to the market value of brass scrap, Rautomead has shown that significant savings can be made in feedstock materials, cost of brass forged and machined brass components.

In the Rautomead process, involving an induction-heated 350kW melting furnace and an RT 850 continuous casting machine, the plant is designed for the production of bars up to 4m long; 15mm - 45mm diameter and hexagonal sections of 15mm - 40mm across flats. Both plant and process are intended for the production of rods and sections for forging and machining at a net output rate of up to 150 tonnes per month, using scrap, machining swarf or virgin metals as feedstock.

Feedstock Preparation, Storage and Feeding to Melting Furnace

Scrap from manufacturing processes such as reject components, centrifuge-dried machine swarf and bar ends of known composition is ideally suited to this process. The scrap should be reasonably clean, dry and free from oil. Trade scrap from unknown sources should be treated with caution.

Machining swarf can be transported by conveyor and fed directly into the furnace using a vibratory table. Sold scrap can be added manually to the vibratory table as the swarf is charged. Regardless of the feeding method, a stock of virgin zinc and lead along with weighing scales must be located on the melting furnace platform. A manually operated "puddling" pole, may also be required to ensure the charge is pushed through the surface of the melt.

Induction Melting

Induction melting is achieved via a 350 kW, 1000Kg capacity, medium frequency coreless steel shell melting furnace with hydraulically operated trunion-tilted fume hood and hydraulic integral lid. The furnace includes hydraulic power pack, load cell weighing system with digital readout, computerised melt manager and a recirculating closed circuit water cooling system.

Metal Transfer

The closed and heated metal transfer launder moves the liquid metal from the melting furnace to the RT850 continuous casting machine crucible. The launder consists of a steel shell fabrication lined with a suitable refractory. The launder is heated, typically using gas fired burners.

Continuous Casting

A 105 kVA graphite crucible resistance heated furnace, operating at an inherently safe, low voltage, is used to cast two strands of brass bar in sizes ranging from 15mm to 45mm diameter. The technology is based around a graphite crucible to contain the brass, graphite resistance heating elements and submerged graphite dies, cooled with copper coolers. Crucible capacity is approx. 750 kg.

Cutting re-draw to length – and rod pointing

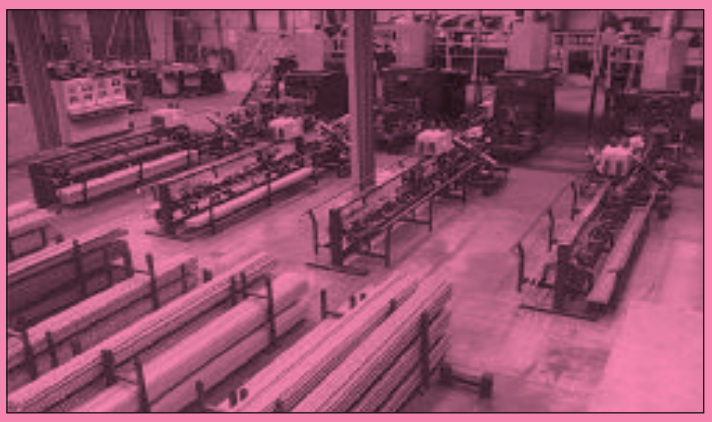
For a size range of 15mm to 45 mm, a hand held electric powered bandsaw is suitable for cutting the strands during the casting process. Cut length is typically 3.0m to 4.0m. The cut bars require one end to be turned down for entry into the shave bench dies. This is achieved using either a multi-tool turning machine or a push type pointer.

Hydraulic Shaving

A 30-tonne hydraulic shave bench, capable of shaving up to 1mm depth over a maximum length of 4m is used. The approximate overall length, including a 3.5m loading table designed to hold a 1 tonne rod bundle, is 15 metres. The die assembly comprises a guide die and two shave dies housed in an acoustic hood to minimise noise. After shaving and ejection, the jaws return to the start point to accept the next rod.

Bar Straightening, Storage and Racking

Where absolute straightness is required in the brass bars, for feeding to automatic machines, for example, the bars can be straightened using a standard two roll straightening machine. If several bar sizes are manufactured, storage racking is required.



RT650

Quality Control and Testing

Throughout the melting and casting process, samples of the molten metal are regularly analysed for chemical composition. This is done using an analytical emission spectrometer, with the laboratory positioned close to the melting and casting shop. Additional quality control checks of the finished bar include a tensile test, elongation and microstructure of the rod.

Fume Extraction

As a minimum, a centrifugal fan and ducting system is required to provide airflow of 24,225 Nm3 /hr for fume extraction from the melting furnace and casting machine. A wet de-duster or filter bag filter - with emission monitoring system - is also recommended.

Secondary Cooling Water System

A secondary cooling water supply to the melting furnace and casting machine primary water systems is also required. This normally comprises a dual pump (one operational, one standby) system. In hot climates refrigerant cooling may be required.

Overall Capital Cost

As the overall capital cost of such a system (excluding buildings) is influenced by local factors including quality of feedstock materials, the extent of automation used and existing equipment available, a budget figure of £500,000 to £750,000 (Euro 800,000 to Euro 1,200,000) is reasonable. The cost for a smaller project would be commensurately less.

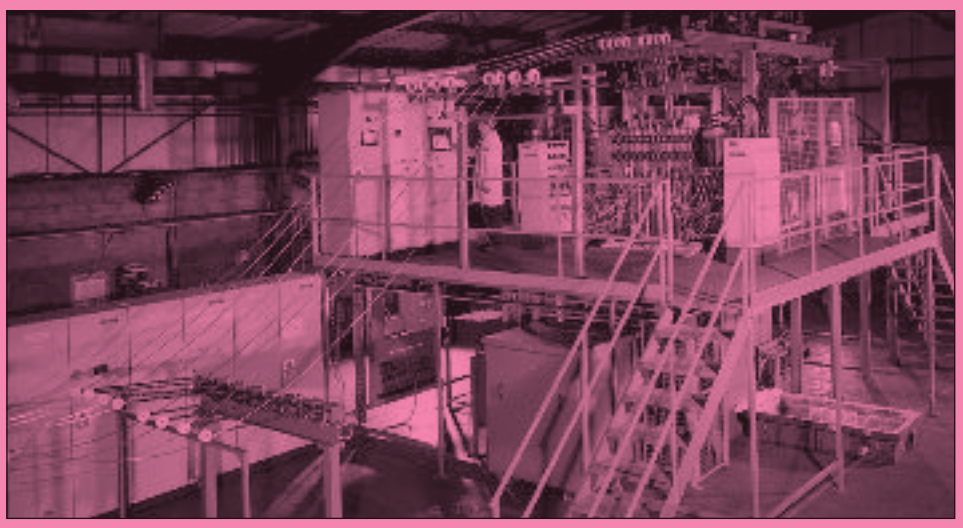
A costing spreadsheet is available on disk from Rautomead International Limited, enabling users to insert their own known local factor costs and operating schedules to work out a cost of production per tonne.

E-mail: sales@rautomead.com

RS Process Minimises Wire Breaks

As the demand for ever-finer wires increases with the miniaturisation of electronic components, far more attention is now being paid to the causes of wire breaks in drawing.

The use of multiwire drawing machines, that can process up to 32 strands simultaneously, greatly increases the efficiency of the fine wire drawing process, but only so long as wire breaks can be routinely avoided. When a wire break does occur, the whole machine must be stopped and re-threaded, wasting valuable time.



RS 3000 continuous copper rod casting machine

Identifying the causes

Wire breaks are commonly attributed to two main sources: the quality of the copper rod and the wire drawing process itself. Identification of the precise source is not always a simple matter. Generally it is more beneficial to study the process sequence as a whole, since in reality, a wire break can actually be the result of a combination of both sources.

Detailed studies into wire breaks occurring in Cu-ETP in drawing to 0.05mm have been carried out recently in the USA, involving the examination and categorisation of over 2,500 wire break samples. This work established that over 90% of all wire breaks were particle failures and that within this total, over 50% were ferrous inclusions and over 30% refractory inclusions. The dominant wire failure gauge occurs at around 0.1mm (38 AWG) and a defect particle size of 0.05mm seemed to be the statistical mean that caused this.

Using scanning electron microscopy, the principal elements causing wire breaks in descending order were found to be:

Iron

As iron occurs in many continuous casting plants, as well as in wire drawing machines, source identification can pose a problem. However, contact with ferrous materials in the Rautomead RS system is limited to the profiled withdrawal rolls and coiler rolls, both of which are made in specially hardened steel and very unlikely to contaminate the surface of the copper rod. No hot or cold rolling occurs and the rod is coiled on wooden pallets.

H-13 Tool Steel

This can generally be traced back to rod mill rolls and guides in the Cu-ETP plant and is likely to have been introduced in the hot rolling process stage. No rolling takes place in the Rautomead RS process for production of 8mm-redraw rod, thereby eliminating this source of wire breaks.

Silicon and Aluminium

These are typical refractory materials used in fabrication of conventional induction furnace linings and hot metal launders. A unique advantage of Rautomead RS graphite furnace technology is that graphite takes the place of fritted alumina ceramic furnace linings substantially reducing this as a possible cause of wire breaks.

Off-Centre Hollows

This is a condition in Cu-ETP production, where a small particle of refractory is introduced into the molten metal flow, floating just below the surface as the metal solidifies. A skin of copper is created over the defect, which then ruptures in drawing. Graphite furnace technology obviates this risk.

Silicon and Slag

These can collect at the surface of the melt in a Cu-ETP plant and wash into the cast. The principal components are copper oxides, with the inclusion of silicon, aluminium and iron. Again, in the Rautomead RS process, the transfer from the melting chamber through to the casting chamber of the crucible is through the base, so that this risk does not arise.

Principal elements causing wire breaks

Iron	25.6%	H-13 Tool Steel	11.0%
Silicon, Aluminium	9.5%	Off-Centre Hollow	8.3%
Silicon	7.6%	Slag	7.1%

The Production of Trolley Wire for High Speed Trains

The demand to introduce faster, high speed, intercity train services to reduce travelling time and compete with the airline services has provided a number of engineering and technical issues to overcome. One of these has been the need to identify a suitable material for the design of the overhead trolley wire cable. In the past, these cables were made with copper, copper tin or copper cadmium alloys, but as train speeds increased and the environmental cost of processing cadmium containing alloys grew, it became necessary to identify an alternative high tensile strength, high conductivity alloy.

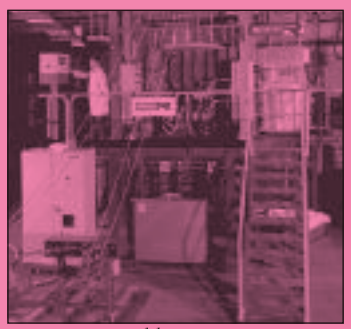
Whilst the Japanese experimented with copper clad steel and copper chrome zirconium alloys, in Europe the solution focused on copper magnesium alloys. The copper magnesium alloy is non-toxic, has high tensile strength and good creep resistance.

Materials used for Trolley Wire – European Specification

Material		Resistivity 10^{-08} Ohm.m	Elongation(min)* %	Tensile Strength(min)* N/mm²
High Conductivity Copper	Cu-ETP	1.777	3	355
Silver Copper Alloy	CuAg 0.1	1.777	3	360
Cadmium Copper Alloy	CuCd 0.7	2.005	2	430
	CuCd 1.0	2.155	2	445
Magnesium Copper Alloy	CuMg 0.1	2.778	3	510
	CuMg 0.5	2.778	5	490
Tin Copper Alloy	cuSn 0.4	2.155	3	450

Unique Demands on Manufacturing Processes

Magnesium is a highly reactive element and is particularly vulnerable to loss when in its liquid state. This places unique demands on the manufacturing equipment design selected to melt alloy and cast the copper magnesium alloy. To achieve quality results during melting and casting, the composition of the Cu Mg alloy must be maintained within tight tolerances.



Model RS 2300

The liquid copper should be maintained in a reducing environment to minimise reaction between the magnesium alloying element and any residual oxygen in the copper. There should be minimum agitation and stirring of the liquid copper and the metal should have a protective layer of high quality graphite flake on the surface of the melt.

At the same time, the design of the casting die/cooler assembly and the control of the linear casting parameters must facilitate the control of the solidification process in order to achieve the desired grain structure required for subsequent downstream rolling/drawing operations.

Specialist providers of continuous casting technology for non-ferrous alloys, Rautomead International Ltd. of Dundee, Scotland, offer a range of equipment with the following core design features that are particularly suited to providing the desired production parameters for the copper magnesium alloy:

Naturally "Oxygen-Free" Environment

A graphite melting and casting crucible provides the reducing containment environment for the liquid copper. The unique graphite process eliminates the oxidation problem by providing a naturally reducing "Oxygen-Free" environment in which oxygen present in the copper reacts with the graphite containment system.

Low-Voltage Resistance

Electric resistance heating provides accurate furnace temperature control without any induced movement or agitation of the melt. It offers sophisticated levels of power and temperature control, allowing the furnace to be operated with a minimum 'superheat' metal temperature. The low-voltage system is also safe to use and easy to maintain.

25 years of die/cooler and withdrawal control technology design and experience, enables Rautomead to provide the correct parameters for the solidification and casting of the copper magnesium alloys.

Upward Vertical or Horizontal Solutions

Rautomead International Ltd. offers two alternative solutions to producers of the copper magnesium alloy wire rods: upward vertical or horizontal type continuous casting equipment. The choice between the two is primarily influenced by the intended production capacity, the upward caster having a larger capacity than the horizontal one.

Both designs use a single electric resistance heated graphite furnace for integrated melting and casting. This ensures a compact and cost-effective plant layout, especially since the Rautomead equipment requires no special foundations or costly civil engineering work.

Model RX 1100

Global Expertise

Rautomead have supplied more than 250 casting machines to customers around the world. Five of these, installed at different customers in Europe, are being used for the production of trolley wire alloys. The first of these five Rautomead machines was installed in 1989; the most recent was in 2002.

Rautomead International Ltd. provides a total service package which includes an extensive after sales care programme, spare parts supply, engineering support, customer training and access to special applications development R&D programmes.

The company also offers equipment and technology for a wide range of other non ferrous alloy continuous casting applications including: copper and copper alloy wires, bronze and brass bars and hollows, gold, silver and precious metal alloys for jewellery and electronic applications.

A Whole World of Continuous Casting Technology

Interwire Exposure for new RDG Copper Rod Caster

"20,000 tpy 8mm CuOF"

Interwire Atlanta 2003 provided the perfect opportunity to present the benefits of the latest Rautomead RDG-3 copper rod casting machine, a model that represents a significant leap forward in the technology of copper rod production.

Combining all the advantages of Rautomead's graphite furnace expertise with Induga GmbH induction heating technology, all in a single melting, holding and casting furnace, the RDG-3 machine has a rated output of 20,000 tonnes of 8mm copper rod per year and impressively low operating costs.

It comprises an automatic cathode feed, a single 1,000 kVA channel-type induction furnace, with separate melting and holding baths, a twenty-strand casting station and five tonne capacity rod coilers. Alumina linings are used in the induction furnace, with a sleeved graphite lining and graphite filter bed in the holding and casting chamber for conditioning of the molten copper prior to casting. Siemens technology provides state-of-the-art control and monitoring of the whole operation.

3RD RAUTOMEAD CONTINUOUS CASTING MACHINE FOR HORNG CHIANG, TAIWAN

INSTALLED & COMMISSIONED IN JUST 3 WEEKS

World-leading continuous casting technology specialists, Rautomead International Ltd. of Dundee, Scotland, have installed and commissioned a third RS 3000 upwards-vertical copper rod casting machine at the Horng Chiang Taiwan plant (formerly Chien Ann Enterprise).

This third Rautomead RS 3000 model copper rod casting machine increases Horng Chiang's monthly production capacity to some 1,500 tonnes of 8.0mm Cu-OF copper wire rod. The "as-cast" rod is drawn to wire for use in the copper foil industry. The RS 3000 machine was supplied complete with automatic materials feed, rod coilers and its own primary closed circuit cooling water system. It was delivered by Rautomead in three 40 feet containers.

Prompt Installation

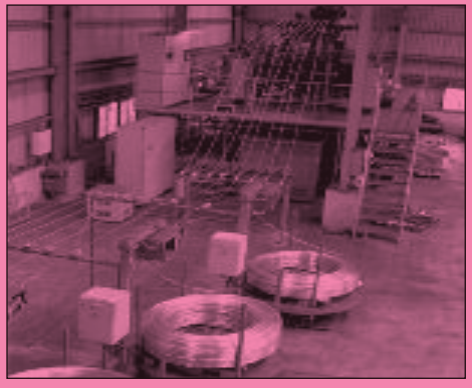
The RS 3000 was installed and commissioned under the supervision of Rautomead's technicians within just three weeks of arrival of the containers at Horng Chiang's factory, thus enabling the customer to obtain immediate advantage of his investment. The first similar machine was installed at Horng Chiang in 1999; the second in 2001 with this latest addition being required to meet increased market demand.

Oxygen reducing

All RS 3000 models installed at the Horng Chiang plant feature naturally oxygen-reducing graphite furnace technology and Rautomead's proprietary low voltage electrical resistance heating system. Each machine is of an integrated melting, holding and casting design.

The machines are used to recycle copper foil scraps and other copper scraps, efficiently converting them to the highest quality 8.0mm wire rod which is then drawn down prior to further processing and supply to the copper foil manufacturing industry.

With over 250 installations, located across 42 countries worldwide, UK-based Rautomead International Limited, views its relationship with every customer as a long-term partnership and places equal emphasis on the quality and support of service provided as on the delivery of highly innovative casting technology.



CASTING ADVANTAGES IN HOLLOW AND SOLID BRONZES

The Rautomead Upwards Vertical Casting RSL process offers manufacturers a number of key advantages in the production of a wide range of hollow and solid sections in leaded bronzes. These include high speed, good concentricity in hollow work, quick casting die change, high production efficiency and a good standard of operating safety.

Feedstock may be in the form of pre-alloyed ingot, or molten metal, poured via a launder from a primary melting furnace. A typical machine is arranged to cast twin strands. The diameter range in hollows is from 22mm up to 60mm, with a minimum wall thickness of 4.5mm.

200kg per hour output

The cast bars are supported over the machine and automatically sawn to length and lowered to the horizontal position. Normal product length is 3-4 metres. Output using an ingot feed, where melting is done in the casting machine itself is approx. 200 kgs per hour. Greater outputs are achievable with separate melting, depending of product sizes. Concentricity in hollow work is normally better than 2%.

Enhanced operator safety

As the casting dies are positioned above the melt, removal and replacement is a simple process and one casting die can be changed while production continues on the neighbouring strand. With the molten metal held beneath the casting station, operating safety is inherently greater than with other designs used in the continuous casting process. A tap hole is also provided at the base of the crucible for emptying when required.

The entire machine is PLC controlled, using pre-programmed AC servo product withdrawal drives. This means that production settings for a wide range of product sizes can be instantly retrieved and accurately repeated.

Technical 'Wire break' Paper Secures *Major Industry Award for Rautomead Chairman*

The International Wire Machinery Association Gala Banquet held in Dusseldorf, Germany, proved an important occasion for Rautomead International, as company chairman, Sir Michael Nairn, was selected to receive the H W Bennett President's Trophy for the best technical paper of the year.

Sir Michael Nairn with H W Bennett President's Trophy

Entitled "Prevention is Better than Cure, a Graphite-based Technology in Continuous Casting of Re-draw Rod for Multi-wire Drawing Machines", the paper was read at an IWMA educational seminar held in Singapore in September 2001 and has been widely commented on in industry circles.

Topical and relevant

Commenting on the award, Sir Michael said, "The issue of wire breaks in the context of the increasing use of multi-wire drawing machines and a growing demand for superfine wire is both topical and very relevant to the needs of the modern wire and cable industry. On behalf of Rautomead International, I am delighted to have received this award and by the encouragement of technical innovation in our industry shown by the IWMA."

The H W Bennett President's Trophy, which was instituted in 1979, has only been awarded on nine previous occasions when the Awards Committee considered papers to have been of a sufficiently high standard.

STOP PRESS...STOP PRESS...STOP PRESS...

Sarcheshmeh (NICICO) Iran will take delivery of **RS 3000** wire rod casting equipment during 2004. The Rautomead machine will enable Sarcheshmeh to supply their customers with either ETP rods/wires from their existing equipment or CuOF rods/wires produced on the Rautomead machine.

With the addition of the Sarcheshmeh machine there will be a total of seven Rautomead CuOF wire rod casting machines installed in Iran.

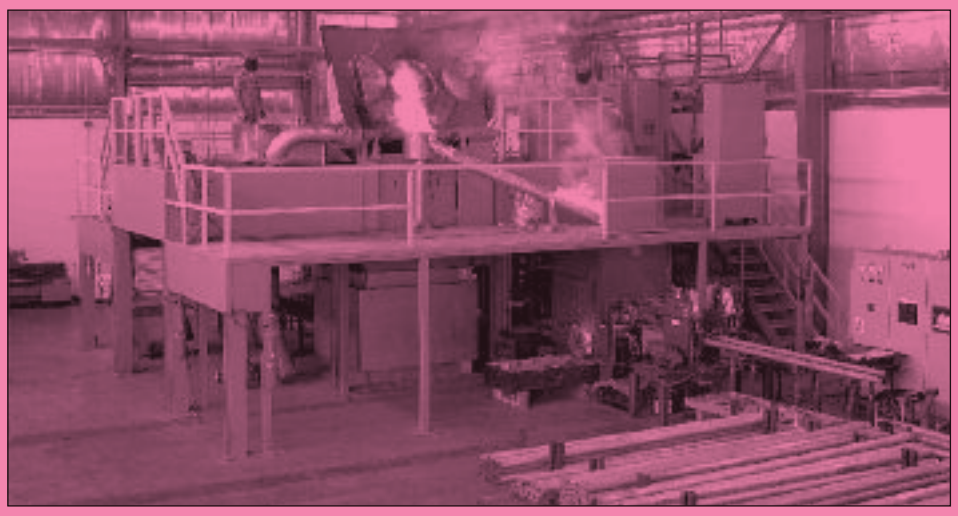
Boliden Wire, UK: RS 1000 copper alloy wire rod casting machine, installed and commissioned, first quarter 2004, in conjunction with separate primary melting and alloying furnaces provides new modern production facilities for 3,000 tonnes per year of brass, bronze and other copper alloy wire rods.

Elektrokoppar, Sweden: took delivery of their SECOND **RS 3000** model continuous casting machine in December 2003. This unit is being installed beside the first line (Nov 2001) and increases production capacity for CuOF and CuAg rod production in Helsingborg to 12,000 tonnes per year.

Sir Michael Nairn, Chairman, Rautomead International Ltd & Mr Bo Samuelsson, President, Bare Wire Division, Elektrokoppar.

Tycan, Australia, commissioned an **RS 3000** model continuous casting machine in January 2004. This machine has capacity of 6,000 tonnes per year of 8.0mm CuOF wire rod and will provide "in house" control of rod quality and supply.

Saudi Mechanical Industries, Riyadh, manufacturers of water pumps installed their first RT 850 model horizontal casting machine in 2002 to produce bronze hollows for bearing manufacture. In 2004 SMI will take delivery of **TWO** MORE **RT 850** model casting machines together with additional melting equipment which will more than double the installed production capacity.



Saudi Mechanical Industries, First RT 850 Casting Line

FIRST FOR RAUTOMEAD IN SERBIA

Grand'd Inzenjering of Bor, has purchased a Rautomead RS 1050/6/8 upwards vertical caster for the production of 8mm oxygen-free copper re-draw rod.

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