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Rautomead Steals the Show

with new copper casting technology

wire Düsseldorf 8–12 April 2002 Special Edition

New Machines to be launched at Dusseldorf

RDG SERIES (see page 4)
- 20,000 tonnes per year, 8.0mm Cu-OF
- Integrated melting and casting, cathode feedstock
- Single furnace, graphite crucible technology

RFS "Rod from Scrap" SERIES (see page 1)
- 8.0mm copper rod
- 2,000 tonnes per year
- Baled wire and compressed granule feedstock

RST SERIES
- Copper strip production for electrical busbar manufacture
- Or thin strip for welded tube

Innovation and enhanced economy are the key influences behind three impressive new Rautomead

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copper & copper alloy rod and tube & strip continuous casting machines that are to be launched at Wire 2002.

First is the Rautomead RDG Series of copper rod casting machines designed to economically produce up to 20,000 tonnes output of 8.0mm diameter rod per annum. With a single integrated melting, holding and casting furnace, operating costs are significantly reduced when compared to other systems.

Next is the RFS "Rod from Scrap" Series designed for converting high quality clean dry baled wire scraps back into 8.0mm diameter copper redraw rod. Finally, the RST Series of integrated melting and casting machines offers continuous upwards-vertical production of copper & copper alloy rod, strip & tube products.

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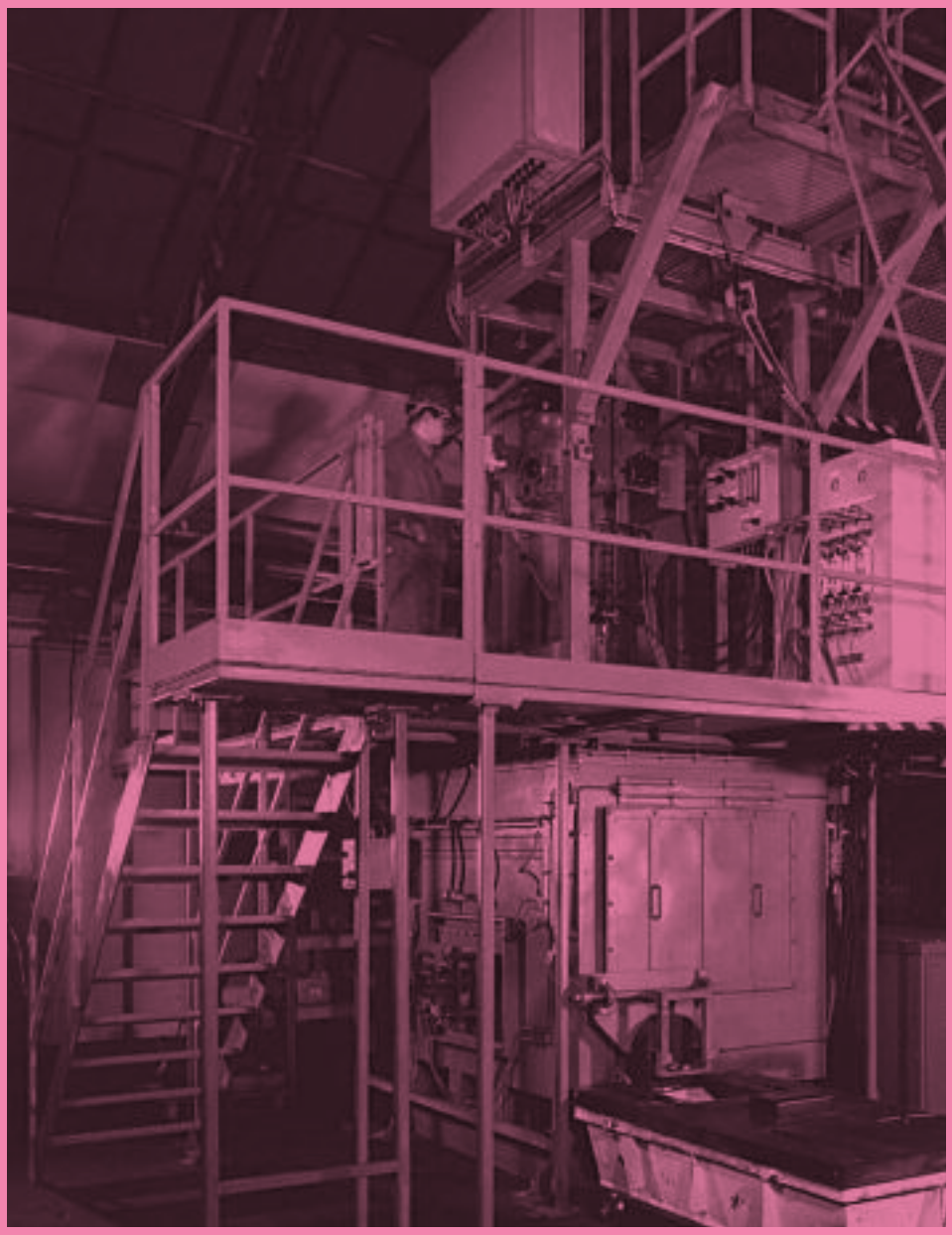
Onward and Upward

The Rautomead RFS "Rod from Scrap" machine represents a novel process for the recycling of clean copper scrap to make copper redraw rod. The machine is designed as an integrated melting and casting unit, is rated at 240 KVA and is capable of melting and casting at a rate of up to 300 kg per hour on a continuous basis.

The withdrawal unit may be fitted with dies and coolers to produce three strands in the diameter range 8mm to 12.7mm. Casting speed depends on product sizes and number of strands. Typically, in production of 8mm rod, the machine will produce three strands at 3.6 metres/minute. Rods are coiled in conventional Rautomead rod coilers. Rod coil weight is up to 4 tonnes.

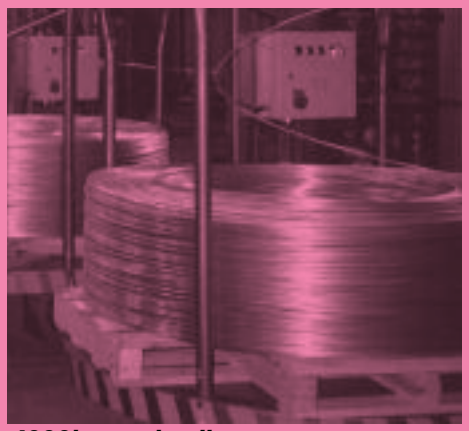


Feedstock from scrap

Clean mill scrap in the form of baled wire or briquetted granulated scrap may be used as feedstock. This may also be blended with a proportion of grade A cathode conforming to BS 6017 - 1981 (1989) Cu-CATH-1. Best results, however, are obtained when the scrap is compacted to around 6.5 gm/cc or more.

Electrical Resistance Heating

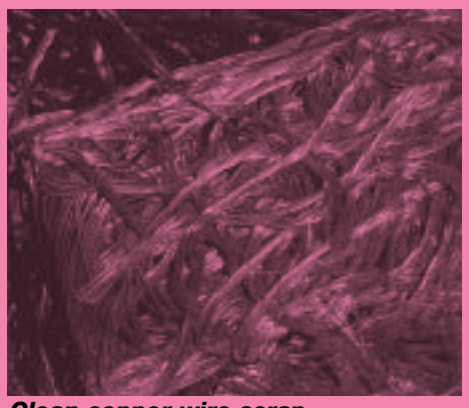
The RFS Series uses an electric resistance-heated twin chamber graphite crucible furnace, comprising a robust fabricated steel shell, mounted on a channel section base frame. This is built up internally from a refractory brick base,



4000kgs rod coiler

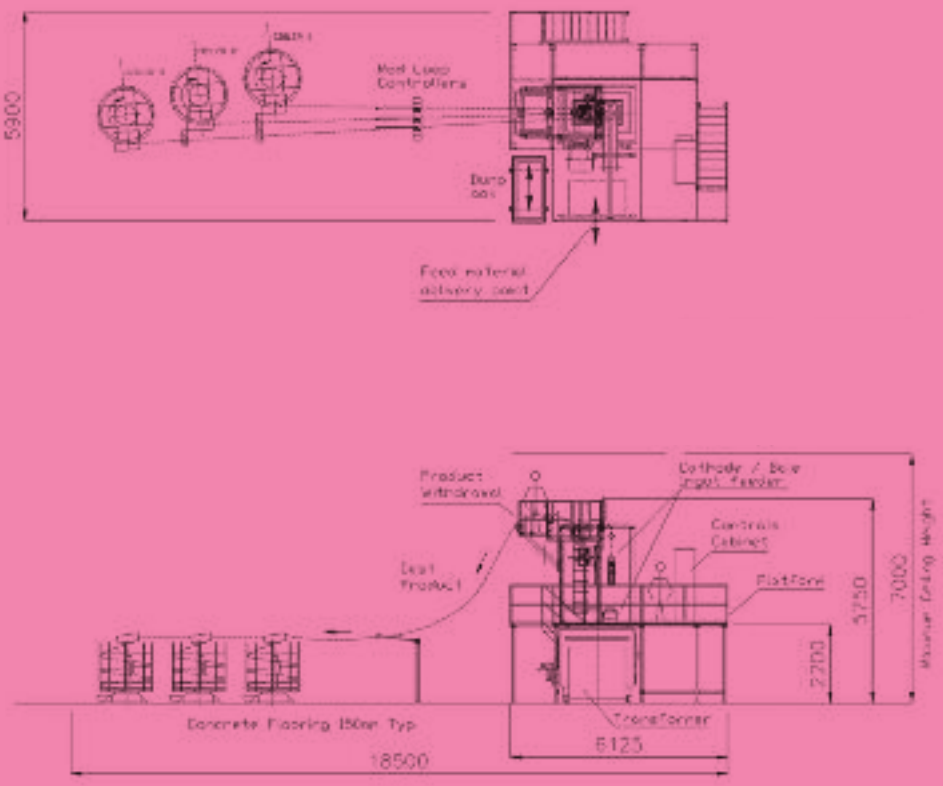
using specially selected refractory and insulation materials.

The interior of the furnace forms a sealed unit, which is purged with inert gas for protection of the graphite crucible and resistance heating element chain that surrounds it. The rear power terminals and secondary power terminals are water-cooled. Side doors are removable for



Clean copper wire scrap

Rod From Scrap - The New RFS Copper Casting Machine



Floor plan of RFS machine

The New RFS Series In Focus

- ***Feedstock***

Clean dry copper wire and granulated scraps, free from plastic, moisture and metallic impurities

- ***Output***

Three strands of 8.0mm diameter rod at 240 - 300 kg/hr.

- ***Casting die life***

Approx. 6 tonnes when processing 100% clean scrap, increasing to approx. 12 tonnes for 100% cathode.

- ***Conductivity***

Conductivity of the "as cast" 8.0mm diameter rod is directly related to feedstock quality, proportions of scrap and cathode. Tests indicate 95% to over 100% IACS.

- ***Oxygen Content***

Nominal 200 ppm in scrap. Oxygen content in cast wire rod 8.0mm, measured at less than 10-15 ppm when using 100% baled wire scraps and briquetted granule scraps.

- ***Drawing of 8.0mm "rod from scrap"***

Sample coils of 8.0mm diameter copper rod, produced using 100% scrap feedstock (60% baled wire, 35% briquetted granules, 5% loose granules) were cast at 80 kg/hr.

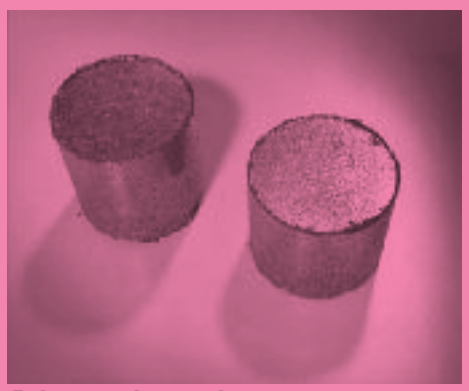
maintenance attention and a taphole for drainage of the crucible in case of emergency and for regular inspection is provided at one side. Crucible capacity is approx. 2,000 kg, giving a molten metal dwell time of 5 to 6 hours for conditioning and oxygen reduction.

Casting Die Assemblies and Product Withdrawal

The casting dies are mounted on a carriage, which is arranged to move up and down and thus to maintain a constant immersion depth of the graphite casting dies in the molten metal. Product withdrawal is by twin driven rolls and pneumatically clamped rear pinch rolls, using a mechanical indexer drive.

Ease of operation

Furnace and casting temperature is automatically controlled and all key production parameters are automatically monitored and alarmed. One operator is required to feed the machine, to monitor production and change coils as required.



Briquetted granular copper scrap

In-built efficiencies

RFS machines are designed for continuous production over long periods. Continuous operation will normally be the most efficient manner of running. However, where it is preferred to shut down over week-ends, the dies can be withdrawn from the melt, lids closed and the temperature reduced to "standby mode", with the metal remaining in the crucible for quick resumption of production.

Minimised Operating Costs

Careful attention has been given to minimising running costs of the RFS machine. The principal cost is electrical power. In continuous operation, the machine can be expected to use approx. 450 kWh per tonne produced. This includes the power required for melting and casting, as well as other ancillary services.

Space Requirements

The RFS machine is 5.9 metres wide by 11.7 metres long (incl. coilers) and requires headroom of approx. 6.5 metres. A normal 150mm reinforced concrete floor is sufficient and no pits or other special foundations are required.

Rautomead Redraws The Rules In

RDG Series: A New Copper Rod Casting Process

Rautomead introduce the new RDG Series copper rod casting machines which represent an economic advancement in the production of oxygen-free copper redraw rod (8.0 mm - 12.7 mm dia.) using a cathode feedstock.

The first model to be introduced is the RDG 3, rated at 1,000 kW and designed to produce 3 tonnes per hour, or approximately 20,000 tonnes per year of 8mm Cu-OF rod. A larger model, the RDG 4 is planned.

INDUCTION FURNACE

By using integrated melting and casting in a single furnace, operating costs are reduced by comparison to other systems that employ separate furnaces for melting and casting.

The integrated furnace in the RDG 3 machine has a capacity of approx. 12 tonnes of copper and a tapping weight of 8 tonnes. Cathodes up to 120 kg are automatically weighed, preheated and fed to the furnace, which incorporates separate melting and casting chambers.

OXYGEN REDUCTION

A graphite filter bed is also incorporated in the casting chamber; a charcoal cover is used over the melting side and a graphite flake cover over the casting side of the furnace. These features ensure full oxygen reduction.

ROD WITHDRAWAL AND COILING

The casting station of the RDG 3 is a twenty strand back-to-back arrangement of casting die and cooler assemblies, mounted on a carriage which adjusts itself automatically up and down for changes in molten metal level. Rod withdrawal is by four separate fast-acting cam indexer drives, capable of over 1,000 cycles per minute.

CONTROLS

The hub of the control system is a master PLC for control of the induction furnace, with linked island controls for cathode feed, rod withdrawal, coilers and cooling water service. All key production parameters are automatically monitored and alarmed, with provision for data collection.

PRODUCT QUALITY

The highest quality oxygen-free as-cast copper re-draw rod in the diameter range 8.0 mm to 12.7 mm for drawing to wire to British Standard 4109 C103 and American ASTM Specification B1, B2, B3 C10200 is achieved. Using a LME Grade A copper cathode feedstock, O_2 content in the rod is typically less than 5 ppm.

Special Features Include:

- Single, integrated melting, holding and casting furnace
- Graphite furnace technology
- Well-proven rod casting, withdrawal and coiling arrangements

Copper Rod Casting Technology

RDG Services:

- **Electric Power**
  Connected load is 1,200 KVA. Nominal furnace power is 1,000 kW at 50 Hz or 60 Hz.
- **Cooling Water**
  A re-circulating primary cooling de-ionised water system with twin pumps and water-to-water heat exchangers cools casting die assemblies.
- **Compressed Air**
  Compressed air (service by others) provides back-up cooling.
- **Molten Metal at Start-Up**
  Molten metal is required at start-up. A separate gas-fired furnace (by others) may be required for this purpose.
- **Propane Gas**
  A gas supply is required for firing the pre-heat torches at start-up and when the furnace has been emptied.
- **Emergency Back-Up**
  An emergency generator (by others) with automatic switchover is recommended for maintaining temperature in event of power failure.
- **Cranage**
  10 tonne overhead traveling crane (by others) is recommended over the casting machine for maintenance purposes.
- **Layout**
  The RDG 3 machine requires approx. 44 metres x 9 metres x 8.5 metre working height.

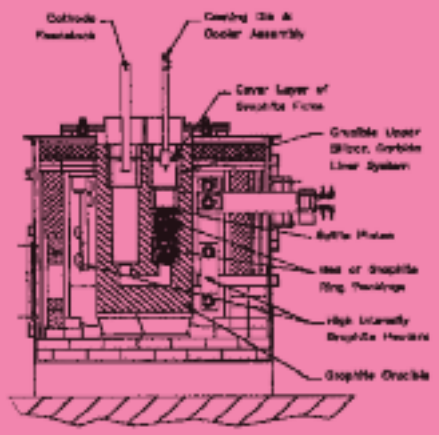
RDG At-A-Glance

Model	RDG 3	Total holding capacity	12 MT
Product	Cu-OF	Connected load	1200 kVA
Strands	20	Nom. power	1,000 kW
Product Sizes	8.0 mm to 12.7 mm	Frequency	50 Hz
Output per Hour	3 MT	KWh/tonne (approx)	300 kWh
Coil weight	4 MT	Oxygen content	< 5ppm
Nom. Output per Year	20,000 MT	Cathode feed	automatic
Feedstock	Cu-CATH-1	Dimensions	44 M x 19 M x 8.5 M(h)

Prevention is Better Than *Cure*

Achieving better quality copper redraw rod for a lower investment.

Using latest graphite furnace technology, copper rod producers can now manufacture better and more consistent quality redraw rod which minimises wire breaks in drawing to fine and superfine wire, and on a small to medium scale.



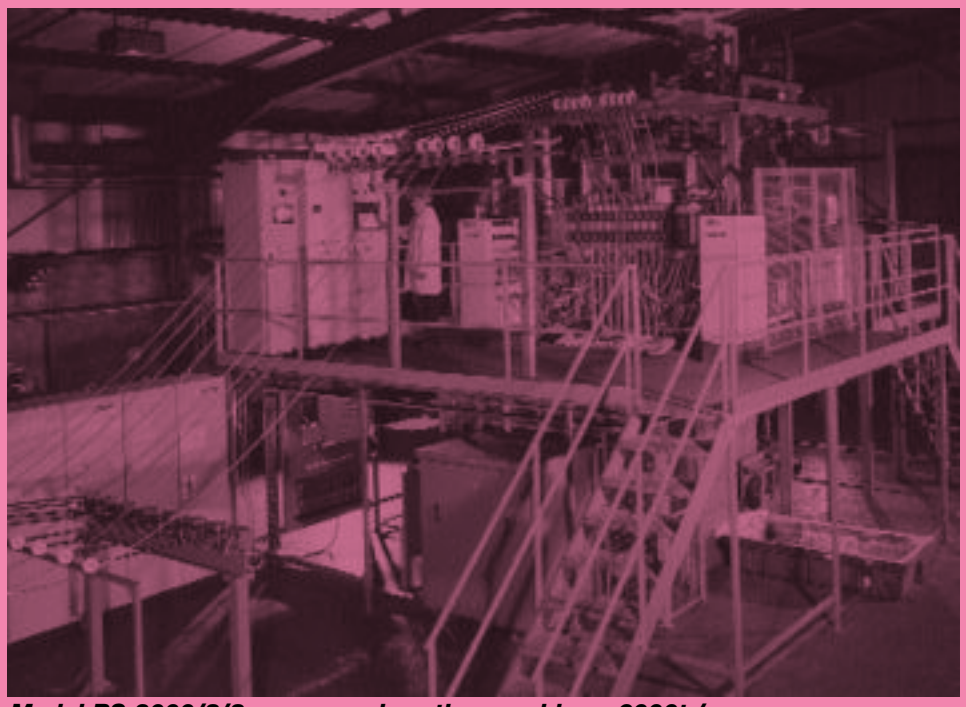
Furnace cut-away elevation drawing

Prior to 1970, a batch process involving casting of wire bars, hot rolling, pickling and butt-welding to form longer lengths was used to produce most copper redraw rod. In the thirty subsequent years, this traditional process has been progressively superseded by continuous billet casting and hot rolling by the now familiar Contirod, Properzi and Southwire processes, which have come to be the accepted means of producing electrolytic tough pitch copper (Cu-ETP) rod.

With good process control and careful grading of coils during the production run, the best quality Cu-ETP rod has conductivity characteristics in excess of 101% IACS and is capable of being drawn to superfine wire with an acceptable rod-break performance. However, this level of performance is usually achieved only in a percentage of the output of large plants with an output range of 50,000 to 200,000 tonnes per year, which must be run close to capacity to be economically viable.

ELECTROLYTIC TOUGH PITCH - CU-ETP

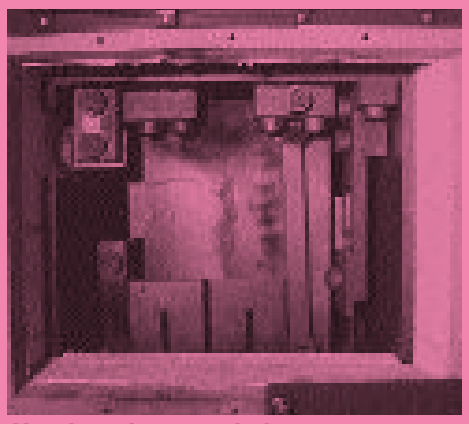
Cu-ETP has a minimum copper content of 99.90%. During its production, oxygen is intentionally alloyed with the copper and controlled to around 200-400ppm. The oxygen acts as a scavenger for dissolved hydrogen and sulphur and will also react with most other impurities to form insoluble oxides at the grain boundaries, preventing them from dissolving in the copper matrix and adversely affecting the conductivity and annealability of the rod and drawn wire. However, while solving one problem, the presence of occluded oxides in the copper wire rod can lead directly to another, as oxides tend to form hard particles and lead to wire breaks in fine wire drawing.



Model RS 3000/8/8 copper rod casting machine - 6000t./year

VERSATILE PRODUCTION - OXYGEN-FREE HIGH CONDUCTIVITY - CU-OF

Cu-OF and its sister material Cu-OFE have minimum copper contents of 99.95% and 99.99% respectively. Alongside the advancing technology of Cu-ETP rod production, Rautomead has developed processes for production of Cu-OF rod. Characteristically, these types of plant are smaller than the well-known Cu-ETP plants, with outputs in the



Heating element chain

range 2,000 to 30,000 tonnes per year, implying a significantly lower investment than for a typical casting and hot rolling plant.

GREATER VERSATILITY

The plants are also more versatile than their large counterparts, offering the possibility of producing a range of materials including alloyed coppers such as Cu-Ag, often used in commutator section of electric motors on account of its higher softening temperatures, as well as CuSn, CuCd and CuMg as trolley wire alloys. A wide range of rod diameters can also be produced.

Other advantages include relatively simple changeover procedures minimising downtime and the fact that rods of different sizes can be made simultaneously.

Also, there is little or almost no oxygen present in the redraw rod present to react with impurities that may be in the copper, avoiding the possibility of their becoming dissolved in the matrix of the copper.

Rautomead Draws on the Experience of Mervyn Cooper

New Product Line Manager key to successful RFS launch

Mervyn Cooper has been appointed to the new position of Product Line manager at Rautomead's Dundee headquarters.

Mervyn, holds a degree in mechanical engineering from the University of Abertay, Dundee, an MBA from the University of Dundee, and has worked for Rautomead since 1984, most recently as Manufacturing Manager.

Focus on new products

In his new position he will oversee the launch and marketing of new Rautomead products (including the RFS series), as they emerge from the company's on-going programme of technical development.

Highest standards

Mervyn will also work in close co-operation with the Engineering, Manufacturing, Sales and Finance departments to ensure that each product performs to Rautomead's exacting standards while meeting the needs and expectations of its UK and international customers.

Full Of Middle Eastern Promise

Rautomead has recently supplied an RT 850 horizontal casting machine to a Middle Eastern customer for the production of bearings stock. These are hollow shells of 50 mm to 80 mm diameter.

The machine will be used in conjunction with an induction heated premelt furnace to recycle bronze turnings into hollow shells in gunmetal alloys for subsequent use in highly automated machining facilities. The rated output of the casting machine is 250 kg/hour. A significant reduction in cost of materials is expected to result from this in-house recycling operation.

Hands-on experience

Rautomead assisted the customer in identifying an experienced consultant metallurgist with hands-on experience of operating Rautomead machines. The consultant will undertake an assignment to provide technical and commercial assistance to the customer after the equipment has been installed and commissioned on site by Rautomead engineers.

Rautomead chairman Sir Michael Nairn said, "This latest sale of a casting machine to the Middle East is particularly pleasing in the sense that it reconfirms, yet again, the opportunities for in-house recycling of raw materials, which was the original rationale for the development of the Rautomead process as long ago as 1978."

A world of continuous casting

ITALY: 15,000 tonnes per year machine for copper wire rod - installation March/April 2002.

IRAN: two machine orders received - delivery June 2002

CHINA: Orders for two copper alloy wire rod machines - delivery May and June 2002.

SWEDEN: New Elektrokoppar machine for the production of copper alloy wire rods - installation completed in January 2002

RUSSIA: RVS model casting machine for processing gold alloys - delivered March 2002.

A *World* of Customer *Service*

With over 250 installations in 40 countries, Rautomead constantly aims to deliver best practice in providing service and support to customers all over the world.

Rautomead machines are used for melting and casting copper, gold, silver and many non-ferrous alloys, to make semi-finished rods, tubes and sections. These in turn, form the feedstock materials in a wide range of industries, from wire and cable, through engineering to electronics, jewellery and minting.

Developed in the early 1980s, the Rautomead process is based on the use of a graphite containment system for the molten metal. Major advances have been made in the casting techniques and in process control over the years.

Specialist training

Long ago Rautomead recognised that a user of hot metal processes requires specialist training and on-going technical advice, not only concerning the process itself, but also in planning the installation, selection of materials and in the down-stream working of the cast products.

A new customer will, therefore, almost invariably send one or two of their key operating personnel to Dundee for training, during the latter stages of construction and testing of the machine before delivery.

Thorough checks

After delivery, Rautomead will normally send one or more engineers to the customer's works to check the installation, to supervise commissioning and to continue the training process. The result is a smoothly executed commissioning programme.

A Customer Service engineer will visit a new installation within six to eight weeks of hand-over to review the status of the plant, answer customer's queries, advise on consumable materials, on quality control procedures, on component identification and on stocking and usage of spares.

Next day delivery

A next-day delivery service for standard spares and consumables is also offered. This is supported by Rautomead's significant and growing commitment to inventory and a highly developed, computer-based control system. Using air-courier service, components can generally reach customers anywhere in the world within three or four days.

Constant improvements

The Engineering and Manufacturing departments at Rautomead are constantly examining the scope for improved materials and component designs. Changes are introduced only when thoroughly tested, with due consideration to the implications for all existing customers, whose machines would be affected. Technical improvements are made available to existing users without charge, except for the cost of the components involved.

Continuous Improvements Online

The brand new Rautomead website is now online, with comprehensive information about all Rautomead continuous casting machines, including the new RFS, RST and RDG Series models.

Easy to navigate, extremely user friendly and providing the opportunity to communicate direct with us, you can visit the new website at www.rautomead.co.uk or at www.continuouscasting.com

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