The Conticast® Non-ferrous Rod Production System.

BACKGROUND

With the ready availability of advanced technology high temperature ceramics, SCADA systems & PC controls to enhance the overall productivity of modern continuous casting systems & an awareness in industry that advantages of in-house materials recycling does give non-ferrous metals machinists, forgers, wire drawers etc, the competitive edge, led to the development of CONTICAST Non-ferrous Rod Production Systems. The technology objective is to address the customer's requirement with a range of high productivity processing equipment, based around the kernel of the CONTICAST process, to manufacture rods, tubes and sections, in a wide range of copper-based alloys, including the pre-treatment of scrap and swarf/chips, pre-melting, continuous casting and the inclusion, as appropriate, of certain rod finishing processes, which may include rod shaving, center-less bar turning, drawing, swaging, profiles milling, bar reeling and section straightening, all on a relatively small scale. These processes enables non-ferrous engineering companies to examine internal recycling the company's own scrap & swarf/chip arising in order to satisfy the company's requirements of semi-finished rod products. CONTICAST can also supply quality control testing equipment and project start up personnel (HR), & chemistry / metallurgy advisory services on an ongoing basis.

THE CONTICAST CONTINUOUS CASTING PROCESS

The basic technology has been proven in production over many years. CONTICAST continuous casting systems are reliable, efficient and simple to operate machines for the production of bars (solids and hollows), wires, strips etc in a wide spectrum range of copper-based alloys.

The CONTICAST machine consists of a rugged fabricated furnace, mounted on steel base sections.

CONTICAST CONTINUOUS CASTING MACHINE (Model RF700HCC)

DESCRIPTION:

Within the CONTICAST machine, a positively located crucible is arranged to feed submerged horizontal or vertically upwards and/or downwards mode graphite die & cooler assembly or alternatively an array of casting dies. Conditioned molten metal flows from the lower or upper part of the crucible directly into the casting die assembly In electrically powered models, graphite heaters are optimally positioned around the crucible & die assembly to give precise thermal profile conditions for the material being cast. High quality refractory materials are used to achieve maximum heat efficiency. High temperature graphite components are protected from oxidation by inert gas atmosphere which assists in protection of the molten metal. The electric versions of the process represent probably the best most technically correct metallurgical system in the world, which exists today to process the defined Conticastable metals. See ALLOYS information in the next section.

Fossil fuel fired models (Nat. gas, lpg, or oil fired versions) have clay-graphite or silicon carbide crucibles according to the production task requirement, in addition to using modern state-of-the-art electronically controlled "low NOx" high efficiency fuel burners .

The machines are fed from the top, often with a fume extraction hood incorporated. Rod withdrawal from the casting die assembly is by generously powered pinch rolls, mounted within separate modular robust & rigid frame systems. Solid state servo-drive or electro-mechanical controllers provide great accuracy and flexibility in setting consistent production conditions to suit the alloy & the sections being produced. Multiple pinch roll assemblies can be provided in standard arrangements, which can be separately driven, enabling multiple rods of differing sizes to be produced at the most appropriate speeds.

Alarm systems may be fitted to give immediate warning of cooling water supply/inert gas pressure failures or of any other change in the critical operational parameters.

ALLOYS

The CONTICAST continuous casting process was originally developed to manufacture leaded brasses for forging and machining, but the range of materials which are now successfully produced includes many different types of brass, gun-metals, tin bronzes, phosphor bronzes, leaded bronzes, aluminium & silicon bronzes, cupro-nickels, sulphur & tellurium coppers, high conductivity oxygen-free coppers. Some alloys of zinc, aluminium & many precious metals, including dental, jewelry & electronic alloys may also be successfully produced. A separate comprehensive list of alloys which can be processed, is available. (Please download the file **CONTICASTABLE ALLOYS.pdf** from our website http://www.conticast.com).

PRODUCT QUALITY

The quality of CONTICAST products has been found to be highly satisfactory & second to none. With α + β, 2 phase leaded brass alloys, the macrostructure on average is generally slightly coarser than the equivalent extruded product, though it is homogeneous/consistent & not at all variable, unlike the latter, whose structure macro-grain size will depend on the bars position within the overall extrusion cycle. However, the as-cast micro-structure is very fine with lead particle size barely resolvable at x 400 magnification. The overall machining, fabrication & finishing characteristics of such products are excellent. The latter is particularly true with respect to polishing & electroplating to jewelry standards eg. Watch bezels.

SIZE RANGES AND PROFILES

The diameter range in which the process is most commonly used is from 6mm to 350mm or equivalent section, though it is possible to produce rods of both greater and smaller sizes than these.

In addition to rounds, many special and generally symmetrical sections may also be produced, including squares, rectangles, hexagons, octagons, cruciform sections and hollows.

USE OF A PREMELTING OR INTEGRATED OPERATION?

CONTICAST machines can be supplied to operate as stand alone units in integrated or combined integrated melting & casting mode, essentially a "cold metal in–cold metal out" process. However, with the addition of a pre-melter furnace & a launder or ladle feed of molten metal to the CONTICAST machine, several productivity advantages may be gained. Features associated with separate pre-melting include:

Production Output

Where the CONTICAST machine is not required to heat the metal from cold, a significant increase in production can be experienced. Using a launder or ladle transfer of molten metal to the CONTICAST machine, the production output capacity of the installation can be 2 - 5 times that of integrated systems.

Heat-Weighing and Alloy Adjustments

When separately pre-melting, it is a simple matter to adjust the composition of the alloy at the melting stage. This means that more random grades of feed-stock may be utilized, thereby reducing the overall metal costs. This will require chemical & metallurgical control, normally by using optical spark emission (OES) or X-ray fluorescence (XRF) spectrographic analyses.

Casting Die Change Time

Changing casting dies require the CONTICAST machine to empty, then remove/exchange the die & refill. Where this can be done from a reservoir of molten metal, total die change time from casting to casting may be expected to be less than 1 hour, compared with 4 to 5 hours when the cold metal must be melted in the continuous casting machine crucible.

CASTING DIE ASSEMBLIES

The casting die & cooler assembly is a 2 part unit, comprising a graphite die insert which connects with the melt outlet orifice at the base of the crucible. This is closely coupled to high conductivity water cooler assembly, which removes the heat efficiently from the newly solidified melt issuing from the system. All cooler assemblies are flow & pressure tested by CONTICAST.

CASTING SPEEDS

A casting die insert may have several individual casting bores capable of producing strands of different sizes and profiles. In production, individual solid strands may generally be started, stopped & restarted, as required. The strands may be run at differing speeds and pulse sequences as appropriate for achieving the desired cosmetic and mechanical properties & characteristics. Casting speeds vary up to approximately 4m/min. (~160"/min.) according to rod size and alloy quality. Production is planned so that the machine is run as close to its designed output capacity as possible, consistent with the maintenance of the strand quality standards.

DISCONTINUOUS OPERATION

The continuous casting process, by definition, operates at its most efficient when operating on a truly continuous basis & the CONTICAST system has been designed to accommodate discontinuous working schedules without unacceptable cost penalties. At the end of the working day the machine may be left with the crucible full of metal, the temperature reduced, in the "stand-by" mode. The temperature may then be quickly increased to the operating level before production is recommenced at the beginning of the following work period.

Whist in "stand-by" mode, the plant's alarm systems continue to fully monitor the status of the plant and a connection may be made to a remote location, to ensure safety and maintenance coverage.

Power use on stand-by is typically 13 - 14 % of maximum power.

MAINTENANCE

A significant feature of all CONTICAST continuous casting equipment design is the ease & simplicity of all maintenance procedures. A complete furnace strip-down & rebuild can be completed from casting to casting within a few hours.

CONTROL SYSTEMS

A separate free-standing control panel is normally supplied with the continuous casting machine. This incorporates the controls for the complete CONTICAST installation, gauges, logging, alarms & Windows PC monitoring systems. With electrically powered models, power feed to the crucible & the casting die assembly is thyristor controlled, giving highly accurate settings. A Windows PC logging data system is used to monitor the system temperatures including inlet/outlet water temperatures. Inert gas controls include two flow meters with a pressure gauge. Failsafe warnings cover water and gas pressure failure and any significant change in operating conditions. These actuate audible &/or visual alarm signals. AC or DC or servosystem electronic control units for the rod withdrawal mechanisms are also incorporated into the control console.

MAINS TRANSFORMER (ELECTRICALLY POWERED MODELS)

A mains electrical power transformer is normally supplied with each machine, ensures that the plants operate on low safe voltages (typ. 24V). Electrical plants are safely isolated from the incoming mains as standard, by using double wound specification power transformers, with an earthed screen between the windings.

STRAND CUT-OFF SYSTEMS

This aspect of the plant operation can be addressed by using a simple hand-held electric band-saw, abrasive disc or carbide tipped cut-off saw units for the strands on achieving the desired length after casting. This can be provided as part of the standard specification. More sophisticated automatic flying saw or shear cutting arrangements alternatively, may by specified as required by the customer.

SERVICES

The essential "hook-up" services required to operate the continuous casting machine & to be provided by the customer are as under:

Power (electrical powered models)

A supply at 400 volts x 3 phase x 50/60Hz is normal, although the equipment may be used on alternative voltages. (The supply should be specified at the time of ordering plant.)

Natural Gas, oil & lpg fossil fuel fired models.

Full details of the fuel supply should be given at time of plant ordering. Gas composition spec, calorific value, line size & pressure must be supplied. Oil fired plants require the full specification of the oil to be advised.

Inert Gas

Oxygen-free nitrogen of specification better than <5ppm each of O_2 and H_2O impurities, has been found to be the most readily available & cheapest gas. The supply may be either from cylinders, liquid bulk storage tank, or nitrogen generator. Consumption may be expected to be around 0.5 – 2.0 cu.metres per hour. (15 – 60cu.ft.) per hour, depending on the model.

Cooling Water

A supply of clean soft (low CaH – we recommend <60ppm total hardness) water at pressure 2.5 – 4 bar & flow rate of ~60 L/min. As the continuity of a flow of cooling water to the casting die-cooler assembly is a critical safety aspect, it is essential the recirculation water pumps are backed-up with an emergency water system provided to kick-in automatically in the event of the normal pumped water system failure.

Fume Extraction

With many alloys & types of feed stocks used, environmental and employee comfort considerations & the quality of working conditions around the CONTICAST installation make it advisable to install fume extraction equipment. In many cases this will be required by the factory regulatory authorities. CONTICAST experience has shown that a combination of spark arrestment, followed by wet dedusting &/or bag filtration equipment of proprietary design are economic & effective methods of removing fumes & other particles.

Local fume emission regulations will dictate the types of plant necessary & CONTICAST can point to specialist companies in the field, capable of handling any given project environmental impact prognosis. In order to maximise the efficiency of the proposed installation, CONTICAST will closely link-liaise with the customer's own staff & contractors, responsible for the project.

Delivery

Every machine has full functionality testing at our works prior to dismantling & shipment. At the customer's site, our engineers will supervise installation and commissioning. It is essential that all building works is completed & customer provided services,- power, oil, gas, water, fume extraction etc.,- are installed & ready for connection at the time of plant start-up. The continuous casting machine should be in regular production at the customer's works within two working weeks from delivery.

CUSTOMER SERVICE

CONTICAST places a top priority on all aspects of customer service on a continuing basis for each and every continuous casting installation. **The Customer's success is Conticast's success.**

We would look to fully study the customer's requirements of semi-finished rod products & the sources of feed-stock available for the continuous casting process & will recommend the best type of installation, in terms of machine size, equipment for the preparation of scrap/swarf, rod finishing equipment, quality control facilities & plant layout.

Assistance will be given either on-site or at our factory training programmes, to ensure that both operating-maintenance personnel obtain the best possible performance from the installation. We will recommend standard stocks of spare parts which should be carried by the customer & assistance may be also given to set up quality control and metallurgical testing procedures. In addition, we maintain stocks of all spare parts at our own works & the services of our engineering staff are usually available at relatively short notice as back-up support to customers when needed. We operate a fast delivery for all spare parts - crucibles, heaters, & casting dies, - which are supplied ready for immediate fitting to the continuous casting machine.

Long Term Commitment

CONTICAST offers a long-term technical service commitment for life to customers, whereby they will be

kept informed of the latest advances in CONTICAST technology and its associated processes. CONTICAST will readily assist in further development of users continuous casting installation, in areas such as processing of other alloys, profiles, section sizes, ancillary processes and in increasing productivity.

ANCILLARY EQUIPMENT

In many circumstances, the CONTICAST continuous casting machine will form part of the jig-saw of some diverse production processes, of which the starting point may be a company's swarf & scrap arisings, with an objective of e.g. producing a brass forged lpg cylinder valve, a machined part, water fitting back nut, tellurium/sulphur copper turned part, a high conductivity copper wire or bus-bar section, 3mm diameter wire etc. A list below includes some of the more common items of ancillary up-down-stream equipment that customers would normally look to interface. CONTICAST's knowledge base can advise/confirm to customers of their requirements & to supply these and other diverse machines:

AA Pre-Melting Furnace - Gas, oil or induction heated tilting pre-melting furnace with launder or ladle feed to continuous casting machine – provides a useful means of increasing output and overall productivity.

BB Swarf Pre-Heater/drier - Gives increases in output and is useful where feed-stock contains quantities of oil containing machining swarf/chips, and which are seriously difficult to otherwise process.

CC Magnetic Separator - used for removing ferrous contamination from feed-stock.

DD Briquetting Press - has been shown to dramatically improve the performance (efficiency of melting and metals recovery) of high % swarf feedstock melting systems.

EE Rod Shaving Machine

Designed to use static shaving dies to shave the surface of continuously cast machining and forging brass rods to remove the characteristic "tiger stripe" pulse marks where surface finish is important in subsequent processing. Special sections may be produced e.g. hexagons, octagons etc sections can be produced from round sections. May also be used as a draw-bench to cold work the section being processed to improve mechanical properties.

FF Rotary Swaging Machine

Used to impart cold work by true compressive structure working on the continuously cast rod. Also and principally, a method of pointing bars for processes DD and JJ and improves mechanical properties.

GG Rod Turning Machine
Used as a process for improving surface finish of brass forging and machining round rod.

HH Bar Reeling Machine
A process which is used to polish/burnish rod surfaces and to straighten round rods.

II Multi-Roll Rod Straightening Machine
A multi plane pressure roller process used to straighten squares, rectangles, hexagons etc.

JJ Optical Emission and X-Ray Spectrometry Equipment
Used for the essential chemistry analysis composition checking of alloys at various stages in the production processes.

KK Coiling Equipment
Specially designed coiler machines to coil the strand(s) directly from the continuous casting machine. Up-coilers and spoolers are used for strip. Down-coilers (with driven & un-driven turntable options) for wire rods - coils of 1,000 to 5,000kg may be produced. All coilers operate synchronously with the CONTICAST machines.

Separate literature is available on all of these machines.

LL Wire Drawing Equipment
Multi draw block machines and Bull-blocks to suit specific requirements, including down to <1.5mm diameter wires.

Twin 29 x 11 (OD X ID) hollows in CuSn5Pb5Zn5Ni0.6 Alloy for water fittings manufacture.

CONTICAST 37Ø as-cast C37700 brass rod (top) & an lpg cylinder valve produced there-from (lower).

ONLY THE IMAGINATION LIMITS THE CAPABILITY OF THESE HIGHLY INNOVATIVE MACHINES.

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